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Competitive Agricultural Industry: Policies, Designs and Infrastructure

Proceedings of the

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NIGERIAN ASSOCIATION OF AGRICULTURAL ECONOMISTS (NAAE)
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16th – 19th October, 2023

Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Comparative Analysis of Profitability among Wet and Dry Season Watermelon Farmers in Jigawa State, Nigeria.

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ABSTRACT
The study was carried out to analyse the Profitability of Watermelon (Citrullus lanatus) production across wet and dry seasons in Jigawa State, Nigeria. Multistage sampling procedures were used for the selection of the respondents. A total of 124 farmers, and 20 key informants were interviewed. Primary data were collected using structured questionnaires and checklist. The data collected were analysed using Net Return Income model. The results revealed that Watermelon production enterprise in the State produce an average Watermelon yield of 17,195.53kg/ha and 25,625.87Kg/ha obtained in both wet and dry seasons respectively. The result further revealed that Watermelon production enterprise was a profitable venture with the dry season farmers obtaining a higher Net farm income of ₦535,760.6810/ha as against ₦292,493.22/ha obtained by the farmers during dry and wet seasons respectively. Furthermore, the study revealed that higher returns for Naira invested was more in dry season (₦4.13) than the wet season (₦2.18). The study recommends the establishment of processing firms, research and access to credit as the remedies suggested for the various constraints identified.

Keywords*: Watermelon, Costs, Profit, Jigawa, Nigeria.*

INTRODUCTION

For decades, Nigerian Agricultural production has been focused on the production of some selected cash crops such as cocoa, rubber, palm kernel, cotton and ground nut for export mainly to Europe and the United States of America. However, this trend has gradually changed after independence of the country form the British Government in 1960, Manyong et al. (2003). Farmers thereafter had the liberty to produce crops of their own choice. This is particularly common in northern Nigeria where farmers shifted to the production of cereals such as maize, guinea corn, rice, and some vegetable crops like tomato, pepper and onions which have comparative advantage over their counterparts in the south. Recently, another fruit vegetable, 'watermelon' has gained acceptance among small scale farmers in the region Saleh (2012).

Watermelon (*Citrullus lanatus*) is an important horticultural crop, mostly known for its sweet and juicy fruit, grown in warm climates all over the world Robinson and Decker-Walters, (1997) Jeffrey, (2011). Harry et al. (2015) observed that Watermelon originates from Africa, but the exact geographical origin and domestication process of the crop is not clear. One probable gene center is in the Kalahari Desert region where the species can still be found in the wild in various forms Vander Vossen et al. (2004), but it has also been suggested that the origin is in the Sahel Region in Northern Africa Wasylikowa and vander Voseen, (2004). It is one of the most widely cultivated Fruit vegetable crops in the world at large and the global production reached 89.9 million mega grams, Food and Agricultural Organization (FAO, 2012).

In Africa, watermelon is grown not only in dry, low altitude tropical areas like Cape Verde, Mali, Mauritania, Chad, Senegal and Nigeria, but also in equatorial countries like Gabon and Democratic Republic of Congo, De Lannoy (2001). However, in Nigeria though there are no official figures recorded for its production, the crop has a wide distribution as a garden crop, while as a commercial vegetable crop production; its cultivation is mostly confined to the drier savanna regions of the country (Anon, 2006). Watermelon production in Nigeria has increased significantly in the last two decades with the major production areas located in the Sahel, Sudan and Guinea Agro-ecological zones. The National Institute of Horticultural Research (NIHORT, 2016) reported that, the cultivation of the crop has extended down to the forest belts of southwestern Nigeria. However, the northern fringes of the Sudan and Sahel savanna ecological zones and the shores of the Lake Chad remain the major production areas NIHORT, (2010)

Watermelon is 92% water and 8% sugar. It is rich in lycopene, an antioxidant that gives it its characteristic colour. It is fat free, and it can be processed and used for juice syrups and sweets. The seeds, are rich in oil and vitamin D. Their sugar content boosts human energy and the high-water content cleans human organs and does well for the urinary and digestive systems. It is obvious that using watermelons in regular diet is very healthy as it has positive curing effect on coronary, liver, bladder and kidney patients, Medicine Net, (2014).

Ignjatovic, (2005) has observed that half kilogram of the fruit can satisfy the daily human need in vitamin C, B complex and traces of carotenes in addition to substantial mineral content like potassium, magnesium, phosphorus, calcium, zinc, iron, Lycopene and cuprum. Apart from these nutritive values, Watermelon, it is also important as a source natural medicine.

Watermelon is rich in carotenoids. Some of the carotenoids in watermelon include lycopene, phytofluene, phytoene, beta-carotene, lutein and neurosporene. Lycopene makes up most of the carotenoids in watermelon. The carotenoids content varies depending on the variety of the watermelon. Depending on the variety, carotenoids content in red fleshed watermelon varies from 37 – 121 mg/kg fresh weight, whereas lycopene varies from 35 – 112 mg/kg fresh weight (HonCod, 2008). According to Saleh (2012) Watermelon production in Northern Nigeria Particularly Northwest and Northeastern parts of the country has over the years gradually became a viable enterprise providing small scale farmers in the region with alternative commercial crop successfully competing with already over plugged fruits and vegetables like Tomatoes, Onions, and Peppers etc. that are being produced in the area. This provides the teeming population with not only a means of livelihood but also the required micronutrients deficient in the diet of the people of the region as reported by FOA (2012).

Problem Statement: Previous studies have revealed that watermelon production has gained acceptance among smallholder producers in Jigawa State due to its huge economic potentials as a profit giving enterprise which is facilitated by the availability of irrigation facilities across the states Muhammad, (2014), Saleh, (2012) and Saleh (2021). The high demand of the commodity from across the country and beyond makes farmers in the area to extend the production of the fruit to cover both dry and wet seasons, thereby ensuring all year-round production and supply of the commodity.

However, preliminary survey suggests that watermelon production in the study area under both irrigation (dry season) and rain-fed (wet season) systems poses similar and varied problems. Producers have serious concerns over fluctuations in volume and value of output from both dry and wet season production. Variations in the amount and prices of inputs used for both wet and dry season production of watermelon leads to differences in efficiency, costs, returns and quality of the watermelon produced. These differences could also vary across locations. Glut and low prices of the commodity is apparently another serious source of concern to producers.

Managing production of a vegetable crop such as watermelon requires detailed and accurate information on the most profitable production system (irrigation or rain-fed) combination(s) of inputs and glut

handling. This information is not common among watermelon producers in the study area. Other researchers have looked at production of watermelon in a general manner as in the case of value chain analysis Saleh, (2012) and Saleh, (2021), resource use and profitability analysis under separate production systems (dry or wet season). This research is an integrated study to look at both irrigated and rain-fed production across locations with demand and supply relationship is an important gap that needs to be filled. Interestingly, production and marketing constitute a continuum hence lack of development in one retard progress in the other, Abba (2009).

Objectives of the Study: The broad objective of the research is to carry out a Profitability analysis of both dry and wet season watermelon production in the study area, while the specific objective is to estimate the costs and returns of the wet and dry season's watermelon production in the study area.

METHODOLOGY

Study area: The study was conducted in Jigawa State of Nigeria which is located between latitude 11^0- 13^0N and longitude 8^0E -10^0E (Figure 1). The state entirely falls under the Sudan Savannah Agro-ecological zone of Nigeria, Isa et al. (2020)

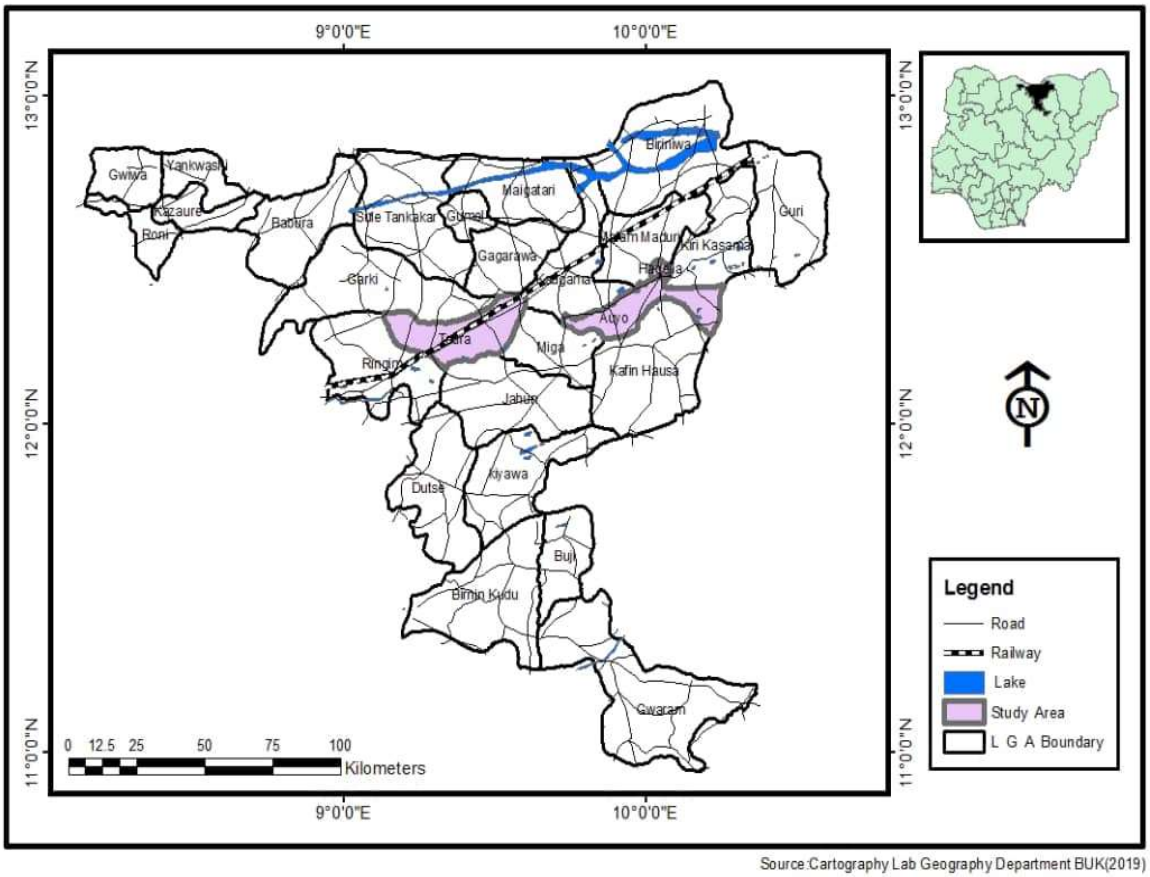


Figure 1: Map of Jigawa State showing the selected LGAs

Sampling Procedure: Multistage sampling technique was employed in the selection of the producers for the study. In the first stage, Kano state was selected purposively as a result of the high concentration of watermelon producers in the state. The second stage involved the selection of production clusters according to the concentration of the Watermelon farmers in the State; specifically, Hadejia, Taura and Auyo Local Government areas were selected. These Local Government areas were selected because of the prevalence of the wet and dry season watermelon production in the areas which was facilitated by the presence of Irrigation facilities in the area. In the third stage, a total of 124farmers were selected

from the list of 260 farmers obtained from the Water Users Association (WUA) in Jigawa States (at a 95% level of confidence).

Table 1: Sample size estimation of the Watermelon Producers

Production Cluster				
	Dry season	Wet season	Dry season	Wet season
Hadejia	71	46	37	24
Taura	46	27	21	13
Auyo	37	33	11	18
Total	**154**	**106**	**69**	**55**

Source: Water users Association (WUA) 2018

This was determined using the formula:

$$X = Z(^{c}/_{100})^{2} r(100\text{-}r)$$

$$N = {}^{Nx}/_{((N\text{-}1)E^{2} + x)}$$

$$E = \text{Sqrt}[{}^{(N\text{ - }n)x}/_{n(N\text{-}1)}]$$

The sample size n and margin of error E are given by:

Where N is the population size,
n = the sample size
r = the fraction of responses that you are interested in,
And $Z(c/100)$ = the critical value for the confidence level c.

The 124-sample size were be allocated across the study locations based on proportions of wet and dry season watermelon farmers in the selected production clusters. Microsoft Excel program was used to randomize lists of farmers to enable random sampling (Table1).

This study recognizes that the estimates of population parameters from a large sample (n>30) are satisfactory estimates of the true population (Koutsoyiannis, 2003). Based on this, the study utilized large sample size (n > 30) but not so large beyond the capabilities of resource available to conduct the study.

In addition, a total of 20 key informant producers of the commodity were identified across the state for qualitative interview to further augment the data on the profitability of watermelon production in the area.

Method of Data Collection: Structured questionnaire were administered by trained enumerators to obtain primary data from dry and wet season watermelon farmers across the states during the 2017 growing seasons. Data collected covered information on the socio-economic characteristics of the watermelon farmers such as age, sex, marital status, household size, educational status, years of experience in the enterprise, extension contact, and access to credit and membership of cooperative societies etc. Data on production inputs including quantities of seeds, fertilizer, chemicals, irrigation water (for dry season enterprise) as well as quantity of labour used by the farmers for both dry and wet season enterprises will all be captured for analysis.

Analytical Techniques: To achieve the objectives for this study, the following analytical tools were used:

The Net Farm Income Models (NFI): The Net Farm Income (NFI) was utilized to evaluate the profitability of both Dry and wet seasons Watermelon producers (Objective ii). Net Farm Income measure returns to naira invested in the enterprise, according to Sanni and Ogundipe (2003) and

Balogun *et al*., (2006). NFI is the income generated from the enterprise, which can be drawn without affecting the future rate of production operation. It measures returns to unpaid factor inputs such as family labour. NFI is expressed as follows:

$NFI_D = GFI - TVC+TFC$…… (1)
Where:
NFI_D = Net income from dry season watermelon production (₦).
GFI = Value of total Watermelon output (₦)
TVC = Total variable cost of watermelon production (₦) expressed as:

$$\sum^{n} P_{i.} X_{.j} = \left(P_{x1}X_1 + P_{x2}X_2 + P_n X_n\right) \text{----------} \quad (2)$$

Where:

P_{X1}= Rental value of farmland dedicated to watermelon (₦/Ha)
$X_{1=}$ Size of farmland dedicated to watermelon production (Ha)
P_{X2}= Unit cost of seed used in Watermelon production (₦/kg)
$X_{2=}$ Quantity of seed used in watermelon production (kg/ha)
P_{X3}= Unit cost of fertilizer used in watermelon production (₦/kg)
$X_{3=}$ Quantity of fertilizer used in watermelon production (kg/ha)
P_{X4}= Unit cost of herbicide used in watermelon production (₦/litre)
$X_{4=}$ Quantity of herbicide used in watermelon production (litre/ha)
$P_{X5=}$ Unit cost of pesticide used in watermelon production (₦/litre)
$X_{5=}$ Quantity of herbicide used in watermelon production (litre/ha)
$P_{X6=}$ Unit cost of labour used in watermelon production (₦/man- day)
$X_{6=}$ Amount of labour utilized in watermelon production (man-day)
$P_{X7=}$ Unit cost of Irrigation water used in watermelon production (₦/day)
$X_{7=}$ Amount of Irrigation water utilized in watermelon production (litres/day)
TFC= Depreciated value of equipment used in watermelon production.

The depreciation method used is the straight-line method where equal periodic charges are estimated over the calculated life span of the asset. This method was used because of uniform annual charges. It is expressed as:

$$D = \frac{P - S}{N} \quad \text{…….. (3)}$$

Where:

D = Depreciation on production asset
P = Original cost of production assets
N = Number of years of production asset's life.
S = Salvage value of the asset.
For Wet Season Watermelon Producers:

$NFI_W = GFI - TVC-TFC$…… (4)

Where:
NFI_W = Net income from wet season watermelon production (₦).
GFI = Value of total watermelon output (₦)
TVC = Total variable cost of watermelon production (N) expressed as:

$$\sum_{i=1}^{n} P_{i.} X_{.j} = \left(P_{x1}X_1 + P_{x2}X_2 + P_n X_n\right) \text{----------} \quad (5)$$

Where,

P_{X1}= Rental value of farmland dedicated to watermelon (₦/Ha)

$X_{1=}$ Size of farmland dedicated to watermelon production (Ha)

P_{X2}= Unit cost of seed used in watermelon production (₦/kg)
$X_{2=}$ Quantity of seed used in watermelon production (kg/ha)
P_{X3}= Unit cost of fertilizer used in watermelon production (₦/kg)
$X_{3=}$ Quantity of fertilizer used in watermelon production (kg/ha)
P_{X4}= Unit cost of herbicide used in watermelon production (₦/litre)
$X_{4=}$ Quantity of herbicide used in watermelon production (litre/ha)
$P_{X5=}$ Unit cost of pesticide used in watermelon production (₦/litre)
$X_{5=}$ Quantity of herbicide used in watermelon production (litre/ha)
$P_{X6=}$ Unit cost of labour used in watermelon production (₦/man- day)
$X_{6=}$ Amount of labour utilized in watermelon production (man-day)
TFC= Depreciated value of equipment used in watermelon production

The depreciation method to be used is the straight-line method where equal periodic charges are estimated over the calculated life span of the asset. This method was used because of uniform annual charges. It is expressed as:

$$D = \frac{P - S}{N} \quad \ldots\ldots (6)$$

Where;

D = Depreciation on production asset

P = Original cost of production assets

N = Number of years of production asset's life.

S = Salvage value of the asset.

RESULTS AND DISCUSSIONS

The results of the profitability analysis (Table 2) presents the costs and returns associated with wet and dry season's watermelon production in the study area. There was a decrease in the size of land used for watermelon production from 1.21ha in Dry season to 0.36ha in Wet season. Information from the field revealed that watermelon competes with other vegetables during wet season production, hence the reduction of the total size of land used for its production. The results revealed that, the variable cost components alone constitute 77% and 69% of the total production cost in wet and dry seasons, respectively. Among the variable components, cost of labour garnered 60% and 51% in wet and dry seasons, respectively. In addition, it also implied that variable cost components constitute the major production cost in the watermelon production enterprise across the state. The result agrees with the findings of Adeoye *et al.* (2011), Saleh (2012) and Muhammad (2014).

The result further revealed that the enterprise is a labour-intensive venture as the costs of labour across the study area and constituted over 33% and 75%of the TVC during the Dry and Wet sesons respectively. Since labour was the major cost component among the TVC, its higher value may be because of the high demand for labour and hence higher prices in the season because of competing needs from other crops. This agrees with the findings of Adeoye *et al.* (2011), Saleh (2012) and Muhammad (2014).

The total yield obtained during wet season was estimated at 17,195.53 kg while 25, 6725.87 kg was realized during the dry season meaning that there was 8,430.34 kg difference in favour of Dry season. This result conforms with the *a priori* expectations that higher watermelon yield could be obtained during dry season because of favorable weather condition occasioned by the absence of heavy downfall

of rain which causes flower abortion as well as less incidences of pests and diseases accompanied by the rainy season when compared to the wet season. This agrees with Saleh (2012) and opinion of the key informants during the period of the survey.

The results also revealed that the average NFI for the dry season enterprise was ₦535,991.41 /ha while that obtained during wet season was found to be ₦292,493.22 /ha implying that watermelon farmers in the state realized profit, and that higher profit to the tune of ₦ 243,498.19 /ha was realized during dry season over that obtained during wet season. In addition, this means that the profit level of the watermelon farmers increased by 44% in dry season over that obtained in wet season. The finding closely agrees with the findings of Adeoye *et al.* (2011) who reported a net margin of ₦288,448.96 k/ha in Oyo State and Saleh (2012) also reported a net income ₦321,654.43 k/ha . The findings, however, strongly disagrees with that of Baba *et al* (2014) who reported a comparatively meager amount of ₦30,946 k/ha in Kebbi State. Finally, the return to naira invested was found to be ₦2.18k and ₦4.13k in wet and dry seasons, respectively. This implies that for every ₦1 invested in the enterprise, an average of ₦2 and ₦4 was realized during wet and dry seasons, respectively.

CONCLUSIONS AND RECOMMENDATIONS

Watermelon production enterprise has grown to be an important venture in terms of income generation and provision of employment for the teaming population in Jigawa State. The enterprise is a profitable venture with varying degrees of profits between the wet and dry seasons.

The study further concludes that higher average yield of the Watermelon was obtained in dry season compared to the wet season. In addition, dry season Watermelon farmers realized more profit and obtained higher return for their investment than their wet season counter parts.

The study recommends that Watermelon farmers devote more of their land and other resources to dry season enterprise to generate more profit. This is because consumption of the commodity and profit generated was higher during dry season as compared to the wet season. In addition, the dry season enterprise is characterized by less incidences of pests and diseases and enjoys less competition of resources with other crops (cereals) usually grown during wet season in the study area.

Table 2: Cost and Returns of the Watermelon Production

Variable	**Wet Season**			**Dry Season**		
	Qty	Cost	%TVC	Qty	Cost	%TVC
Seed (kg)	0.36	19,902.31	19.15	1.21	5,511.74	5.82
Fertilizer (kg)	296	44,126.71	42.45	121.94	15,979.02	16.85
Pesticides (litre)	3.44	2,253.13	2.17	0.82	1,589.42	1.68
Herbicides (litre)	3.67	2,360.00	2.27	0.00	0.00	0.00
Labour (MDS)	44	35,283.33	33.95	59	71,584.42	75.64
TVC		103,925.48	100		94,644.60	100
Fixed Inputs						
Farm size	0.61	28,140.63		1.01	15,822.23	
Water pump	0.00	0.00		01	15,470.51	
Siphon	0.00	0.00		01	1,978.02	
Sprayers	01	2,061.77		01	1,833.33	
TFC		30,202.40			35,104.09	
Total Cost (TC)		134,127.88			129,768.69	
Returns						
Average yield (Kg/ha)	17,195.53				25,625.87	
Average Price (₦/Kg)	24.81				25.98	
Total Revenue (₦/ha)	426,621.10				665,760.10	
Net Farm Income (₦/ha)	292,493.22				535,991.41	
R.N.I	2.18				4.13	

Source: Field survey 2018

REFERENCES

Abba, A. (2009). Framework for Agricultural Market Analysis: Theories and Applications. Ahmadu Bello University Press Limited, Zaria Kaduna State, Nigeria www.abupressltd.com

Adeoye, I.B., F.B. Olajide-Taiwo, O. Adelani, J.M. Usman and M.A. Badmus, (2011). Economic analysis of watermelon based production system in Oyo State. *Nigerian Journal of Agricultural and Biological Sciences, 1(2): 2- 3.*

Baba M.D. ,Yelwa J.M., Yakubu G. , and Sanchi I. D.(2014) Comparative profitability analysis of watermelon and pepper Production in danko-wasagu local government area of kebbi State, Nigeria. *Review of Knowledge economy: Vol.1, No.2, pp.39-47*

Balogun, O. S., Akinyemi, O., Simoyan, J. B. and Olowoluwa, I. J. (2006): Profitability Analysis and Resource Use Efficiency of Yam/Millet Crop Mixtures in Gwagwalada Kuje Area Councils, Abuja, Nigeria. In: Haruna, U. et al. (Eds). Consolidation of Growth and Development of Agricultural Sector. Proceedings of the 9th Annual National Conference of Nigerian Association of Agricultural Economists held at the Abubakar Tafawa Balewa University, Bauchi. pp 15-18

De Lannoy, (2001). Crop Production in Tropical Africa. Romain H.R (Ed). Published by Directorate General for International Cooperation (DGIC), Brussels, Belgium. Pp.236

FAO (2011) Agricultural statistics for 2011. Food and Agriculture Organization of the United Nations, http://apps.fao.org/page/collections?subset=agriculture retrieved 18.08.2014

Harry, S. Paris (2015). Origin and Emergence of the sweet desert watermelon {Citrullus lanatus}, Vol 116(2) Egypt annals of Botany. Pp133-148

HonCode (2008). Watermelon: Nutritional Value and Health Benefits of Watermelon Flesh. http://www.dietaryfiberfood.com/index.php retrieved 19.10.2010

Ignjatovic, M. (2005). About Watermelons. Watermelon-Serbia.com. http://www.watermelon-serbia.com/english/strainice/olubenicama.htm retrieved 8.2.2011

Isah H. M, Raimi M. O, Sawyerr H. O, Odipe O. E, Bashir B. G, Suleiman H. (2020). Qualitative Adverse Health Experience Associated with Pesticides Usage among Farmers from Kura, Kano State, Nigeria. Merit Research Journal of Medicine and Medical Sciences (ISSN: 2354-323X) Vol. 8, No. 8, pp. 432-447, August, DOI: 10.5281/zenodo.4008682. https://meritresearchjournals.org/mms/content/2020/August/Isah%20et%20al.htm

Jarret, B., R. Bill, W. Tom and A. Garry, 1996. Cucurbits Germplasm Report, pp: 29-66. Watermelon National Germplasm System, Agricultural Service, U.S.D.A

Kim, B. (2008). Water Melon Nutrition: How to get the most nutrition value of watermelon. Health and beyond. http://www.chetday.com/index.html

Koutsoyionnis, A. (2003). Theory of econometrics. Macmillan press limited London. 3rd edition pp. 231-238 Saleh, A. (2012) Value Chain analysis of Watermelon in the Kano River Irrigation project (KRIP) Kano State, Nigeria.(An un published thesis submitted to the Department of Agricultural Economics and extension, Faculty of Agriculture, Bayero University, Kano, Nigeria.)

Manyong, V. M., A. Ikpi, J. K. Olayemi, S.A. Yusif O. Omonona, and F.S Idachaba (2003) Agriculture in Nigeria: Identifying Opportunities for increased Commercialization and Investment. A technical report funded by USAID/Nigeria and implemented by the International Institute of Tropical Agriculture (IITA) in collaboration with the University of Ibadan (UI)

Medicine Net (2004). Definition of Watermelon. http://www.medicinenet.com/script/main/hp.asp retrieved 4.6.2009

Muhammad B. A.(2014) Economic Analysis Of Watermelon (Citrillus Lanatus) Production in selected Local Government Areas Of Kano State, Nigeria: (A Thesis Submitted To The School Of Postgraduate Studies, Ahmadu Bello University, Zaria, In Partial Fulfillment Of The Requirement For The Award Of Master Of Science In Agricultural Economics Department Of Agricultural Economics And Rural Sociology, Faculty Of Agriculture, Ahmadu Bello University, Zaria, Nigeria).

Muhammad H. (2018) Econometric Analysis of Food Security and Poverty Status of Smallholder Maize Framers in the Savannah of Northern Nigeria. .(An un published thesis submitted to the

Department of Agricultural Economics and extension, Faculty of Agriculture, Bayero University, Kano, Nigeria.) In Partial Fulfillment of the Requirement for the Award of Doctor of Philosophy (PhD) in Agricultural economics.

NIHORT (2000). National Horticultural Research Institute; *25 years of research into Horticultural Crops Development in Nigeria* (1975 – 2000). A Commemorative Publication.

NIHORT (2010). National Horticultural Research Institute; *35 years of research into Horticultural Crops Development in Nigeria* (1975 – 2010). A Commemorative Publication.

Nutrition and health (2000) Dietry guidelines for Ameicans. United States, Washington DC. Department of Agriculture US Department of health and human services.

Saleh, A. (2021) Comparative Analysis of the Wet and Dry Season Watermelon Production in Kano and Jigawa States, Nigeria. An Unpublished Ph.D Thesis Submitted to the Department of Agricultural Economics and Extension, Faculty of Agriculture, Bayero University, Kano.

Sanni, S. A. and Ogundipe, S. O. (2003). Economics of Four Modules of Poultry Production in Nigeria. Proceeding of the 28th Annual Conference of Animal Scientists, March 2003. pp. 436-43 NIHORT (2010). National Horticultural Research Institute; 35 years of research into Horticultural Crops Development in Nigeria (1975 – 2010). A Commemorative Publication.

Vander Vossen HAM, Denton OA, El Tahir, IM (2004). Citrullus lanatus (Thunb.) Plant Resources of Tropical Africa 2. Vegetables. PROTA

Wasylikowa K, van der Veen M (2004). An archaeobotanical contribution to the history of watermelon, *Citrullus lanatus* (Thunb.)Matsum. & Nakai (syn. C. vulgaris Schrad.). Vegetable. History Archaeobot journal. 13: 213-217.

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Assessment of the Effect of Farmers-Herders Conflict on Actors Across Yam Value Chain in Benue State, Nigeria

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INTRODUCTION

The two main branches of agriculture are crop production and animal husbandry. These branches are dependent on one another both positively and negatively. This is because crops provide feeds to animals and animals supply animal feaces as manure for crop production in symbiotic relationship. On the other hand, animals can destroy both the crop and environment (land, water, air) if not effectively controlled and this is usually, the origin of conflict between farmers and cattle herders (Enwelu *et al.,* 2017). The scenario in Nigeria is such that cattle is mainly produced in the north while southern part of Nigeria is suitable for crop production with flourishing grassland/vegetation for cattle grazing (Ukamaka, Danjuma, Mbolle, Achonam and Mbadiwe, 2017).

Farming and pastoralism communities have over time developed interdependent relationships through reciprocity, others by exchange and support and that have been the primary source of livelihood for most farming households in developing countries including Nigeria, making them depend mostly on renewable resources (Moritz, 2010). The produce of farming households and herdsmen remains the primary source of food for both the rural and urban population in developing countries such as Nigeria, Ghana, Cameroon, Tanzania and Kenya (Rukwe, Abdullahi, Faruk and Nwaeze, 2019). For instance, International Fund for Agricultural Development (IFAD) (2013) reported that smallholder farmers in Asia and sub-Saharan Africa produce 80% of the food they consume, which is thus the major source of food security. But in several West African countries like Nigeria, recurrent farmer–herder conflicts threaten peace, food security, economy and the livelihoods of rural farmers, since such conflicts are on the rise and often violent in the sub-region (Rukwe *et al.,* 2019).

The agricultural sector is an important sector in developing countries and Nigeria is no exception and according to data from the World Bank, agriculture is the largest employer of labor in Nigeria (International Development Association (IDA), 2021). Employment in agriculture (% of total employment) in Nigeria was reported at 36.38% in 2019. The sector is also the largest income generating activity, with contributions to Gross Domestic Product (GDP) of about 24-30%. Unfortunately, the agricultural sector is particularly vulnerable to violent conflict; through killings, injuries, maiming of individuals, threats, fear, migration and displacement, with its direct effect on labour supply and demand of agricultural households (John and Ruth, 2019).

For many years in Nigeria, farmers and cattle herders have been in conflict over land rights. But the disputes have reached crisis levels in recent years, killing thousands of people and displacing many thousands more from their homes, left in ruins by attacks (United Nations sustainable Development Group, 2020). The history of Nigeria is replete with conflict of various dimensions, ranging from religious to sectional violence and to the currently escalating clashes between livelihood groups, particularly between sedentary farmers and Itinerant herdsmen across the country (Emmanuel and Stanley, 2019).
Yams (*Dioscorea species*) are annual root tuber bearing plants with more than 600 species out of which six are socially and economically important in terms of food, cash and medicine (International Institute of Tropical Agriculture (IITA), 2014). Some of the yam species are water yam (Dioscorea alata), white yam (*Dioscorea rotundata*), yellow yam (*Dioscorea cayanensis*), chinese yam (*Dioscorea esculanta*) and three-leaf yams (Zaknayiba and Tanko, 2013). Yam is grown in tropical region and mostly produced in the Savannah region of West Africa where rainfall is in two seasons i.e. wet and dry seasons and it is also grown in Latin America and Caribbean countries like Columbia, Brazil, Haiti Cuba and Jamaica (Food and Agricultural Organization, FAO, 2013). Yams are the fifth most harvested crop in Nigeria, following cassava, maize, guinea corn and beans/cowpea and moreover, after cassava, yams are the most harvested tuber crops in the country (National Bureau of Statistics, NBS, 2020).

Ivarsson and Alvstam (2005) defined value chain as a vehicle by which new forms of production, technologies, logistics, labour processes and organizational relations and networks are introduced. A value chain consists of all stages of a technical production process as well as of the interaction between these stages. The production process starts at the stage of input supply, then covers production, processing, marketing and ends with the consumption of a certain product and the technical production process can generally be separated into five stages: input supply, primary production, processing, marketing and consumption (Iddi, Donkoh, Danso-Abbeam, Karg, and Akoto-Danso, 2018).

At every stage in yam value chain, one or several different actors can be found. The first step of the production process is the input supply, for the yam production process, the major inputs required to produce yam are seed yam, land, labour, equipment for preparing the land, staking materials and agrochemicals. After production if the product is not marketed in its raw condition, processing is the next step. In yam processing, raw materials get transformed into processed products such as powdered yam, bread, apple pie, etc. Transformation becomes more and more important as consumers, especially in urban centers ask for a high variety of products and prefer more and more processed foods for easy cooking. In the study area, food vendors mostly do yam processing. Activities like classifying or packing also fall under the category of transformation. The next stage in the process is trade and marketing. Marketing involves the process (es) of business organization, which makes available products or services of value to the consumer from the point of production. The American Marketing Association (AMA) (2013) describes marketing as the activity, set of institutions and processes for creating, communicating, delivering and exchanging offerings that have value for customers, clients, partners and society at large. It should be noted that like many food items in Nigeria, not much processing is done with yam. However, yam is transported from production centers where the tuber is in abundance to urban centers for higher prices. Thus, even though there would not have been any physical value addition, in terms of the price, one can say that there is a value addition. The marketers consist mainly of wholesalers and retailers. The last stage is consumption of the good. Even though the consumers participate neither in the production process nor add value to the product, they are part of the chain, as in most cases the consumer is the driving power of the whole process. Yam contributes to wealth and food security of the people of sub-Saharan Africa but it yield has been declining due to several factors including farmer-herder conflicts (Ikeh *et al*., 2019). It is against this background that this study seeks to assess the impact of Farmers-Herders conflict on actors along Yam value chain in Benue State, Nigeria.

Statement of the Problem: In the past, conflicts have always existed between farmers and cattle herders in Nigeria that some scholars state that conflicts resulting from cattle grazing have existed for as long as the practice of agriculture, however, what is worrisome is the current magnitude of the conflicts and

the reverberating consequences on the nation especially her ailing economy (Abbas, 2012). The herders now attack farming communities with sophisticated weapons leading to infrastructural facilities' destruction**,** raping and burning of houses and property, also in certain cases, the entire communities are razed with fire and members rendered homeless (Abbas, 2012). The perennial nature of the clashes between itinerant cattle herders and farmers in Nigeria informs the growing concern for viable and lasting methods to improve on the relationship between these coexisting livelihood groups.

As noted by Nwosu (2017), while an accurate account of the death toll resulting from herdsmen-farmer violence in Nigeria is difficult to come by due to the lack of a dedicated database, newspaper reports of various incidents involving the herds men and farmers in settled communities reveal that the conflicts have resulted in the loss of over 60,000 lives since 2001, making it deadlier than the notorious Boko Haram uprising (Ogbette, Attama & Okoh, 2018). The conflict between herdsmen and farmers in Nigeria has continued to escalate as evidenced by recent killings in some communities and local government areas across Benue State especially as experienced in some communities of Agatu, Logo and Guma Local Government Areas in 2018 (Umoh, 2018).

Research has been conducted in some states of the federation including Benue on Herdsmen/Farmers conflict. For instance, Christopher (2018) analysed the conflicts between herdsmen and farmers in Nigeria with emphasis on the causes and socio-religious and political effects on National Development, Girei, Ugwuanyi and Turai (2019) studied the effect of Farmers–Herdsmen Crisis on Yam Production in Southern Agricultural Zone of Nasarawa State, Nigeria adopting Gross Margin Analysis (GMA) approach, Peter (2019) conducted a research on impact of the conflict between farmers and herdsmen on food production in the Agro-Ecological Zone-B of Benue State, Nigeria. Onwunyi and Anekwe (2020) investigated how Fulani-herdsmen and farmers clashes in Benue State affected food security in the State and Nigeria in general. Also, Mnguashima and Olushola (2020) in their survey in Benue State established the effects of farmers-herdsmen land-use conflict on livelihoods of farming households. Solomon (2021) studied the impact of the farmers and herdsmen conflict on food security focused on Taraba State; they examined the extent to which conflicts between farmers and herders affect food production, food availability, food stability, food utilization in Taraba State. It is however clear from the previous studies that no studies exist on the effect of farmers-herders conflict on all the actors along yam value chain in Benue State but few exist on the impact of the conflict on specific actors along yam value chain or other crops and it is in a bid of filling this knowledge gap that the study seeks to assess the effect of farmers-herders conflict on actors across yam value chain in Benue State, Nigeria and aims to approach it with a different methodology as against descriptive statistics, correlation analysis and gross margin analytical techniques used in some related studies. The foregoing give rise to the following research questions: what are the socio-economic characteristics of actors in the yam value chain in the study area, what are the causes of farmers-herders conflict in the study area and what is the effect of farmers-herders conflict on the welfare of actors across yam value chain?

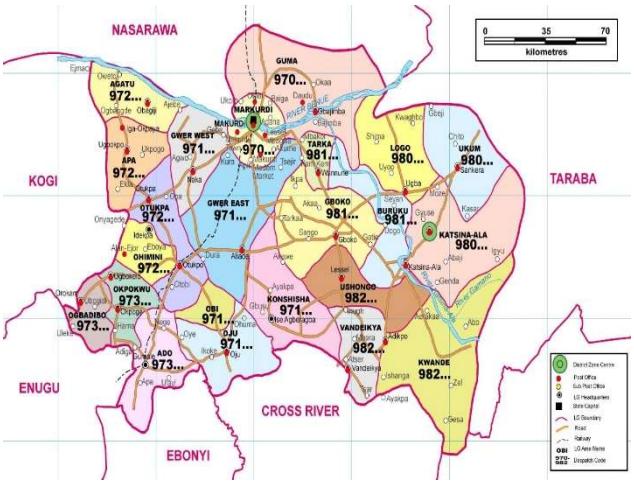
Objectives of the Study: The broad objective of this study is to assess the effect of farmers-herders conflict on actors across yam value chain in Benue State, Nigeria. The specific objectives are to:

i. describe the socio-economic characteristics of actors in the yam value chain in the study area,
ii. identify the causes of farmers-herders conflict in the study area, and
iii. determine the effect of farmers-herders conflict on the welfare of actors across yam value chain.

METHODOLOGY

The Study Area: The study was conducted in Benue State, Nigeria. Benue State was created in 1976 by the government of General Murtala Mohammed. It is in the Middle Belt Zone (North Central Nigeria). Benue State is bordered by Nassarawa to the North; Taraba to the East; Cross River to the South; Enugu and Ebonyi to the South-East and Kogi to the South-West. The State also shares a common boundary with the Republic of Cameroon on the south-east. Benue State's geographic coordinates are Longitude 7^0 47' and 10^0 0' East, Latitudes 6^0 25' and 8^0 8' North. The climate is tropical manifesting two distinct

seasons – the raining season from April to October, and the dry season from November to March. Tropical climate of the State favours a wide range of crops such as cereal grains (rice, maize, sorghum and millet), oil seeds (soybean, pigeon pea and groundnuts), tree crops (mango, cashew, guava, pear, oil palm Avengia spp. cocoa) and roots and tubers (cassava, yams, sweet potato and cocoyam).



Population and Sampling Technique: The population for this study comprise of all yam famers, marketers and processors in the study area. A multi-stage sampling technique was used for this study. In the first stage, Four (4) Local Governments known for yam production was purposively selected. In the second stage, two (2) villages were randomly selected from each local governments giving a total of Eight (8) villages. In the third stage, twenty (20) yam farmers, five (5) yam marketers and five (5) yam processors were randomly selected from each village giving a total of two hundred and forty respondents (240) for the study.

Method of Data Collection and Analysis: Primary data used for the study were collected using a questionnaire which was assisted with interview method to take care of respondents with no formal education.

Socio-economic characteristics of the actors across yam value chain was analysed using descriptive statistics such as mean, percentages etc, causes of farmers-herders' conflicts in the study area was analysed using factor analysis and the effect of farmers-herders conflict on the welfare of actors across the yam value chain was analysed using Propensity Score Matching (PSM).

RESULTS AND DISCUSSION

Socio-economic Characteristics of Actors across Yam Value Chain: The Socio-economic characteristics of the respondents are presented in Table 1. The result revealed that, the mean age of all the actors across yam value chain was 45 years. This implies that, the actors were within their productive age, and this is an advantage as they won't have any limitation as regard physical strength in carrying out their farming and business activities. This finding agrees Ajayi *et al.* (2020) who reported that majority of the farmers were within the age of 21-50 years with mean age of 43.7 years and that it implies that the respondents were still in their active and productive age with capacity to carry out yam production process and the finding agrees with the result of Rashid (2012) who asserted that majority of yam producers in his study area were young.

Table 1: Socio-economic Characteristics of Actors across Yam Value Chain

Socio-economic characteristics	Farmers			Marketers			Processors			Pooled		
	Frequency	%	Mean	Frequency	%	Mean	Frequency	%	Mean	Frequency	%	Mean
Age												
21-30	9	5.6		7	17.5		5	12.5		21	8.6	
31-40	44	25.5	46	15	37.5	41	12	30.0	42	71	29.6	45
41-50	53	33.1		9	22.5		8	20.0		70	29.2	
51-60	36	22.5		9	22.5		6	15.0		51	21.3	
60 and above	18	11.3		0	0.0		9	22.5		27	11.3	
Gender												
Male	101	63.1		16	40.0		7	17.5		124	51.7	
Female	59	36.9		24	60.0		33	82.5		116	48.3	
Marital Status												
Single	12	7.5		8	20.0		3	7.5		23	9.6	
Married	105	65.6		24	60.0		26	65.0		155	64.5	
Divorced	22	13.8		5	12.5		8	20.0		35	14.6	
Widow	21	13.1		3	7.5		3	7.5		27	11.3	
Household size												
5-9	92	57.5		9	22.5		13	32.5		114	47.5	
10-14	31	19.4	10	22	55.0	11	19	47.5	9	72	30.0	10
15-19	37	23.1		9	22.5		8	20.9		54	22.5	
Educational qualification												
Non-formal Education	32	20.0		7	17.5		10	25.0		49	20.4	
Primary	39	24.4		9	22.5		8	20.0		56	23.3	
Secondary	64	40.0		16	40.0		19	47.5		99	41.3	
Tertiary	25	15.6		8	20.0		3	7.5		36	15.0	
Farm Size (hectare)												
1-5	113	70.6								113	70.6	
6-10	33	20.6	4							33	20.6	4
11-15	14	8.8								14	8.8	
Farming/Marketing/Processing Experience												
1-10	13	8.1		7	17.5		11	27.5		31	12.9	
11-20	42	26.3	27	23	57.5	18	18	45.0	19	83	34.6	15
21-30	33	20.6		8	20.0		9	22.5		50	20.8	

31-40	56	35.0	2	5.0		2	5.0		60	25.0	
41 and above	16	10.0	0	0.0		0	0.0		16	6.7	
Access To Extension Services											
Yes	51	31.9	9	22.5		11	27.5		71	29.6	
No	109	68.1	31	77.5		29	72.5		169	70.4	
Access To Credit Facility											
Yes	13	8.1	7	17.5		8	20.0		28	11.7	
No	147	91.9	33	82.5		32	80.0		212	88.3	
Member of Cooperative Society											
Member	109	68.1	27	67.5		9	22.5		145	60.4	
Non-member	51	31.9	13	32.5		31	77.5		95	39.6	
Annual Income											
100,000 – 500,000	108	67.5	231,937	4	10	250,342	18	45.0	233,832	130	54.2	245,453
501,000 – 1,000,000	39	24.4	31	77.5		20	50.0		90	37.5	
1,000,000 and above	13	8.1	5	12.5		2	5.0		20	8.3	
Household Monthly Food Expenditure											
10,000 – 50,000	154	96.3	37,368	37	92.5	35,432	37	92.5		228	95.0	36,573
51,000 – 100,000	6	3.7	3	7.5		1	2.5		10	4.2	
100,000 and above	0	0.0	0	0.0		2	5.0		2	0.8	

Source: Field survey, 2022.

Most (63.1%) of the yam farmers were male, while 36.9% were female. This shows that there were more male yam farmers in the study area than the females and this could be because of the tedious nature of yam farming. This result agrees with that of Ajayi *et al.* (2020) who opined that majority of the respondents were male farmers than female farmers and that the dominance of male in yam production could be because of the strenuous nature of activities involved in the production which demands much physical energy. The result also reveals that, there were more female yam marketers and processors with the percentage of 60% and 82.5% respectively than the male in the study area. Women general involvement in marketing and processing activities could also be the major reason why there were more here than in farming. Majority (64.5%) of the actors across yam value chain in the study area were married as most of the farmers, marketers and processor with the percentages of 65.6%, 60.0% and 65.0% respectively were married, while 14.6 % are divorced. This means that, the actors had helping hands in carrying out their farming, marketing and processing activities as the case may be because of the availability of their partners who would assist each other in growing the business. The mean household size of the actors was 10 persons and this means that, the actors had enough hands to help them in carrying out their various activities along the value chain, as a result increasing their

business size as well as their gain. The result also show that, 41.3% of the actors across yam value chain had secondary education while 23.3% had primary education, 20.4% had no formal education and 15% had tertiary education. This shows that most of the actors i.e farmers, marketers and processors across yam value chain stopped at secondary level of education and did not attain higher level of education, and this could affect their level of improvement or adoption of improved methods of farming, marketing and processing as they were limited in exposure. Most (70.6%) of the yam farmers had farm sizes between 1-5 hectares, while 20.6% had 6-10 hectares and 8.8% had 11-15 hectares. This shows that, in the study area yam farming was still in the hands of peasant farmers as a result of the small farm size put into cultivation. It can be inferred that, the farmers if supported with farm machines and other modern yam farming technologies, can increase their production by farming more hectares thereby contribute in moving the state and Nigeria at large towards food security. The study revealed that most (35%) of the farmers had farming experiences between 31-40 years, majority (57.5%) of the marketers had a marketing experience between 11-20 years and most (45%) of the processors had a processing experience between 11-20 years. This implies that yam farming, marketing and processing are old occupation the study area. The result shows that majority of the actors across yam value chain in the study area had no access to extension services as 68.1%, 77.5% and 72.5% of the farmers, marketers and processors respectively had no access to extension services and this could have negative effects on the output of the actors across the yam value chain as they won't be exposed to the latest technologies on how to carry out their various activities to improve their output in the chain. Majority (88.3%) of the actors across yam value chain in the study area had no access to credit facilities. This depicts that many of the actors were still the ones funding their activities and this could be the reason why the farmers couldn't put large area of land into cultivation and marketers couldn't build well known warehouses and the processors not having nationally recognized processing plants. As regards Cooperative membership, most (60.4%) of the actors in yam value chain were members of cooperative societies. The membership of cooperative societies could be an advantage to the actors as some of them sometimes helped in disseminating helpful information in either farming, marketing or processing. Some of the cooperatives assist members with funds at a no or low interest rates to support their businesses. On the annual income, the findings reveals that majority (54.2%) of the actors had annual income between 100,000-500,000 naira. This implies that most of the actors are running their businesses on a small scale considering their level of income annually and it also shows that there is room for improvement on their income given the current economic reality. A large part (92.5%) of the actors in yam value chain expended between 10,000-50,000 naira on household food monthly, while 2.5% expended between 51,000-100,000 naira and 5% expended above 100,000 naira on household food on monthly basis. This reveals that much is spent on household food on monthly basis compared to the mean of their annual income.

Causes of Farmers-Herders Conflict: Table 2 shows the factor analysis of the actor's perceived causes of farmers-herders conflict in the study area using varimax rotation method. The KMO index of 0.631, 0.504, 0.609 and 0.584 for the farmers, marketers, processors and pooled respectively and the Bartletts sphericity of 0.000 shows the suitability of the data for factor analysis. According to the results, three factors were extracted based on the items loadings as causes of farmers-herders conflict. These factors were: Economic factors; Environmental/climatic factors; and Institutional factors. The causes that loaded on factor 1 were the major causes of farmers-herders conflict in the study area followed by causes loaded under factor 2 and factor 3.

For the pooled **(**comprising of the farmers, marketers and processors**),** the major causes that loaded very high under this economic factor (factor one) were destruction of stored produce on the farm (0.803), insufficient grazing land (0.703), burning of the farmers houses (0.658) and

Table 4.2: Causes of Farmers-Herders Conflict in the Study Area

Causes/factors loading	**Farmers**			**Marketers**			**Processors**			**Pooled**		
	1	2	3	1	2	3	1	2	3	1	2	3
Destruction of stored produce on the farm	**0.915**	-0.052	-0.037	**0.882**	0.221	0.201	**0.752**	0.289	0.241	**0.803**	-0.071	0.010
Insufficient grazing land	**0.812**	-0.002	0.017	**0.794**	0.218	0.257	**0.735**	0.231	-0.005	**0.703**	-0.010	0.101
Burning of the farmer houses	**0.780**	-0.005	0.132	**0.757**	0.317	0.407	**0.704**	-0.147	0.079	**0.658**	0.145	0.053
Disregard for local traditional authority	**0.661**	-0.069	-0.073	**0.732**	-0.222	0.014	**0.478**	-0.147	0.090	**0.497**	-0.139	0.034
Indiscriminate bush burning	**0.597**	-0.190	0.026	**0.342**	-0.080	0.140	**0.409**	-0.263	-0.217	**0.415**	0.071	0.067
Cattle rustling	**0.448**	-0.096	-0.194	**0.340**	0.063	0.023	**0.406**	0.217	-0.174	**0.398**	-0.147	-0.135
Overgrazing	**0.421**	-0.131	-0.073	**0.341**	0.064	0.230	**0.354**	-0.118	0.220	**0.371**	-0.073	-0.074
The inability of government in most cases to respond quickly to distress calls and early warning signs	**0.362**	0.139	0.037	**0.321**	-0.034	-0.241	**0.352**	-0.106	-0.090	**0.308**	0.036	0.087
Destruction of crop by cattle	**0.361**	-0.071	0.049	**0.320**	0.099	-0.172	**0.349**	0.102	-0.161	**0.304**	0.067	0.003
Farm fragmentation	**0.341**	0.053	0.059	**0.315**	-0.016	0.002	**0.335**	0.101	-0.038	**0.301**	-0.135	0.129
Farmlands left fallow	-0.184	**0.913**	-0.065	-0.117	**0.700**	0.059	-0.089	**0.586**	0.013	-0.122	**0.854**	0.003
Farming across cattle routes	-0.212	**0.891**	0.017	0.123	**0.645**	0.127	-0.202	**0.502**	-0.185	-0.211	**0.729**	0.129
Climate change	-0.152	**0.881**	-0.097	-0.059	**0.627**	-0.074	0.069	**0.495**	-0.235	-0.153	**0.726**	-0.136
Over-grazing of land	-0.022	**0.790**	0.381	-0.134	**0.567**	-0.010	-0.175	**0.472**	-0.146	0.161	**0.642**	-0.169

Setting traps for herds by farmers	0.013	**0.531**	-0.059	0.313	**0.493**	0.149	-0.056	**0.464**	0.299	0.201	**0.543**	-0.086
Contamination of streams by cattle	-0.060	**0.453**	0.097	0.301	**0.463**	0.342	0.041	**0.458**	0.149	0.070	**0.422**	0.094
Harassment of nomadic youth by youth of host community	-0.101	0.159	**0.582**	0.126	0.045	**0.544**	-0.110	-0.126	**0.696**	0.098	0.030	**0.582**
Claim of citizenship	-0.050	-0.125	**0.553**	0.231	-0.009	**0.537**	-0.038	0.094	**0.653**	-0.045	-0.136	**0.553**
Competition for land and other resources	-0.020	0.031	**0.543**	-0.055	0.048	**0.505**	0.263	0.100	**0.643**	-0.072	0.117	**0.543**
Political difference	0.000	-0.034	**0.434**	0.104	-0.172	**0.444**	-0.020	0.245	**0.466**	-0.019	-0.004	**0.434**
Language barrier	-0.051	-0.020	**0.327**	-0.117	0.194	**0.441**	-0.228	-0.015	**0.464**	-0.064	0.227	**0.357**
Lack of political will by the government to arrest and punish the offenders adequately	-0.167	-0.133	**0.324**	0.166	-0.412	**0.439**	0.136	0.077	**0.458**	0.031	0.089	**0.344**
Unauthorized encroachment into farmlands	-0.182	-0.097	**0.322**	-0.149	0.015	**0.417**	-0.200	0.007	**0.404**	-0.050	0.009	**0.332**
Declining influence of traditional leaders	0.047	0.065	**0.321**	-0.019	0.129	**0.351**	-0.110	0.013	**0.390**	-0.185	-0.081	**0.322**
Cultural difference	-0.101	0.159	**0.301**	0.206	0.049	**0.312**	-0.033	0.011	**0.380**	-0.053	0.022	**0.314**

Source: Computed from field Survey, 2022. LEGEND: factor 1= Economic factors, Factor 2= Environmental/Climatic factors Factor 3= Institutional factors. The KMO index for the farmers, marketers, processors and pooled are 0.631, 0.504, 0.609 and 0.584 respectively.

disregard for local traditional authority (0.497). This shows that in the study area, the major economic factor causing farmers-herders conflict were destruction of stored produce on the farm, insufficient grazing land, burning of the farmer houses and disregard for local traditional authority. This is followed by indiscriminate bush burning (0.415), cattle rustling (0.398), overgrazing (0.371), the inability of

government in most cases to respond quickly to distress calls and early warning signs (0.308), destruction of crop by cattle (0.304) and farm fragmentation (0.301). This reveals that other economic factors that caused farmers-herders conflict in the study area according to the perspective of all the actors in yam value chain were cattle rustling, indiscriminate bush burning, destruction of crop by cattle etc.

The significant causes of farmer-herders conflict under the second factor which is environmental/climatic factors were farmlands left fallow (0.854), farming across cattle routes (0.729), climate change (0.726), over-grazing of land (0.642), setting traps for herds by farmers (0.543) and contamination of streams by cattle (0.422). This depicts that, farmlands left to fallow, farming across cattle routes, climate change and overgrazing are some of the major causes of farmer-herders conflict in the study area tagged environmental/climatic factor.

On factor three (institutional factors); harassment of nomadic youths by youths of host community (0.582), claim of citizenship (0.553), competition for land and other resources (0.543), political difference (0.434), language barrier (0.357), lack of political will by the government to arrest and punish the offenders adequately (0.344), unauthorized encroachment into farmlands (0.332), declining influence of traditional leaders (0.322) and cultural difference (0.314) were regarded as causes of farmers-herders conflict. The findings reveals that harassment of nomadic youth by youths of host community and the quest for rights over resources such as land, water sources and language barrier were some of the causes of farmers-herders conflict according to the actors across the yam value chain. This finding is supported by Ajayi *et al.* (2020) who show that straying of cattle into neighbouring farms as indicated by all the respondents, followed by destruction of crops and over-grazing of land which ranked 1st, 2nd and 3rd respectively, were the major causes of the conflict among all the identified causes. This finding agrees with Olaleye *et al.* (2010) who reported that the pastoralists do encounter problems with the local people because farmers' crops were being destroyed by their cattle. Others include indiscriminate burning of bush, contamination of stream by cattle and disregard for local authority by the pastoralist which ranked 4th, 5th and 6th, respectively, among the causes of conflict identified Ajayi *et al.* (2020)

Effect of Farmers-Herders Conflict on the Welfare of Actors (Farmers, Marketers and Processors) across Yam Value Chain in the Study Area: Estimates of the logit model on farmers-herders conflict on the welfare of actors across yam value chain and estimates of the average treatment effects on the treated (farmers, marketers and processors) are presented in Table 3 and Table 4

Table 3: Estimates of the Logit Model on Farmers-herders Conflict and Actors across Yam value Chain in the study area

Conflict	Coefficient	Std. Err.	Z	P Values
Age	0.0840857	0.0721193	1.17	0.024**
Marital Status	2.450191	1.021243	2.40	0.016**
Household Size	-0.9593597	0.2172435	-4.42	0.000***
Farming/Marketing/Processing Experience	-0.0196657	0.0961772	-0.20	0.001**
Extension Access	-0.0625029	1.374426	-0.05	0.964
Credit Access	-3.128757	3.013298	-1.04	0.299
Annual Income	-1.270006	1.170006	-1.09	0.019***
Farm Size	0.9369549	0.2295285	4.08	0.000***
Constant	-1.282016	2.266178	-0.57	0.572

Source: Computed from Field Survey, 2022 *** and ** = significant @ 1% and 5% respectively.
Dependent Variable = Yam value chain actors Conflict Experience

Table 4: Estimates of the Average Treatment Effect on the Treated (Actors across Yam value Chain)

ESTIMATORS	ATT	STD. ERR.	T-STAT
Nearest Neighbour Matching	38,854.1667	1568.879	2.37
Radius Matching	46,111.1111	8974.549	2.21

Source: Computed from Field Survey, 2022

The quality of matching indicates the extent to which matching on the propensity score balances the relevant variables between less hit actors and worst hit actors because of the conflict. For this study, the approach by Sianesi (2004) was used. This involves comparing the Pseudo R2 before and after matching to assess the quality of the matching procedure. Result of this comparison test reveals there was low value of the Pseudo R2 after matching, confirming that there was no systematic difference in the distribution of covariance between conflict worst hit and mildly/less hit actors after the matching procedure. Based on the success of the matching procedure, it was possible to examine the differences in the income between worst and mild hit actors by the conflict. This difference in income (which is the outcome of the "treatment effects") denotes the effect of farmer-herders conflict on the actors' welfare. The estimators employed to select the worst hit to act as matches for the mildly hit farmers are nearest-neighbour, radius and kernel matching estimators. However, estimates of the nearest-neighbour and radius matching methods showed significant relationship, hence, are reported and discussed.

Estimates of the logit model indicated that age, marital status and farm size had positive relationship with farmer-herders conflict experienced by yam value chain actors in the study area with the farm size and age significant at 1% and 5% level of probability respectively and it means that an increase in age, marital status and farm size would lead to the increase of the number of farmers-herders conflicts experienced by actors across yam value chain. This implies that generally, when the actors are aged, with more wives, they could be very prone to the attack as they won't be so energetic to deal with the physical, emotional and psychological trauma that comes with it. The result also shows that household size, farming/marketing/processing experience, extension access, credit access and annual income all have negative relationship with farmer-herders conflict which means that an increase in all the variables mentioned will lead to the reduction of cases of the conflict in the study area.

The results of propensity score matching used to determine the effect of farmer-herders conflict on the actor's welfare is presented in Table 4.3.8. Income of the actors was used as the welfare indicator in the analysis. Based on the success of the matching procedure, the differences in the income between worst and mild hit actors by the conflict was examined. The estimators employed to select the two group's i.e the target (less hit actors) and the control group are Nearest-Neighbour and Radius matching. The results of the estimated Average Treatment Effect on the Treated (ATT) represents the effect of farmer-herders conflict on the actor's welfare (Income). The result shows that the Nearest Neighbour and Radius Matching estimators had indirect effect on the income of the actors. The indirect relationship implies that farmer-herders conflict negatively affects the income of the actors. It shows that, actors with less cases of farmer-herders conflict in the state had more income than those with worst conflict experiences. The Nearest-Neighbour and Radius Matching methods indicated that less hit actors because of the conflict had ₦ 38,854 and ₦ 46,111 more income, respectively. Peter (2019) in his study on impact of the conflict between farmers and herdsmen on food production in the agro-ecological Zone-B of Benue State, Nigeria reported that, there was a 56% reduction in food production because of the conflict between farmers and herdsmen in the zone. The result also showed that there was a 62% reduction in the income and standard of living among farmers in Benue State because of the conflict. Kayode *et al.* (2020) opined that the activities and the damage caused by nomad/pastoralist in the order of the impact as follows: the compaction of soil was the highest, damage and eating of the crops on the field and the third was indiscriminate bush burning leading to fire outbreaks on farms. Other damages were: stealing of farm produce by herders, overgrazing of the fallow land, land degradation, pollution of water points, land erosion, total invasion of the farm, killing and maiming of the farmers, sexual harassment of the women and kidnapping of the farmers. All these activities in one way or another contributed to the food insecurity status of the nation.

CONCLUSION AND RECOMMENDATIONS

The study was undertaken to assess the effect of farmers-herders conflict on actors across yam value chain in Benue State, Nigeria. The clashes have led to the loss of many lives and property in the State hampering agricultural activities and the entire state economy and the study concludes that, the clashes

were often triggered or caused by destruction of stored produce on the farm, insufficient grazing land, burning of the farmer houses, disregard for local traditional authority, farming across cattle routes, climate change, competition for land and other resources, political difference and many more. Actors with less cases of farmers-herders conflict in the State had more income than those with worst conflict experiences.

The study recommends that, the Federal and State government should formulate policies restraining farmers from cultivating on define cattle routes and also restraining herders from straying into farmlands stating clearly the punishment for defaulters. Also the farmers and herders on their own should ensure the security of their assets and refraining from intentionally inducing the conflicts. Also to improve the welfare of actors in yam value chain in the study area, all the stakeholders in the conflict menace such as the farmers, herders, marketers, processors and all other members of the society should actively be involved in finding a permanent way of solving the problem complementing the efforts of the government and other relevant Non-Governmental Organizations concerned in solving the problem.

REFERENCES

Abbass I.M. (2012): No retreat no surrender: conflict for survival between Fulani pastoralists and farmers in northern Nigeria. European Scientific Journal 8: 331 –346.

Ajayi, O.J., Y. Muhammed, J. H. Tsado, H. U. Muhammad and V. M. Akpata (2020). Effect of Communal Conflict on Yam Production in Agatu Local Government Area of Benue State, Nigeria. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS). e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 13, Issue 2 Ser. I (February 2020), PP 01-06*

American Marketing Association (AMA), (2013). Approved Definition of Marketing by Board of Directors, July 2013. https://www.ama.org/AboutAMA/Pages/Definition-of-Marketing.aspx

Christopher I. Ndubuisi (2018). A critical analysis of conflicts between herdsmen and farmers in Nigeria: Causes and socio-religious and political effects on national development. HTS Teologiese Studies/Theological Studies 74(1), a5065. https://doi.org/10.4102/hts.v74i1.5065.

Dimelu M. U., Salifu D. E., Enwelu A. I. and Igbokwe E. M. (2017). Challenges of herdsmen-farmers' conflict in livestock production in Nigeria: Experience of pastoralists in Kogi State, Nigeria. *African Journal of Agricultural Research*. Vol. 12(8), pp. 642-650, 23 February, 2017. DOI:10.5897/AJAR2016.11740.

Emmanuel Nwakanma and Stanley Ebitare Boroh (2019).Demography of Conflict and the Herders-Farmers Crisis in Nigeria. *The Nigerian Journal of Sociology and Anthropology* ISSN: 0331-4111 Volume 17, No. 2, November 2019 Pages 28-40

FAO (2013), FAOSTAT, database (online) Available at http://bit.ly/ nmozzi Accessed, 10 April, 2014.

Girei, A. A., L. S. Ugwuanyi and H. M. Turai (2019). Effect of Farmers – Herdsmen Crisis on Yam Production in Southern Agricultural Zone of Nasarawa State, Nigeria. *Asian Journal of Research in Agriculture and Forestry 2(4): 1-7, 2018.*

Iddi, F. Y., Donkoh, S. A., Danso-Abbeam, G. Karg, H, Akoto-Danso, E. K. (2018). Marketing Efficiency Analysis of Yam Value Chain in the Northern Region of Ghana. *International journal of development.* Volume 5 No. 1, June, 2018.

Ikeh, A., Ndaeyo, N., Uduak, G., Udoh, E., Obinaju, L., and Nkeme, K. (2019). Evaluation of yield productivity and economic returns of some yam (Dioscorea esculenta Poir) genotypes grown in a kaolinitc ultisol. *Journal of Biology, Agriculture and Healthcare, 2*(6), 65–69.

International Development Association (2021). Agriculture. https://ida.worldbank.org/en/topics/results/agriculture

International Institute for Tropical Agriculture (IITA) yam org/yam; 2009. (Accessed 15 March 2014).

Ivarsson, I. and Alvstam, C.G. (2005). Technology transfer from TNCs to local suppliers in developing countries: A study of AB Volvo's truck and bus plants in Brazil, China, India, and Mexico**.** *World Development,* 33(8): 13251344.

John Chiwuzulum Odozi and Ruth Uwaifo Oyelere (2021). Does violent conflict affect the labor supply of farm households? The Nigerian experience. *Agricultural and Resource Economics Review* (2021), 50, 401–435. doi:10.1017/age.2021.14

Kayode Samuel Obaniyi, Ayorinde Kolawole, Abiodun Ajala, Abigail Adeyonu, Adedayo Oguntade (2020). Assessment of crop farmers coping strategies to pastoralism/nomad activities in Nigeria. *Open Agriculture* 2020; 5: 219–226

Mnguashima Valentina Soomiyol and Olushola Fadairo (2020). Climate-induced conflicts and livelihoods of farming households in Nigeria: lessons from farmers-herdsmen conflict-ridden communities in Benue State. *Agricultura Tropica et Subtropica, 53/2, 93–103, 2020.* DOI: 10.2478/ats-2020-0010

Moritz M. (2010). Understanding Herder-Farmer Conflicts in West Africa: Outline of a processual approach. Hum. Org. 69(2):138-148.

National Bureau of Statistics (NBS), (2020). LSMS – Integrated Survey on agriculture: General Household Survey Panel 2018/19 Available at www.nigeriastat.gov.ng/pages/download 194 Accessed 17 January, 2021.

Ogbette, Afamefuna Samuel, Attama, Augustine Onyenachira and Okoh, Joel Ogechukwu (2018). Fulani-Herdsmen and Farmers Crises under Buhari's Administration-Causes, Effects and its Management (2015-2018). *International Journal of Peace and Conflict Studies* (IJPCS), Vol. 5, No 2, Dec., 2018

Olaleye, R. S., Odutola,J. O., Ojo, M. A., Umar, I. S. and Ndanitsa, M. A. (2010). Perceived effectiveness of conflict resolution methods for improved Farmer-Pastoralist relationship in Chikun Local Government Area of Kaduna State, Nigeria. *The Nigerian Journal of Rural Extension and Development*, 3, 54 – 58

Peter A. Kwaghtser (2019). Impact of the conflict between farmers and herdsmen on food production in the agro-ecological Zone-B of Benue State, Nigeria. *Ianna Journal of Interdisciplinary Studies.* Volume 1, Issue 1, October 2019 EISSN: 2735-9891.

Rashid, S. (2012). Land Use Conflict between Farmers and Herdsmen – Implications for Agricultural and Rural Development in Nigeria. *Rural Development- Contemporary Issues and Practices.* DIO: 10.5772/45787

Rukwe D.T, Abdullahi Y.M, Faruk A.U and Nwaeze U (2019). The Effects of Farmers-Herders Conflict on Farming Households in Southern Taraba State, Nigeria. *South Asian Research Journal of Agriculture and Fisheries*. Volume-1, Issue-3, Oct-Nov-2019. DOI: 10.36346/SARJAF.2019.v01i03.006

Sianesi, B. (2004). Evaluation of the active labour market programme in Sweden. *The review of economics and statistics*. Vol. 86.

Solomon, Binga Lezuya (2021). Impact of the Farmers and Herdsmen Conflict on Food Security; Focus on Taraba State. *International Journal of Research and Innovation in Social Science* (IJRISS). Volume V, Issue III, March 2021|ISSN 2454-6186

Ugochukwu Mmaduabuchi Onwunyi and Nneka Justina Anekwe (2020). Interrogating clashes in Benue State and their implications on food security in Nigeria. *Socialscientia Journal of the Social Sciences and Humanities*. Volume 5. Number 3. September 2020

Ukamaka, D. M., Danjuma, S. E., Mbolle, C. J., Achonam, E. I. and Mbadiwe, I. E. (2017). Livelihood issues in herdsmen farmers conflict among farming communities in Kogi State. *Nigeria. African Journal of Agricultural Research,* 12 (24), 2105-2115.

Umoh, P. (2018). Bloody Farmers/Fulani Herdsmen Clashes in Benue: 40 Killed Scores Injured, 2000 Displaced. Vanguard, p.11.

United Nations sustainable Development Group (2020).Climate crisis in Nigeria: The UN fosters dialogue between farmers and cattle herders over shrinking land.

Zaknayiba D.B, Tanko L (2013). Costs and return analysis of yam production among small scale farmers in Karu local government area, Nasarawa State, Nigeria. PAT. 2013; 9(1):73-80.

NIGERIAN ASSOCIATION OF AGRICULTURAL ECONOMISTS (NAAE)
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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Local Beverages Industry Competitiveness Facts from Burukutu and Kunu Agriprenuership by Rural Women in Dekina Kogi State, Nigeria

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Abstract

Local beverages are competitive enterprises. The study examined competitiveness of the processing and marketing of Burukutu and Kunu by rural women in Kogi State, Nigeria. Stratified, proportionate random sampling technique was used to ensure that the different groups of the population were represented. Data generated through primary survey were analyzed using descriptive statistics and gross margin analysis. Results showed that females dominated the processing and marketing of Burukutu and Kunu in Kogi State. They accounted for 71% marketers and 38.5% of processors. The proportion of males that engaged in marketing and processing accounted for 28.4% and 61.7%, respectively. About 66% of marketers and 61% of processors were married. Housewives constituted 55% of those who engage in marketing and processing of burukutu and Kunu. About 44% of them were marketers while 11.5% were processors. The highest educational level of 48% and 38% of marketers and processors respectively was First School Leaving Certificate, while 25.7% and 25.5% of marketers and processors respectively possessed no educational qualification. The majority of the processors realized up to ₦25,000.00 and ₦35,000.00 respectively. It was recommended that processors should expand their businesses to include supplying to increase their profit margin and generate income.

Keywords: Socio-economics, Profitability, Processing, Marketing,

INTRODUCTION

1.1 Background Information

Guinea corn (Sorghum alum) and Pearl millet (Pennisetum glacum) are staple foods in many African countries, where other cereals, which depend on low rainfall and high temperature, do not grow. They are of special importance in countries lying to the south of the Sahara where they account for half of all food consumption. Sorghum and Millet are major sources of calories, proteins and vitamins for the Nigerian population resident in the Sudan Savannah and the Sahel agro-ecological zones (Jain and Majmudar, 1995). Mali, Niger and Nigeria are the three major producers of Sorghum and Millet in Africa. Nigeria accounts for about 39% (4200,000 metric tonnes) of the total African Sorghum and Millet production (Miracle, 1985). Most of the Sorghum and Millet produced in Nigeria are used for human consumption (Rooney and Macdonough, 1987; Nkama, Abbo and Igene, 1994).

Sorghum originated in the north-eastern quadrant of Africa, where the greatest variability in wild and cultivated species are found. Currently, it is the leading cereal grain on the Africa continent, and Nigeria is the world's second largest producer of grain sorghum. The plant is drought resistant and is, therefore, an extremely important commodity that provides necessary food and feed for millions of

people living in semi-arid worldwide. Sorghum is mainly grown as one of the major crops (often besides millet) on community or private fields and mostly consumed locally.

Sorghum can be grown successfully on a wide range of soil types and environmental conditions. It is well suited to heavy vertisols found commonly in the tropics, where its tolerance to water logging is often required, but is equally suited to light sandy soils. It tolerates a range of soil pH from 5.0 – 8.5 and is more tolerant to salinity than maize. It is adapted to poor soils and can produce grains on soils where many other crops would fail (Hubbard, Hall and Earle, 1990).

Worldwide, 40 million hectares are devoted to sorghum production. In the United States of America, Sorghum is used primarily as corn substitute for livestock feed because its nutritional value is almost the same. In arid regions, in less developed regions of the world, sorghum is an important food crop especially for subsistence farmers. It is used to make foods, such as couscous, sorghum flour and porridge. It can also be made into excellent wall board for building houses, as well as biodegradable packaging. It does not conduct static electricity, so it is also being used in packaging materials for sensitive electronic equipment (Subramanian Miracle and Jambunathan, 1980).

In Nigeria, Sorghum is used to produce beer. Beers are essentially alcoholic beverages made from cereal products. The cereals, barely in Europe and Sorghum in Africa, are malted in order to produce enzymes and to modify the major substrates – starch and protein in beer brewing. The major part of sorghum crop in South Africa and Nigeria is used in the malted form for the brewing of Sorghum beer that is Bantu beer, Kaffir beer, Pito or Burukutu.

Sorghum is also used in manufacturing malt extract, baby foods and porridge.

Pearl Millet (Pennisetum glacum) is today the world's sixth most important cereal grain. It accounts for almost half of the global millet production and is the most important specie of millet both in terms of cropped area and in contribution to food security in regions of Africa and Asia. Many of the statistics are only rough estimates; data should be treated with caution (FAO, 2005). Pearl millet is resistant to drought and is a crop that thrives on any soil. Generally, Pearl millet is considered more efficient in utilization of soil moisture and has a higher level of heat tolerance than does sorghum and maize. These facts make millet an important food staple all over the African Continent, especially in the semi-arid areas of the western Sahel where other crops tend to fail because of inadequate rainfall and poor soil conditions.

Sorghum and Pearl millet may be prepared so that they ferment over-night and are cooked to make porridge. Such cereal preparations are always consumed as thick porridge but may be diluted and drunk as gruel. The nutritional value of these products depends very much on the degree of refinement of the cereals. In one case, for example, the protein digestibility was raised from 60% before to 80% after treatment (Dreyer and Cancannon, 1975).

Burukutu and Kunu are some of the indigenous alcoholic and non-alcoholic beverages taken as drinks by the locals in sub-Saharan Africa. They are cereal-based traditional beverages produced from sorghum and millet, which are rich in carbohydrate fermented agricultural products. They are usually brewed in different styles with different tastes depending on the area and are usually low in alcohol content. These beverages, apart from serving as inebriating drinks, are also important in fulfilling social obligations such as marriage, naming and burial ceremonies (Sanni and Lonner, 1993).

In Nigeria, the brewing of Burukutu and Kunu is traditionally associated with the people in the northern part of the country, but migration has led to its production and consumption throughout the whole country. The industry is mostly controlled by women between the age range of 18-60 years. Therefore, production of Burukutu and Kunu not only provides psychological and social functions, but has important implications for the food system and economy of the country (Sefa-Dedel and Asante, 1988).

Burukutu is golden yellow to dark brown in colour with tastes varying from slightly sweet to very sour while Kunu, a non-alcoholic beverage, is of low viscousity and has a sweetsour taste and

milky cream appearance (Adeyemi and Umar, 1994). Both beverages contain lactic acid, sugar, amino acids, 2-3% alcohol and some vitamins and proteins (Bunsah, 1990). Burukutu and Kunu are popular drinks in Nigeria owing to their refreshing nature, thirst quenching and low price (Adeyemi and Umar, 1994).

The production of Burukutu is as a result of mixed, spontaneously generated fermentation with yeasts and lactic acid and bacteria as the predominating micro-organisms. However, the yeast flora is mainly responsible for the alcohol content of the beverage while Kunu does not involve all these. These drinks constitute a major source of energy and protein for people in Nigeria and most African countries. They serve as staple food for many of the world's poorest and least privileged people (Hulse, 1980).

1.2 Statement of the Problem

There are myriad of challenges in the processing and marketing of Burukutu and Kunu drinks in Dekina Local Government Area of Kogi State and other parts of the country for over a decade now which has posed a lot of concern to the researchers. The production processes of Burukutu and Kunu drinks are largely traditional and crudely handled in homes and consequently, the production has not increased substantially more than a cottage industry. Many of them are gradually acquiring label of drink for the poor population that is associated with low income (Odunfa, 1985). Hence, subsequent quest through research and development, by various organizations and industries in an attempt to seek complete improvement to address the challenges associated with the processing and marketing of Burukutu and Kunu through a more scientific method, is yet to be accomplished. This has hindered the increase and enhancement of the market value of the products.

The transformation of millet and sorghum to its by-products are known to be surrounded by various opposing factors which include the followings: inadequate raw material, grading and cleaning process, lack of modern processing technology, improper handling and processing techniques employed by the local producers, inadequate methods of preserving the drinks available to the producers, lack of homogeneity and unattractive presentation/packaging (Nout, 1985; Odunfa, 1985; Chausan & Kadem, 1989; Ojo, 1991; Idachaba, 1991; Ewell and Jones, 1991 and Majasan, 1995).

The above problems have greatly affected the quality, durability, marketability and profitability of the products. If these problems are allowed to persist for long, it will demoralize the producers and consequently the final consumers.

From the foregoing, to maintain and sustain the profitability of the crops and their byproducts, the production and processing need to be moved from its subsistence to commercial level because of the value attachment to the two crops which form the thrust of the work.

1.3 Research Objectives

The broad objective of this study is to conduct an economic analysis of the processing and marketing of local agro-based drinks, Burukutu and Kunu, by rural women in Dekina Local Government Area of Kogi State.

The specific objectives are to:

i. describe the socio-economic characteristics of the processors and marketers; ii. describe the processing systems used by Burukutu and Kunu processors in Dekina

Local Government Area; iii. calculate the profitability of processing and marketing Burukutu and Kunu and iv. describe the marketing system of Burukutu and Kunu.

1.4 Study Hypothesis

The null hypothesis that guided the study is:

i. there is no statistical difference between revenue generated by Burukutu and Kunu enterprises.

1.5 Justification of Study

Fermented foods play an important socio-economic role in developing countries, as well as making a major contribution to the protein requirement of natural population. These foods are made under primitive conditions which result to low yield and poor quality. This study is considering some indigenous fermented beverages which are alcoholic and nonalcoholic beverages (Burukutu and Kunu). Traditionally, women carry out fermented food processing activities, the production is craft-based despite the dawn of science and technology. In Nigeria, most of the rural women are gainfully self-employed and are contributing immensely to the development of agriculture in the economy, including women in Dekina Local Government Area of Kogi State who produce Burukutu and Kunu for consumption.

The findings of this study will help to highlight the activities of rural women in Burukutu and Kunu production and marketing. Moreover, the study will help the Nigerian government to appreciate the contributions of these women and hence seek ways of encouraging them in their processing and marketing activities thereby increasing productivity and income (FAO, 1994).

Agribusiness students will gain more knowledge about modernizing the processing and marketing technologies as there will be need to apply some materials and equipment for better quality control and faster production. In the industrial scale operations, a quantitative approach is desirable to enable the optimum design of fermentative containers, incubation room and their heating, cooling and insulator capacities (Daengsubha and Suwana-adth, 1985).

To consumers, when the law of demand and supply is applied, may wish to go for the products (Burukutu and Kunu) based on the cost of local technology in their production as compared to other industrially produced agro-based drinks like beer, malt, can drinks etc. Daluba (2000) opined that industrial outputs whose production processes need higher technical know-how which leads to higher prices are not affordable by low income consumers. For most production processes, profit maximization is always the key focus of the producers thus traders of Burukutu and Kunu, which are gotten from sorghum and millet, are fully engaged in the business because of the profit or gain margin accruing from it.

The results of this study will serve as a pointer to economists (planners) on the need to keep the government at various levels abreast of the economic value of the drinks (Burukutu and Kunu) and re-emphasize the production of these drinks on commercial level instead of its present state (subsistence level), (Ibitoye, 2006).

The findings from this study will be of immense benefit to the rural dwellers as the marketing and processing are sources of employment, as these (marketing and processing) have gone a long way to provide shelter and clothing for processors and marketers. The Ministry of Agriculture and Natural Resources will be assisted with the findings from this study as it will create room for more agricultural extension workers to be trained by the ministry and posted to rural areas to educate processors and marketers on the adoption of innovation (use of seeds with low tannin, packaging homogeneity etc.) as a way of improving production for maximum yield to meet the market demand (FAO, 1994).

Finally, researchers will be encouraged to research further into other areas like the agronomic practices including modern harvesting procedures and storage processes including control of pests and diseases affecting the production of the crops (sorghum and millet).

1.6 Limitations of the Study

The study is limited by the following:

- There is constraints of finance to cater for transportation to various places within the study area.
- There was the problem of long distance covered by the researchers and there was uneasy access to the rural women involved in the enterprise which include processing and marketing of the Burukutu and Kunu.

- Most of the respondents had little education and this reduced the speed of data collection as interpretation to the local languages was done.

Despite these constraints, the researchers were able to conduct and complete the research.

METHODOLOGY

3.1 Study Area

The study area is Dekina Local Government Area of Kogi State which is one of the twenty one Local Government Areas of the state. Dekina Local Government Area is situated between Latitudes 7º 15′ and 8º 0' north and Longitudes 6º 45′ and 7º 30' east. Agriculture in the Local Government Area is mainly practised on small-scale by farmers. Agricultural products include yams, cassava, maize, sorghum and millet and animals like goats, sheep, chickens and turkey in small holdings. The grains produced in the Local Government Area are for food such as fufu and eko but millet and sorghum are mainly processed into Burukutu and Kunu as local agro-based drinks. These drinks are served at festivals, burials, marriages and title taking ceremonies and even for household consumption. Dekina Local Government Area has a total population of 1,033,456 million out of the total population of 8.52 million for Kogi State (National Population Census, 2006), with land area 2,461 km^2 with three districts comprising Biraidu, Dekina and Okura.

3.2 Sampling Procedure

The researchers made use of multistage and stratified/proportionate random sampling technique. The reason for stratifying rather than taking a simple sample was to ensure that the different groups of which the population is composed were represented in the sample. The technique is the most robust sampling technique as it satisfies the conditions of the peculiarities of the populations and ensures that each condition is actually put into consideration (Awotunde and Ogudulunu, 2004).

Stratification was done based on the fact that the population of the rural women in the study area was not the same. The population of processors and marketers of Burukutu and Kunu in the study area vary. There are more marketers than processors. The total number of respondents selected per district was at least 0.015 percent of the population of marketers and processors in the district by using simple random sampling technique as performed by Omede, (2008). This selection is presented in Table 3.1.

Table 3.1: Distribution of Population and Sample Based on Districts

Items	Biraidu	Dekina	Okura	Total
Total of People	365414	344486	323556	1033456
Sample	55	52	49	156

For the purpose of this study because the number of marketers was higher than that of the processors, the total sample was a reflection of 70% marketers and 30% processors. This is represented in the Table 3.2.

Table 3.2: Distribution of Processors and Marketers of Burukutu and Kunu based on Sample from the Three Districts That Make Up Dekina L.G.A.

Items	Biraidu	Dekina	Okura	Total
Sample	55	52	49	156
Marketers	39	36	34	109
Processors	16	16	15	47

Source: Derived from Table 3.1

3.3 Data Collection

Primary data were collected with two sets of questionnaires. The first set was administered on processors of sorghum and millet drinks into Burukutu and Kunu. The second set was administered on marketers.

3.4 Data Analysis

Objectives i, iii, iv & v were achieved using descriptive statistics, while objective ii was achieved using Net Income (NI) Analysis and returns per naira of investment. Net Income is represented as: NI = TR – TC,

Where NI is net farm income = total revenue –total cost.

TR = total revenue,

TC = total cost made up of total variable cost (TVC) and total fixed costs (TFC) which involved depreciation of fixed assets using straight line method with five year useful life of the assets.

The null hypothesis was tested using Student's t-test and multiple regression. The first hypothesis was tested using the t-test, the formula is given as:

$$t = \frac{\bar{X}_i - \bar{X}_2}{\sqrt{\frac{(n_1 - 1) S_1^2 \square (n_2 - 1) S^2_2}{(n_1 \square n_2) - 2}}}$$

where t = calculated student t-test;

$\bar{X}_i$ = mean revenue of Burukutu enterprise;

$\bar{X}_2$ = mean revenue of Kunu enterprise;

S_1^2 and S^2_2 are the variance of the number of entrepreneurs in Burukutu and Kunu enterprises, respectively; and

n_1 and n_2 are the number of entrepreneurs in Burukutu and Kunu enterprises.

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Processors and Marketers

4.1.1 Sex and Marital Status

Females dominated marketers of Burukutu and Kunu in Kogi State. Female marketers accounted 71.6 percent of the marketers while males accounted for about 28.4 percent. With respect to processing, males were more than females. Male processors accounted for 61.7 percent of the survey while female accounted for 38.3 percent. Processing activities involve starting the engine which if manually operated required some strong efforts. This may deter females from becoming processors (Table 4.1).

Table 4.1: Sex of processors and marketers

Items	Marketers		Processors	
	Male	Female	Male	Female
Sex	31(28.4)	78(71.6)	29(61.7)	18(38.3)

Source: Computed from field survey

About 66 percent of marketers and 61.7 of processors were married. Single individuals who were marketers accounted for less than one percent. No single individual was a processor. Since none of the processors were single, it indicated that the business applied to married people. Generally, married people dominated the processing and marketing. Like other farm business, it is possible that the family provided labour to support this business. Based on marital status, divorced, single and separated individuals had poor representation in the sample (Table 4.2).

Table 4.2: Cross tabulation of marital status of processors and marketers

Items	Marketers	Processors	Total
Single	7(0.06)	0(0.0)	7(4.7)
Married	72(66.1)	29(61.7)	101(64.8)
Widowed	15(13.8)	14(29.8)	29(18.6)
Divorced	5(0.05)	1(0.02)	6(3.8)
Separated	10(0.09)	3(0.06)	13(8.3)
Total	109(100)	47(100)	156(100)

Source: Computed from field survey

4.1.2 Position in Household and Family Size

Household position can be a means of categorizing responsibilities in families. It may indicate flow of resources into and out of households. Housewives constituted 62.5 percent of those who engaged in marketing and 38.3 percent of processors of Burukutu and Kunu. Housewives dominate marketing and processing of the drinks (Table 4.3). The result indicated that most women were marketers while there was no major difference among the males (husbands) in marketing and processing of Burukutu and Kunu. It could be inferred that since more men engage in processing than women, processing requires more energy.

Table 4.3: Position in household of marketers and processors

Items	Marketers	Processors	Total
House wife	68(62.5)	18(38.3)	86(55.1)
Husband	30(27.5)	29(61.7)	59(37.8)
Others	11(10.1)	0(0.0)	11(7.1)
Total	109(100)	47(100)	156(100)

Source: Computed from field survey

Marketers had more number of children who were less than 15 years than processors.

Table 4.4 showed that there were more females in the households of marketers and processors. The numbers of households having four or five females were more than the number of households having males of the same number. This may not be an indication that female children assist more in marketing and processing of the drinks because of their tender ages.

Table 4.4: Family size, children less than 15 years

No of children in Household	Marketers		Processors	
	Males	Females	Males	females
0	21(19.3)	22(20.2)	0.0(0.0)	1(2.1)
1	20(18.3)	28(25.7)	1(2.1)	1(2.1)
2	36(33.0)	11(10.1)	18(38.3)	3(6.4)
3	27(24.8)	8(7.3)	26(55.3)	0.0(0.0)
4	2(1.8)	5(4.6)	2(4.2)	7(14.9)
5	2(1.8)	15(13.8)	0.0(.0)	19(40.4)
More than 5	1(0.9)	20(18.3)	0.0(.0)	16(34.0)
Total	109(100)	109(100)	47(100	47(100.0

Source: Computed from field survey

4.1.3 Age and Years of Experience

Age can be an indication of physical strength for working. Age group of 31 to 40 and 41-50 dominated the marketers and processors of Burukutu and Kunu. This indicated that adults were engaged in the business (Table 4.5).

Table 4. 5: Age of marketers and processors

Age category	Marketers	Processors	Total
20-30 years	13(11.9)	9(8.3)	22(14.1)
31-40 years	49(45.0)	14(29.8)	63(40.4)
41-50 years	46(42.2)	17(36.2)	63(40.4)
More than 50	1(0.9)	7(14.9)	8(5.1)
Total	109(70)	47(30)	156(100)

Source: Computed from field survey.

The engagement of adults in farm activities is preferable than that of old people because of the dictates of life cycle hypothesis. In a similar vein, Agbugba and Nwagbo (2006) reported that the mean age of producers and marketers of vegetables in Abia was 35 years.

Years of experience can indicate level of managerial expertise. Interestingly, a good proportion of the respondents had about 12 years experience in processing and marketing of Burukutu and Kunu (Table 4.6). It is possible that they had developed capacity to manage the enterprise with their wealth of experiences.

Table 4.6: Years of experience of marketers and processors

Experience in years	Marketers	Processors	Total
1-10	36(33.0)	4(8.5)	40(25.6)
11-20	45(41.3)	13(27.7)	58(37.2)
21-30	24(22.0)	7(14.9)	31(19.9)
31-40	2(1.8)	8(17.0)	10(6.4)
41-50	2(1.8)	13(27.7)	15(9.6)
More than 50	0(0.0	2(4.3)	2(1.3)
Total	109(100)	47(100)	156(100)

Source: Computed from field survey

4.1.4 Education and Income

The highest educational level of 48 and 38 percent of marketers and processors was first School Leaving Certificate, while 25.7 and 25.5 percent of marketers and processors possessed no educational qualification (Table 4.7).

Table 4.7 Educational level of respondents

Education level	Marketers	Processors	Total
no primary education	28(25.7)	12(25.5)	40(25.6)
primary education	53(48.6)	18(38.3)	71(45.5)
tertiary education	28(25.7)	17(36.2)	45(28.8)
Total	109 (100)	47 (30)	156(100)

Source: Computed from field survey

However, the majority of the processors and marketers had at least primary school certificate, while 25.7 percent of the processors and 36.2 percent of marketers had tertiary educational qualification. The result is in consonance with Aihonosu, Balogun and Shittu, (2005) who reported that majority of swamp rice farmers in Ogun Water Side L.G.A possessed First School Leaving Certificate. Similarly, Tokula, Asomugha and Okwusi (2006) reported that in Abia State, the literacy level of rural farmers consisted of primary, secondary and tertiary certificates in the following percentages, 56, 24 and 8 respectively..

The majority of the processors realized up to ₦25,000.00 while majority of marketers realized up to ₦ 45, 000.00. The proportion of marketers who realized up to ₦30,000 was more than those of processors. The Table 4.8 illustrated that marketers made more money than processors.

Table 4.8: Income level of Processors and Marketers

Income levels	Marketers	Processors	Total
15,000-20,000	1(0.9)	11(23.4)	12(7.7)
20,000-25,000	7(6.4)	27(57.5)	34(21.8)
25,000-30,000	6(5.5)	8(17.0)	14(9.0)
30,000-35000	22(20.2)	1(4.3)	23(14.7)
35,000-40,000	21(19.3)	0(0.0)	21(13.5)
40,000-45,000	52(47.7)	0(0.0)	52(33.3)
Total	109 (100)	47(100)	156 (100)

Source: Computed from field survey

The result is in line with Echebiri (2001) who classified annual rural household income in southern Nigeria into low (less than ₦100,000), medium (less than ₦200,000) and high (above ₦200,000). That study found that majority (54%) had low income while 27% and 19% had medium and high income respectively. A Gini index of 0.45 was reported for income variation/inequality. It was reported that income varied with occupation, gender and age, with farmers earning more income than artisans while traders, on the average, had the highest income and artisans had more income than fishermen. With reference to gender, Echebiri (2001) noted that 55 percent were males whose average income was higher than that of females were among low income households; while 87% of males and 13% of females belonged to the medium income level. Also, 92% of males and just 3% of females belonged to the high income group. In terms of age, 40-49, dominated the low and medium income levels while 50-59 dominated the high income levels. The result suggests that income increases with age among the working class.

4.2 Processing Systems Used by Burukutu And Kunu Processors

. Figure 4.1 is a step by step representation of Burukutu processing method.

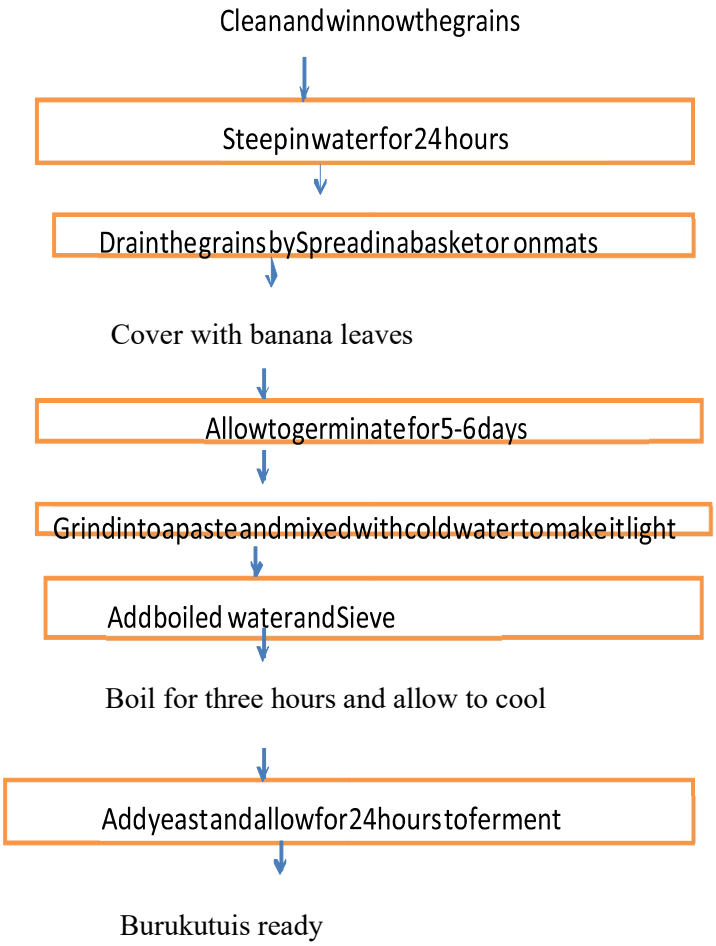


Figure 4.1: Steps for Processing Burukutu; Source: Field survey

The use of simple and traditional methods characterized the processing of these drinks.

The process of preparation of Burukutu involved cleaning the grains and soaking in water to activate the enzymes. This allows for easy application of biotechnology (covering with leaves and sprouting). This is followed by milling, sieving and fermentation. All the respondents were of the view that the preparation steps were meticulously followed without any alteration.

The process of preparation of Kunu was similar to that of Burukutu (Figure 4.2). It involved cleaning the grains and soaking in water to activate the enzymes. This allows for easy application of biotechnology (covering with leaves and sprouting). This is followed by milling and sieving. Fermentation is not allowed. Thus, one of the major differences between Burukutu and Kunu is that the former is a fermented/alcoholic beverage, while the latter is not. Again, all the respondents were of the view that the preparation steps were meticulously followed without any alteration.

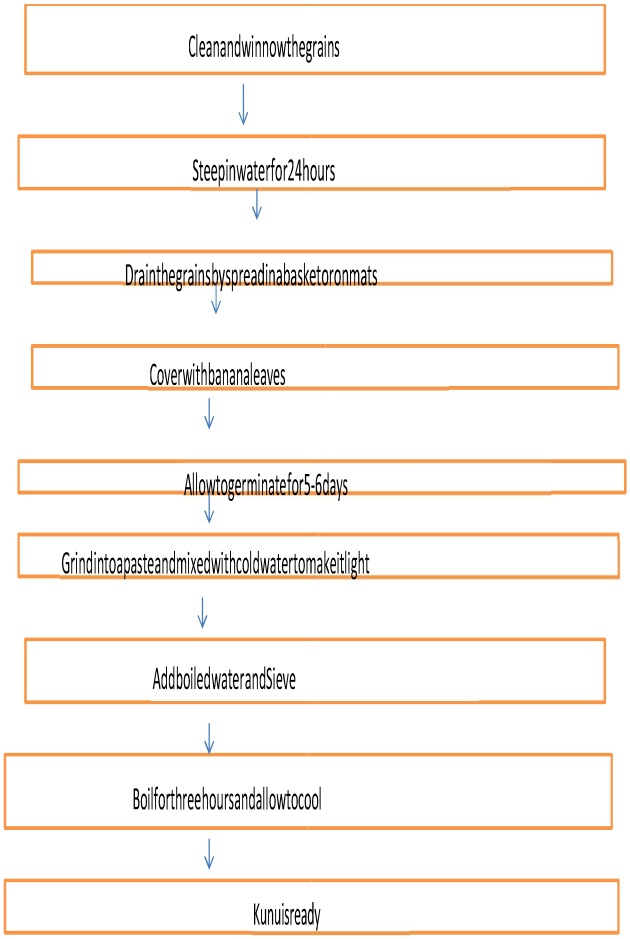


Figure 4.2: Steps for processing of Kunu

Source: Field survey

4.4 Marketing System of Burukutu and Kunu

A simple marketing channel characterizes the distribution of Burukutu and Kunu. Processors sold directly to consumers while retailers also sold to consumers (Figure 4.3). This distribution channel could facilitate easy access of the products by consumers since the shelf live is very limited.

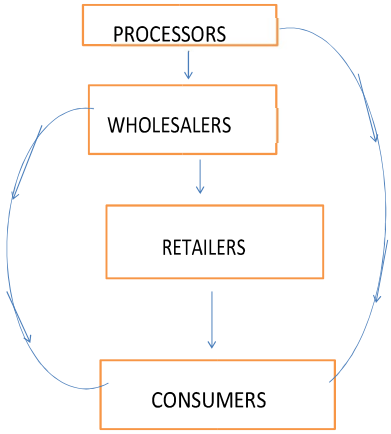


Figure 4.3: Marketing channels of Burukutu and Kunu

Source: Field survey

In addition, the sale of Burukutu and Kunu was by hawking or in a shop. The survey indicated that 64.7 percent have a shop for selling Burukutu while 42.3 percent of Kunu sellers also had a shop. On the other hand, 35.3 and 57.7 percent of Burukutu and Kunu sellers did not have any shop for their business. This indicated that hawking was one of the ways used to sell these products (Table 4.9).

Table 4.9: Sale of Burukutu and Kunu in a shop or by hawking

Item	Burukutu	Kunu
Have shop for selling	101(64.7)	66(42.3)
Don't have shop for selling	55(35.3)	90(57.7)
Total	156 (100)	156(100)

Source: Field survey

4.4.1 Profitability of Processing of Burukutu and Kunu

The gross margin and net enterprise income of processing Burukutu and Kunu were ₦24836.94 and ₦19615.00 respectively (Table 4.10). This is an indication that processing of agro-based drinks can be a lucrative business that will lead to wealth creation and poverty alleviation.

Table 4.10 Gross Margin of Processing of Burukutu and Kunu

Items	₦	₦	₦	₦
Revenue	Burukutu	Burukutu	Kunu	Kunu
Sales of Burukutu	83,414		51395.3	
Consumption	8,342		3139.5	
Gifts	2,085		784.8	
Total revenue (TR)		93,841.00		55,891.52
Variable cost				
Transportation	1041.06		1000.0	
Grinding raw materials	1200.00		1200.00	
Labour	2700.00		2000.00	
Cost of raw materials	24836.94		21,778	
Total Variable cost (TVC)		29778.00		25,978.00
Gross margin (TR-TVC)		64063.00		29913.52
Fixed cost				
Basin	1,707.00		1,200.00	
Drums	4241.49		2240.00	
Sieve	202.13		202.13	
Calabash	196.81		196.81	
Jerry can	337.02		337.02	

Cups	38.09		38.09	
Depreciation of small tools with zero salvage value for three years		2240.85		4,214.05
Actual cost used 1/12 of 6,723				
Fixed cost eg machine 55,500, 8.4% depreciation for 10 years with zero salvage value		4,662.00		4,662.00
Net enterprise income (GMTotal Fixed Cost)		57160.15		21037.47

Source: Field survey

4.4.2 Profitability of Processing of Burukutu and Kunu

Burukutu and Kunu are stored in gallons hence their measurement is in liters. The gross margin analysis showed that marketing of Burukutu and Kunu constitute a profitable business. The average marketer makes a gross margin of ₦71889.0 and ₦18720.6 from Burukutu and Kunu respectively, while the net enterprise income of the enterprises respectively were ₦39690.00 and ₦3110.6 per month. The revenue generated from Burukutu was more than Kunu because Burukutu sales for about ₦40 per liter while Kunu was 30, also the quantity of Burukutu sold was more than that of Kunu (Table 4.11).

Table 4.11: Profit and loss account of marketers of Burukutu and Kunu

Table 4.11 Marketing of Burukutu and Kunu

Items	₦	₦	₦	₦
Revenue	Burukutu	Burukutu	Kunu	Kunu
Sales of Burukutu	98,520		50500	
Consumption	10,000		5,000	
Gifts	2,000		2,500	
Total revenue (TR)		110520.00		58000.00
Variable cost				
Transportation	5000		25000.00	
Labour	4000.00		2500.00	
Cost of Burukutu	30500.00		2000.00	
Total variable cost (TVC)		39500.00		29500
Gross margin (TR-TVC)		71020.00		28500
Fixed cost				
Gross margin				
Fixed cost				
Basin	2000.00		2000.00	
Drums	500.00		500.00	
Calabash	1500		1500	
Jerry can	1000		1000	
Cups	500		500	
Depreciation of small tools with zero salvage value for three years		1833.33		1833.33
Net enterprise income		69186.67		26666.67

Computed from field data

4.4.3 Test of differences in gross margin between the processors and marketers of burukutu and Kunu
The t-test statistic was used to test the differences between the gross margin made from marketing of Burukutu and Kunu as well as processors of Kurukutu and Kunu. It may be informative to note that all marketers surveyed sell both Burukutu and Kunu using the same facilities. Quantities of Burukutu and Kunu sold, given out and consumed differed.

Table 4.12: Test for difference between gross margin of Burukutu and Kunu enterprises

Enterprises	Mean	mean difference	Std deviation	t-value
Marketing of Burukutu	71020	42520	31447.87	12.01***
Marketing of Kunu	28500			
Processing of Burukutu	64063	34150	2234.11	10.21***
Processing of Kunu	29913			

***=Significant at 1% probability level; Source: Computed from field survey

The t-test showed that differences in income from Burukutu and Kunu were significant. It indicated that marketing of Burukutu was more profitable than Kunu. Thus, marketers make more money than processors (Table 4.12).

SUMMARY, CONCLUSION AND RECOMMENDATIONS

SUMMARY

Burukutu and Kunu are one of the indigenous alcoholic and non-alcoholic beverages taken as drinks by the locals in sub-Saharan Africa. They are cereal-based traditional beverages produced from sorghum and millet, which are rich in carbohydrate fermented agricultural products. They are usually brewed in many different styles with different tastes depending on the area and are usually low in alcohol content. These beverages apart from serving as inebriating drinks are also important in fulfilling social obligations such as marriage, naming and burial ceremonies. The broad objectives of this study were to examine the processing and marketing of local agro-based drinks, Burukutu and Kunu in Dekina Local Government Area of Kogi State. The specific objectives were to: (i) describe the socio-economic characteristics of the processors and marketers (ii) describe the processing systems used by Burukutu and Kunu processors in Dekina Local Government Area (iii) examine the role of gender in Burukutu and Kunu processing and marketing (iv) describe the marketing system of Burukutu and Kunu; and (v) estimate the profitability of Burukutu and Kunu drink enterprises in the area (vi). The null hypotheses that guided the study were: (i) there was no statistical difference between revenue generated by Burukutu and Kunu enterprises; and (ii) revenue of these enterprises did not depend on socio-economic characteristics of the processors and marketers. Data were generated through primary survey. Stratified, proportionate random sampling technique was used to ensure the different groups of which the population is composed are represented in the sample. It is because the number of marketers is higher than that of the processors that 70% and 30% respectively were selected. Data were analyzed using descriptive statistics, gross margin and regression analysis.

Results showed that females dominated the processing and marketing of Burukutu and Kunu in Kogi State. They accounted for 61.5 percent, while the males accounted for 38.5 percent of the respondents. There were no major difference in the percentage of males that engage in marketing and processing as they accounted for 19.9 and 18.6 percent respectively; unlike the females where 50 percent and 11.5 engaged in marketing and processing respectively. About 65 percent of marketers and processors were married and 46.2 percent out of this proportion were marketers, thus majority of the marketers were married. Household position can be a means of categorizing responsibilities in families.

It may indicate flow of resources into and out of households. Housewives constituted 55 percent of those who engaged in marketing and processing of burukutu and Kunu. About 44 percent of them were marketers while 11.5 percent were processors. The result indicated that most women were marketers while there was no major difference among the males (husbands) in marketing and processing of Burukutu and Kunu.

Marketers had more number of children who were less than 15 years than processors.

Out of 109 processors, 12.8 percent of them had at least five females while out of 47 marketers, 10.3 percent of them had at least five females. Similarly, 17.3 percent of the marketers had at least three males who were less than 15 years while for processors it was zero. The processing and marketing of these agro-based drinks is a type of family business. Thus, family size could be a cheap source of labour. The number of children more than 15 years was fewer per household, for instance about three children per household dominated the household of marketers while very few household (15%) had up to five children. Age group of 31 to 40 and 41-50 dominated the marketers and processors of Burukutu and Kunu. This indicates that adults are engaged in the business. The engagement of adults in farm activities is preferable than that of old people because of the dictates of life cycle hypothesis.

Years of experience can indicate level of managerial expertise. Interestingly, a good proportion of the respondents possess about 12 years of experience in processing and marketing of Burukutu and Kunu. It is possible that they have developed capacity to manage the enterprise with their wealth of experiences. The highest educational level of 34 and 11 percent of marketers and processors was First School Leaving Certificate, while 17 and seven percent of marketers and processors possessed no educational qualification. However, the majority of the processors and marketers had at least primary school certificate, only about 28 percent of the processors and marketers possessed tertiary educational qualification.

The majority of the processors realized up to ₦25,000.00 while majority of marketers realized up to ₦35,000.00. The proportion of marketers who made up to ₦ 30,000 was more than those of processors. However, both processors and marketers made some money from the enterprise.

The process of preparation of Burukutu involves cleaning the grains, soaking in water to activate the enzymes. This allows for easy application of biotechnology (covering with leaves and sprouting). This was followed by milling, sieving and fermentation. All the respondents were of the view that the preparation steps were meticulously followed without any alteration. On the other hand, the process of preparation of Kunu was similar to that of Burukutu. It involved cleaning the grains and soaking in water to activate the enzymes. This allows for easy application of biotechnology (covering with leaves and sprouting). This is followed by milling and sieving but fermentation was not allowed. Thus, one of the major differences between Burukutu and Kunu was that the former is a fermented/alcoholic beverage, while the latter is not. Again, all the respondents were of the view that the preparation steps were meticulously followed without any alteration. Forty-six percent of the respondents were of the opinion that men and women share responsibility in production of the raw materials namely millet and sorghum. Men somehow dominate the production of the raw materials as 32 percent of the respondents opined that only men produce the raw materials but 19 percent gave credit to women while 2.6 percent reserved their comments.

Female marketers of Burukutu and Kunu were more than males. Sixty and 53 percent of the respondents were of the view that women were marketers, while 46 percent held their view private. Eleven and 19 percents of the respondents were of the view that major marketers of Kunu and Burukutu constituted both male and female. There were more retailers of Burukutu and Kunu than their wholesalers. The result showed that 42 percent and 46 percent engaged in retailing of Burukutu and Kunu respectively as well as eight percent and seven percent that engaged in both wholesale and retail of Burukutu and Kunu; while 35 and 32 percent engaged in wholesale of Burukutu and Kunu. It was expected that retailers will outnumber wholesalers because the retailers deal with the distribution to final consumers. Shelf life is a factor indicating durability of the processed agro-product; beyond the shelf life, the product is considered poisonous. The shelf life of locally processed agro-based drinks is

usually low. This calls for optimization and mechanization of the processing to achieve higher shelf life. The majority of respondents were of the view that burukutu and Kunu lasts for three to four days. This is very small when compared with shelf life of bottled drinks.

CONCLUSION

It has been insightful to conduct an economic analysis of the processing and marketing of local agro-based drinks, Burukutu and Kunu by rural women in Dekina Local Government Area of Kogi State. Both male and female participated in this lucrative business. The enterprise can be a means of processing millet and sorghum into other useful forms. The study has revealed that the local processing methods were used till date. There is need to improve on it by mechanizing the process.

Area of further research

Other researchers could examine the challenges and factors for integrating Burukutu and Kunu markets as well as strategies to encourage more consumption of Kunu. Efforts can be made to examine the value of these food drinks on wellbeing of women and pregnant women. Also, consumption preferences among people of different age groups along gender line can be examined.

RECOMMENDATIONS

- Processors of Burukutu and Kunu can integrate marketing of the products since the mean gross margin and net enterprise income of marketers were more than those of processors. This can be applicable for households that enjoy large size.

REFERENCES

Adeyemi, I.A. and Umar, S. (1994). Effect of Method of Manufacture on Quality Characteristics of Kunu Zaki and Millet-based Beverage Nig. Food J., 12:34-41.

Agbugba, I.K and Nwagbo, E.C. (2006). "Then Performance of vegetable production and marketing in Anambra State Nigeria" Proceedings of the 19th Annual Conference of FMAN Pp. 133-136.

Aihonosu, T.O., Balogun, V.O. and M.A Shittu, M.A. (2005). "Swamp Rice Production in Ogun State Waterside Local Government Area of Ogun State, Nigeria" Proceedings of the 19th Annual Conference of Farm Management Association of Nigeria Pp. 78-83.

Akankpo,G.O. and Asa, U.A. (2006). "Gender Role in Maize Production in Ini L.G.A. Akwa Ibom State". Proceedings of The 40thAnnual Conference of the Agricultural Society of Nigeria. Pp 606-609.

Arene, C.J. (1998). Introduction to Agricultural Marketing Analysis for Developing Economics. Nsukka: Fulladu Publishing Company.

Arene,C.J. and Mkpado, M. (2004) "Counter-Urbanization and Agricultural Productivity in Nigeria." Journal of Rural Development Vol. 23 (1) Pp 73 -81.

Chidebelu, S.A.N.D. (1991). "Hired Labour on Small-holder Farms in Southern Nigeria" in Issues in African Rural Development C. Doss and C. and Olson (eds). Wiorock

Daengsubha, W. and Suwana-adth. M. (1985). Development of Indigenous Fermented Foods in Thailand and other South East Asian Developing Countries: IFS/UNU. Foods in Thailand and other South East Asian Development of Indigenous fermented foods and food technology in Africa. Doula Cameroun, Oct. 1985.

Daluba, N.E. (1995). The Role of Women in Agriculture. A paper presented at the annual agricultural students' week, Kogi State College of Education, Ankpa.

Echebiri, R.N. (2001). An Analysis of the Influence on Socio-Economic Variables on Household Income, Consumption Expenditure and Savings in Rural Southern Eastern Nigeria. Ph. D Thesis Dept of Agric. Economics, University of Nigeria Nsukka.

Echebiri, R.N. (2001). An Analysis of the Influence on Socio-Economic Variables on Household Income, Consumption Expenditure and Savings in Rural Southern Eastern Nigeria. Ph. D Thesis Dept of Agric. Economics, University of Nigeria Nsukka.

Hubbard, J.C., Hall, T.S. and H.M. Earle (1990). Enzyme Inhibition by Polyphenols of Sorghum Grain and Malt. Journal of Science Food and Agriculture, 26, 13-19.
Hulse, T. (1980). African Journal of Biotechnology Vol. 6(5) pp. 587-590 5th March, 2007.
Ibitoye, S.J. (2006). Evaluation of Sorghum and Millet Production in Kogi State East Agricultural Development Project Farming Areas. Teacher Education Journal. Ankpa: Kogi State College of Education, 6(2), 26-35.
Imoh, A.N (2003). "Effect of Family Size on the Participation of Women in Development Projects in Mbaise, Imo State Nigeria. An Unpublished Ph.D Dissertation, Michael Okpara University of Agriculture Umudike, Abia State
International.
Jain, W.S. and Majmudar, R.A. (1995). Mashing with Kaffircorn Malt: Factors Affecting Sugar Production. Journal of Science Food and Agriculture, 17, 3-14.
Nchare, A. (2007) Analysis of Factors Affecting Technical Efficiency of Arabica Coffee Producers in Cameroon AERC Research Paper 163
Nout, M.J.R. (1985). Upgrading Traditional Biotechnological Processes IFS/UNU Workshop on Development of Indigenous Fermented Foods and Food Technology in Africa. Douala, Cameroon, Oct. 1985.
Odunfa, S.A. (1985). Microbiological Changes during the Traditional Production of Ogi-baba, a West African Fermented Sorghum Gruel. J. Cereal Sci. 3:173-180.
Odunfa, S.A. (1994). Cereal fermentation in African Countries 2nd ed., Journal of Science and Nutrition, pp. 108-109.
Ojo, N.O. (1991). The role of Agro-Industries in Promoting Food Culture in Nigeria CBN Econ. Fin. Rev. 29:306-314.
Okorji, E.C. (1989). "Demand Elasticities for Food Crops in major Yam Producing Areas of Southern Eastern Nigeria."Ph.D. Thesis Dept of Agric. Econs. University of Nigeria Nsukka.
Olayide, S.O. and Bello-Osaigie, V.E. (1980). Roles of Women in Nigerian Small Farming Centre for Agricultural and Rural Development. Ibadan: University Press.
Olayide, S.O. and Heady, E.O. (1982). Introduction to Agricultural Production Economics. Ibadan: University Press.
Oliveria, A; Larsen, D.; Bittencourt, M. and Graham, D. (2003). The Potential for Financial Savings in Rural Mozanbica Households.' A paper presented at the International Agricultural Economics Conference 16th -22nd August Durban, South Africa.
Omede, J. (2008). Population Explosive and its Major Economic Effects on People in Dekina Local Government Area of Kogi State. Kaduna: Uneeks Publishers and Associates.
Pingali, P., Y. Bigot, and H.P. Binswanger, (1997), Agricultural Mechanization and the Evolution of Farming Systems in Sub-Saharan Africa, The World Bank, Washington, DC.
Rooney, L.W. and Macdonough, L.E. (1987). The Chemistry and Processing of Sorghum Grains. Cereal Science Today, 13 (v), pp. 259-261, 285, 286.
Subramanian, V., Miracle, O. and Jambunathan, R. (1980). Traditional Methods of Processing Sorghum and Pearl Millet Grains in India. Rep. int., Association, Cereal Chemistry, Vol. 10, pp. 115-118.
Tokula, M. H; Asomugha, G.N. and Okwusi, M. (2006). "Evaluation of the Level of Adoption of NRCRI Improved Technology Package in the Host Communities" Proceedings of the 40th Annual Conference of Agricultural Society of Nigeria Pp. 323 -327.
Yusuf, S. A. (2008). Social Capital and Household Welfare in Kwara State, Nigeria J. Hum. Ecol., 23(3):219 - 229

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Comparative Assessment of NSPRI Fish Smoking Innovation Kiln Models: An Experimental Approach

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Abstract

This study examined the effectiveness of charcoal-powered, gas-powered and electricity-powered kilns developed by Nigerian Stored Products Research Institute (NSPRI). Specifically, this study estimated the costs and return of these kilns; analysed the proximate parameters of the fish processed in these kilns; and assessed the acceptability of the products from the kilns. The cat-fish for the experiment was procured from a reputable farm; processed and smoked in each of the kilns of 25kg capacity. And samples were taken for Economic, Sensory and Proximate analyses. The findings indicate that charcoal is the most profitable kiln with benefit-cost ratio of 1.27 while gas and electricity kilns had 1.21 and 1.23 respectively. Additionally, the payback periods for gas, electricity, and charcoal kilns were 12weeks, 11weeks, and 9weeks respectively. The sensory study shows that the gas-powered kiln was preferred over others. The outcomes of the proximate analysis demonstrate that the gas-powered kiln, followed by the charcoal-powered kiln, had a comparative advantage over the others. Conclusively, gas-powered kiln model was adjudged the best. It is recommended that policies that can reduce the cost of gas and electricity in the country are encouraged to promote safe and hygienic food.

Keywords: Fish Smoking Kiln, Sensory Analysis, Costs and return analysis, Proximate Analysis, payback period.

Introduction

Fish is one of the most important foods on the planet. Its flesh is a source of top quality protein for many in developing parts of the world. Its production stands as the world's fastest growing sub-sector of agriculture with an annual growth rate of 8.9%, and has been contributing significantly to the world economy since 1970 (WFC, 2009; Elbadawi *et al.*, 2022; Ukoba *et al.*, 2023;). Locally, aside from provision of employment for millions of people (majorly women), its contribution to Nigerian gross domestic products (GDP) and agricultural GDP is put at 1% and 3.24% respectively (NBS, 2014; Adewole, 2022). Despite this encouraging increase in production, large percentage of the catches is being exposed to postharvest losses due to its perishability nature and lack of appropriate postharvest handling facilities that could aid value addition. Appropriate postharvest handling practices are important to minimize post-harvest losses and to maintain the quality of products such as fish (Keerthana *et al.*, 2022). Potential postharvest handling activities includes; processing, packaging and storage. The activities can be carried out in a variety of ways which include smoking, salting, drying, charring, canning, icing and chilling (Ayodeji, 2020; Mouritsen, 2017).

Locally, fish processors have engaged themselves in smoking of fish for quality enhancement and shelf life extension. However, it is pertinent to note that fish produced through traditional method of smoking are highly contaminated by different concentration of Polycyclic Aromatic Hydrocarbons (PAHs) traceable to the process (Olabemiwo *et al.,* 2011; Singh, 2016; Assogba *et al.*, 2022). And such quality can endanger the life of consumers. In the light of this, Nigerian Stored Products Research Institute (NSPRI) developed three models of kiln to sustainably address the menace. The three models are charcoal, gas and electricity powered kilns. The evaluation carried out on the three models revealed the suitability of the kilns for production of high quality dehydrated fish with minimum PAHs in the permissible range (Omodara *et al.,* 2016; Osineye *et al.*, 2020). However, the evaluation did not consider the economic aspect which is expected to give detail information on the operation cost of each model and the economic worth of the products from them with respect to consumer's preference.

Statement of Research Problem

The choice of the public in adoption of any technology (including models of NSPRI Smoking Kiln) is guided majorly by technicalities of use, availability and affordability of the technology, operation costs with respect to the economic return, and the lifespan of the technology. NSPRI Fish Smoking Kiln Models have proven effective for production of safe and hygienic smoked fish; however, information on their respective cost efficiencies is not available.

Hence, the need to estimate the costs and return structure of these proven technologies which will guide the choice and decision of potential adopters so as to maximize profit.

Aim and Objectives:

The aim of this study is to determine the Cost-Benefit Ratio of the three models of smoking kiln developed by NSPRI.

The specific objectives are to:

i. estimate the costs and return (cost-benefit ratio) of the three models of NSPRI smoking kiln in fish value addition.
ii. carry out sensory analysis on the products from the three models;
iii. analyse the proximate parameters of the fish processed in the three models of NSPRI smoking kiln in fish value addition

Materials and Methods

Study Location:

The study was conducted at Nigerian Stored Research Institute's headquarters Ilorin, Kwara State.

Experimental Materials:

i. Charcoal, gas and electricity powered fish kilns (25 kg capacity).
ii. 75 kg of catfish (to be sourced from a single farm in Ilorin)
iii. 1.0 bags of charcoal
iv. Power generator (Alternative electricity)
v. Cooking gas
vi. Petrol for generator
vii. Consumables (salt, vegetable oil)
viii. Composite packaging Material
ix. Temperature regulator for electricity powered kiln

Experimental Activities:

i. **Processing of Fish:** Seventy-five (75) kilograms of Cat-Fish were purchased from a well reputable farm, and shared into three (3) equal parts (25kg each) for each of the model. The fish were processed using the three models of kiln identified using necessary fish value addition protocol developed by the Institute. The preparation of the fish was jointly carried out before dividing them into three groups in line with the models under consideration. Each of the models was fed with a group and necessary monitoring was offered in accordance with the set objectives.

Standard Operation Procedure of Smoked Fish using NSPRI Fish Smoking Kiln Models

Procurement of fish
Sorting
Killing with salt solution
Washing
Degutting
Washing
Soaking in salt solution
Slating on the tray
Smoking/Drying
Packaging
Storing
Marketing

ii. **Sensory Evaluation:** A panel of 30 members drawn from the neighbourhood environs were used to assess the acceptability of the fish products from the three kiln's models for Sensory evaluation.

iii. **Proximate and microbial Evaluation:** These were done by analysing samples (fresh and Smoked/Dried fish) from the each of the three models .

iv. **Packaging of Dried/Smoked Fish:** The dried fish from the kilns were packaged in composite packaging material for shelf life study. This was carried out to establish the effects of source of energy on the quality of dried/smoked fish with respect to its behaviour during storage.

v. **Marketing of Packaged Fish:** The opportunity to taste the products and place price on them based on their satisfaction with the products and in line with obtainable cost of dried fish in the local market within Ilorin metropolis was given to the public.

vi. **Profitability Analysis:** Necessary economic analysis parameters were determined for each model, such as: Benefit Cost Ratio (BCR), and Pay-Back Period (PBP)

vii. **Statistical Analysis:** The results obtained from the three models were subjected to statistical analysis to establish the most economically viable model among the three.

RESULTS AND DISCUSSION

Economics Analysis of Smoked Fish

Table 1: comparative Analysis of three different types of NSPRI fish smoking kiln (Gas, Electricity and Charcoal).

S/N	Variable	Item	Gas	Electricity	Charcoal
1	**Fixed Inputs (Depreciation)**	Smoking Kiln	85.37	90.85	82.63
		Utensils (bowl, knives, trays, etc)	8.58	8.58	8.58
	TFC		**93.95**	**99.43**	**91.21**
	Variable Inputs	Fish	20,240.00	20,560.00	20,480.00
		groundnut oil	50.00	50.00	50.00
		Salt	60.00	60.00	60.00
		Water	45.00	45.00	45.00
		Consumables	70.00	70.00	70.00
		tooth picks	100.00	100.00	100.00
		Cost of heat	1,882.56	1,388.40	925.00
		Labour	1,600.00	1,600.00	1,600.00
	TVC		**24,047.56**	**23,873.40**	**23,330.00**
	Revenue	smoked fish	28,521.76	28,913.07	29,217.42
		fish oil	465.00	435.00	420.00
		waste (intestines)	171.00	173.50	173.00
	TR		**29,157.76**	**29,521.57**	**29,810.42**
	TC		24,141.51	23,972.83	23,421.21
	GM		5,110.20	5,648.17	6,480.42
	NI		5,016.25	5,548.74	6,389.20
	BCR		1.21	1.23	1.27
	Pay-Back Period		35.85	34.18	27.26
			2.99	2.85	2.27
	PBP (Weeks)		12	11	9

Experimental source: 2020

Table 1 shows the result of comparative analysis of three different types of NSPRI fish smoking kiln (Gas, Electricity and Charcoal powered). It was observed that charcoal powered kiln is more profitable than the other two. Although, it is cheaper, but more stressful and labour intense compared to the other two. The profitability parameters show that the Benefit Cost Ratios (BCR) is 1.21, 1.23 and 1.27 for gas, electricity and charcoal powered kilns respectively. This implies that on every on every ₦1:00 spent on fish using gas powered kiln, 21kobo will be realised as profit. Furthermore, the payback period for the kiln ranges between two and three months with Charcoal having the potential to pay back within 9 weeks (i.e. 2 months and 8days).

Sensory Analysis of Smoked Fish

Comparative analysis of three models of NSPRI smoking kiln was conducted and task given to the panellists were to observe, feel and taste the samples of fish dried with these three models also check how much they like and dislike to pay for the samples. From their responses; it was observed that in

appearance (fig. 1) the fish smoked with gas smoking kiln was extremely likes (42.9%) followed by that of electricity (32.1%) while that of charcoal type was the least but Gas and electricity were slightly disliked

In taste (fig 2), fish smoked with gas type was liked extremely followed by that of charcoal type and that of gas but smoking with gas were slightly and moderately disliked. In aroma (fig 3), fish smoked with charcoal and gas were jointly liked extremely (44%) while that with electricity was neither like nor dislike. From the judgments on the fish samples; when the 1kg of smoking kiln with charcoal cost ₦1000 the average cost price of smoking with electricity and gas cost ₦975 and ₦1090 respectively

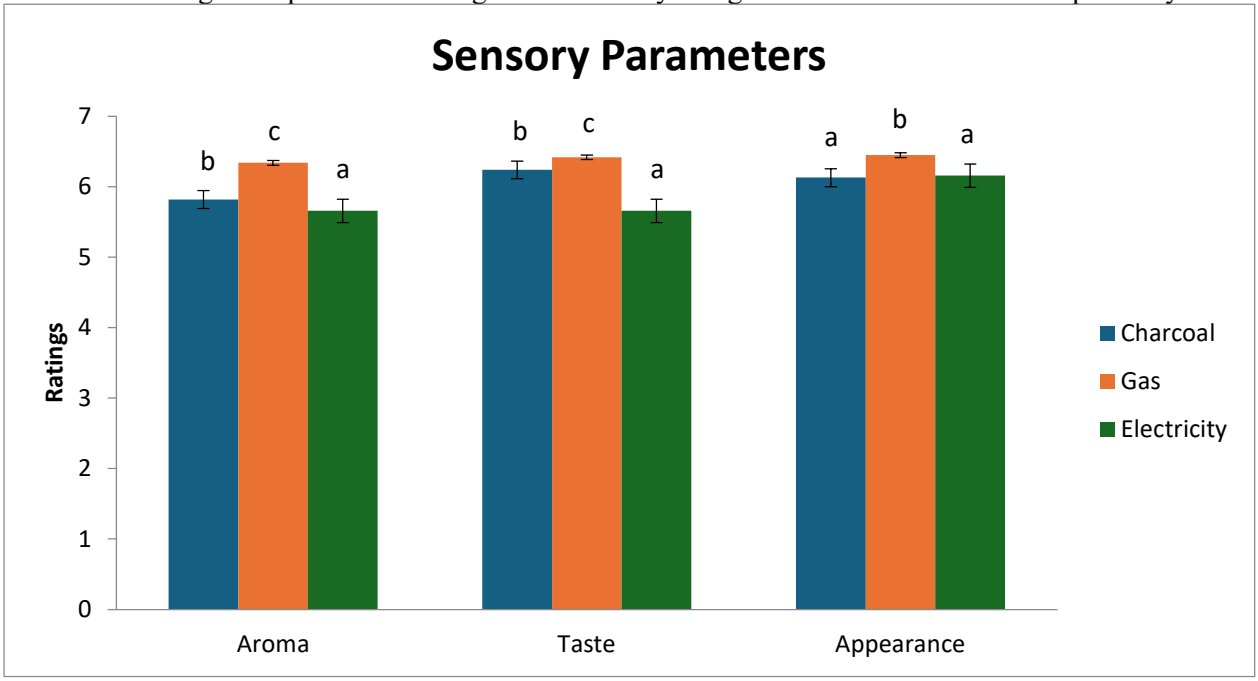


Fig. 1: Sensory parameters of the 3 models of NSPRI Fish Smoking Kiln.

The Gas was adjudged to be the best rate model for the three parameters, followed by charcoal model which was adjudged better then electricity model in both aroma and taste.

PROXIMATE ANALYSIS OF FISH SMOKED IN THREE DIFFERENT KILNS

Table 2: Proximate analysis of fish smoked in three different types of NSPRI Smoking Kilns

Parameters	Smoking Kiln Type		
	Charcoal	Electricity	Gas
Moisture content (%)	31.967±0.136 ^{c}	15.603±0.338 ^{b}	7.481±0.745 ^{a}
Ash (%)	1.309±0.154 ^{a}	1.934±0.136 ^{b}	1.921±0.001 ^{b}
Carbohydrate (%)	8.545±0.273 ^{b}	5.684±0.067 ^{a}	22.083±0.400 ^{c}
Cal (kjl / 100g)	1678.063±2.878 ^{a}	2027.461±9.707 ^{b}	2092.266±10.268 ^{c}
Protein (%)	26.428±0.002 ^{a}	41.162±0.001 ^{c}	34.564±0.002 ^{b}
Crude Lipids (%)	29.019±0.196 ^{a}	33.028±0.287 ^{c}	30.405±0.095 ^{b}
Crude Fibre (%)	2.730±0.056 ^{a}	2.590±0.253 ^{a}	3.546±0.249 ^{b}

Mean ± Standard Error along the row with different superscripts are significantly different ($p<0.05$)

In Table 2, the differences in the proximate composition of the smoked fish from the Charcoal, Electricity and Gas powered heat sources were significantly ($p<0.05$). The results show that Gas

powered kiln had a comparative advantage over others followed by electricity powered kiln. These results when compared with NIOMR Kiln smoked fish shows slight increase in the parameters of NSPRI kiln smoked fish for examples the crude fibre of cat fish processed using NIOMR kiln was 2.18 while the least of NSPRI kiln was 2.59 which is Electricity powered (Okereke, Okpara and Ogumuka, 2014).

Conclusion and Recommendations

Effective and efficient fish processing determines its shelf-life and market acceptability. Based on the findings of this study, it is concluded that gas powered kiln model was adjudged the best based on its good both proximate and sensory performance except for the economics which was due to the hike in the cost of gas. Next to gas powered kiln model is the charcoal heat source. The charcoal powered kiln model competed strongly with gas especially when assessing the economics and sensory parameters. However, where prohibition on tree falling for cooking and charcoal making is in existence, then, charcoal powered kiln model will not be encouraged. Therefore, gas powered kiln model remains the best for smoked fish processing.

It is therefore recommended that Federal Government should formulate policies that can reduce the cost of gas and electricity in the country to help preserve our natural endowment such as tree to reduce competition on the use of wood for other purposes. This in turn will help maximize and popularize these proven technologies and thereby promotes safe and hygienic food so as to attain the global food security and livelihood improvement goal.

References

Adewole, E. G. (2022). *Perceived Influence of Funding, Managerial Skills and Business Environment on the Success of Small and Medium Scale Enterprises* (Doctoral dissertation, Kwara State University (Nigeria)).

Assogba, M. F., Afé, O. H. I., Ahouansou, R. H., Anihouvi, D. G. H., Kpoclou, Y. E., Djago, D., ... & Anihouvi, V. B. (2022). Performances of the barrel kiln used in cottage industry for fish processing and effects on physicochemical characteristics and safety of smoked fish products. *Journal of the Science of Food and Agriculture*, *102*(2), 851-861.

Ayodeji Ahmed, A. Y. E. L. O. J. A. (2020). Glimpse of fish as perishable staple. *Al-Qadisiyah Journal For Agriculture Sciences*, *10*(2), 349-375.

Elbadawi, I., Elbashir, A., Osman, A., Elobaid, A. H., Eltahir, E., Alhelo, A., & Suliman, K. M. (2022). Policy Research.

Keerthana, P. S., Gopan, S., Rajabudeen, R., Fathima, R., Shibu, K., Nisha, R., ... & Sreekanth, G. B. (2022). Post-harvest losses in the fisheries sector-facts, figures, challenges and strategies. *Int J Fish Aquat Stud*, *10*, 101-8.

Mouritsen, O. G., & Styrbæk, K. (2017). *Mouthfeel: how texture makes taste*. Columbia University Press.

National Bureau of Statistics (NBS), 2014 – (Locally, aside from provision of employment for millions of people (majorly women), its contribution to Nigerian gross domestic products (GDP) and agricultural GDP is put at 1% and 3.24% respectively)

Ndife, J., Ahmad, T. B., Dandago, M. A., & Gambo, A. (2019). Comparative quality assessment of commercial sun-dried catfish (Clasias garienpinus) from Kano and wudil metropolises, Nigeria. *Bayero Journal of Pure and Applied Sciences*, *12*(1), 132-140.

Okereke, A. N., Okpara, J. Y. and Ogumuka, S. O. (2014). Comparative nutritional composition of smoked catfish (clarias gariepinus) produced from NIOMR smoking kiln and local cut drum oven. American Journal of Food Technology 9(7): 377-381.

Okereke, Okpara and Ogumuka, 2014). – (These results when compared with NIOMR Kiln smoked fish shows slight increase in the parameters of NSPRI kiln smoked fish for examples the crude fibre of cat fish processed using NIOMR kiln was 2.18 while the least of NSPRI kiln was 2.59 which is Electricity powered)

Olabemiwo *et al.,* 2011 – (However, it is pertinent to note that fish produced through traditional method of smoking are highly contaminated by different concentration of Polycyclic Aromatic Hydrocarbons (PAHs) traceable to the process)

Omodara *et al.,* 2016 – (The three models are charcoal, gas and electricity powered kilns. The evaluation carried out on the three models revealed the suitability of the kilns for production of high quality dehydrated fish with minimum PAHs in the permissible range)

Osineye, O., Abiodun-Solanke, A. J., Mangai, E., Okeke, E., & Jahnezim, B. (2020). Comparison of polyaromatic hydrocarbon residue concentrations in Clarias gariepinus smoked with traditional and mechanical kilns. *Journal of Health Pollution*, *10*(28), 201215.

Singh, L., Varshney, J. G., & Agarwal, T. (2016). Polycyclic aromatic hydrocarbons' formation and occurrence in processed food. *Food chemistry*, *199*, 768-781.

Ukoba, M. O., Diemuodeke, E. O., Briggs, T. A., Imran, M., Owebor, K., & Nwachukwu, C. O. (2023). Geographic information systems (GIS) approach for assessing the biomass energy potential and identification of appropriate biomass conversion technologies in Nigeria. *Biomass and Bioenergy*, *170*, 106726.

World Fish Center, 2009 – (Its production stands as the world's fastest growing sub-sector of agriculture with an annual growth rate of 8.9%, and has been contributing significantly to the world economy since 1970)

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Effect of Climate Change and Adaptation Measures on Food Security of Catfish Farmers in Ondo State, Nigeria

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Abstract

Change in climate is already a reality as all countries are already taking action to reduce their gas emissions from greenhouse and get ready for its effects. Two stage sampling techniques were employed in selecting the 231 catfish farmers for the study. Results revealed that the average age for catfish farmers was 42 years with a standard deviation of 10.69. In addition, male dominated the enterprise with an average of 0.76 and a standard deviation of 0.43 and that majority of the respondents were married with mean of 2.00 and a standard deviation of 0.622. Average number of years spent in school was 13 years. The distribution of cat fish farmers according to years of fishing experience showed the mean farming experience of the fish farming was 11 years with a standard deviation of 7.74. Food secure households were estimated to be 42.86% while 57.14% of the respondents were food insecure. Introduction of programmes educating the catfish farmers about climate change, boosting adaptive capacity that can increase catfish production, and the introduction of sustainable fishing operations that will advance the quality of life for those at risk from the climate change effects should all be done by the necessary stakeholders.

Keyword: Climate Change, Adaptation Measures, Cat fish farmers, Food Security, Food Security Index, Weighted Mean

Introduction

Change in climate is a worldwide trend that affects various sectors and regions of the world, but especially agriculture, which is highly dependent on weather and environmental conditions. Since change in climate is already a reality, all nations must take action to cut their gas emission from greenhouse and be ready for its effects. Because of their higher susceptibility to the climate change effects, adaptation is especially important for developing countries. Africa is one of the most susceptible continents to climate change where it is estimated that by 2050, 6% of the population will experience chronic hunger or undernourishment, Adeleke, Ajibefun, and Famoofo (2016). Lam, et al., (2011) revealed that extreme and devastating are the effects of climate variability over the past 30 years. Although West Africa erstwhile classified as one of the climate change regions with the greatest vulnerability, there is not enough awareness of the extent of the phenomena compared to the threats that the region faces. Nigeria is a nation with strong climatic variations and biological variety. Due to the desertification process moving southward, Adeleke, Ajibefun, and Famoofo (2016) reported that the nation is susceptible to the climate change effects.

Change in climate poses a menace to all aspects of human existence, not just the socioeconomic and agricultural development of any one country (Adejuwon, 2004). The average weather during a specific time period was the Intergovernmental Panel on Climate Change (IPPC)'s definition of climate change in 2007, IPPC, (2007). It is a statistical description of appropriate quantities over a range of instant periods, from months to thousands or millions of years, in terms of their mean and variability. Variability in total rainfall, temperature, air, and humidity are all detrimental to the aquaculture system's ability to produce. These problems have caused large productivity losses and increased socioeconomic and financial vulnerability among farmers. The following effects of climate change on fish production have been noted by Allison et al., (2007) and Adebayo, (2012): an increase in rainfall rate, too much wind, an earlier start to the season, occurrence of drought, an increase in drought, occurrence of flood in the farm area, a prolonged harmattan season, an increase in pond size, and an increase in precipitation. According to Adebayo and Daramola (2013) general decline in productivity and produce quality, which invariably endangers the condition of food security at both the national and household levels is recognized as climate change effect on catfish in Nigeria is recognized. Habitat degradation, overfishing, pollution, parasites, diseases, and more recently, due to the increased variability brought on by climate change have threaten fisheries resources. Climate unevenness and alteration, which have gotten worse in view of the fact that the latter third of the 20th century, IPCC, (2011), haven't gotten nearly as much attention as the other dangers.

Drought, flooding, and silt deposition have an impact on fish production because they cause fish mortality and significant changes in water quality (Oyebola, 2021). Since catfish farmers rely on high-quality water to achieve a plentiful harvest, their livelihoods are invariably impacted. Effective adaptation methods are required for catfish farmers to be able to deal with the effects of climate change. Measure, recognised by Kurukulasuriya and Mendalsohn (2006) as one of the strategy choices was adaptation which can lessen the negative effects of climate change. According to the IPCC (2011), "climate change adaptation" refers to the capacity to modify a natural or human system in reaction to present or predictable climatic stimuli or their effects in a way that minimizes damage or takes benefit of beneficial chances.

Catfish farming is one of the most important aquaculture activities in many countries, providing food and income for millions of people. However, catfish farming is susceptible to the climate change impacts as rising temperatures, water scarcity, water quality degradation, diseases and pests. These impacts can reduce catfish growth, survival, quality and profitability, and threaten the food security and

livelihoods of catfish farmers and consumers. Therefore, it is essential for catfish farmers to adapt to the changing climate by adopting various strategies that can enhance their resilience and productivity. Some of these strategies include changing the species or breeds of catfish, using water-saving technologies, improving water quality management, diversifying income sources, accessing credit, extension services, information and markets. However, the adoption of these strategies depends on various factors, such as socio-economic variables of farmers, farm size, resources access, policies and institutions.

Therefore, catfish producers can adjust to climate change by diversifying their sources of income, moving, switching to other species, or, in the worst case scenario, ceasing fish production (Coulthard, 2008). Catfish producers must therefore employ adaptation measures to lessen the effects of climate change in order to maximise the production of catfish needed to feed the world's expanding population. Moreover, the effectiveness of these strategies in improving catfish production and food security is not well understood and documented. There is therefore the need to examine the effect of climate change and adaptation measures on cat fish farmers' food security in Ondo State, Nigeria. This study therefore aims to fill this gap by analyzing the socioeconomics variables of catfish farmers and the climate change effects and adaptation measures on the food security of catfish farmers in Ondo State, Nigeria, a major catfish-producing State in the country Nigeria.

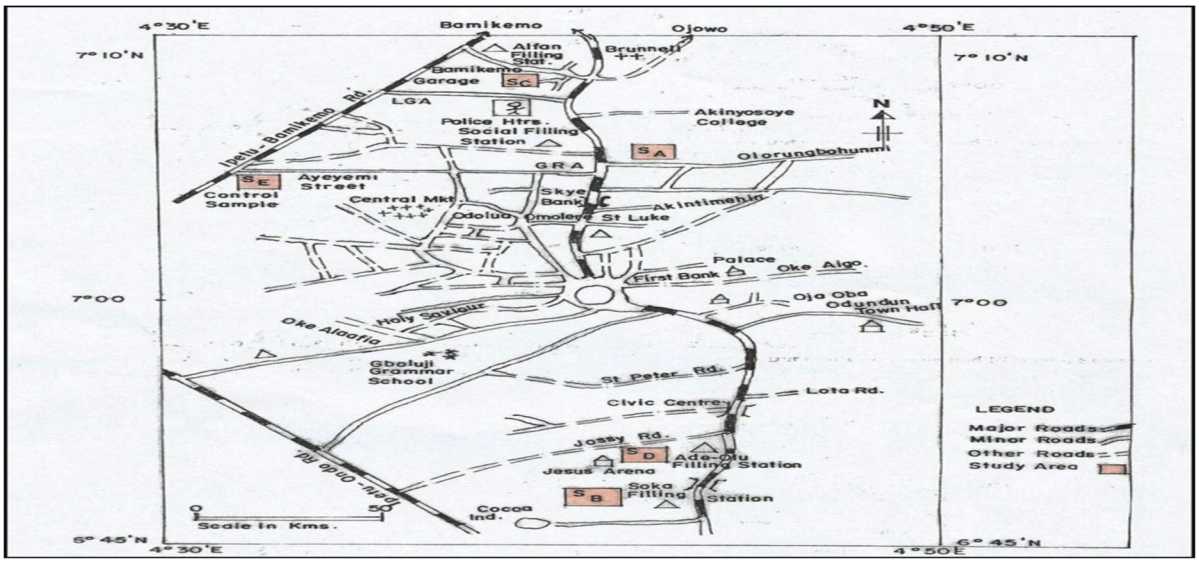
Material and Method

Ondo State is the study area for this study. With coordinates of 5° 45 N 40151E, it has a about 14. 793, 723 square kilometre land area and 3.441,024 million people. There are 18 Local Government Areas (LGAs) in it. Its climate has two distinct seasons: the rainy season (April to October), and the dry season (November to March). It is located in the tropics. Additionally, it is a state that produces oil in Nigeria. Bitumen limestone, kaolin, glass sand, and granite are further minerals that can be found in the state in significant quantities, National Boundary Commission (NBC) of Nigeria (2020). The study employed two stage sampling technique. The first stage is the purposive selection of Ondo State. This is because it is noted for cat fish farming in Nigeria. By making use of the list of the registered fish farmers (Table 1), a random selection of two hundred and thirty one (231) cat fish farmers were selected for this study.

Table 1: Registered Catfish Farmers in Ondo State

S/N	LGAS	CAT FISH FARMERS
1	Akoko North East	19
2	Akoko North West	6
3	Akoko South East	1
4	Akoko South West	6
5	Akure North	12
6	Akure South	42
7	Ese Odo	15
8	Ilaje	52
9	Idanre	2
10	Ifedore	18
11	Ile-Oluji/Okeigbo	8
12	Irele	1
13	Odigbo	9
14	Okitipupa	17
15	Ondo East	3
16	Ondo West	38
17	Ose	3
18	Owo	32
Total		284

Ondo State of Nigeria Digest of Agricultural Statistics (2009)



The study Areas (Ondo State of Nigeria Digest of Agricultural Statistics (2009))

Both descriptive (such as percentages, means, and frequency tables) and inferential (Likert Scale, Food Security Index and Weighted Mean) analytical tools were employed in analyzing the data collection.

Likert scale

Likert scale was use for ranking respondents response to climate indicators in the study area. A likert scale is a type of rating scale used to measure attitudes or perceptions of individual regarding a particular topic or issue, Likert, (1931) adapted by Adeleke, Ajibefun and Famoofo (2016). However Likert scale can be used to collect data on the how strongly or how frequently respondent believe that climate change has affected catfish production. In order to gather information, Likert-type questions with a four-point rating scale were utilized, Adeleke, Ajibefun and Famoofo (2016). The questions ranged from: Strongly Agreed, Agreed, Undecided, Disagreed, and Strongly Disagreed on the scale of 5 to 1 respectively.

Weighted Mean (WM)

Simple, weighted and geometric average are the three approaches that are most frequently employed to calculate an average (or mean). When forecasting nonrecurring (NR) costs utilizing ratios of NR expenses to first unit production costs, analysts frequently employ averages as estimating guidance. The applicability of utilising simple and weighted averages has some scholarly critics. The "wrong math," according to some observers, is how simple averages are created because it violates the fundamental principles of mathematics. According to Shu-Ping (2011), weighted averages are based on the "correct maths" and need to be used as such. Other analysts contend that the geometric average is the best strategy because both simple and weighted averages have drawbacks., Shu-Ping (2011).

Given a set of n observations

$$Z_1, Z_2 \dots \dots \dots \dots \dots \dots \dots \dots \dots Z_n$$

WM is defined by the following formulas

$$\boldsymbol{WM} = \frac{\sum_{i=1}^{n} \boldsymbol{w_i Z_i}}{\sum_{i=1}^{n} \boldsymbol{w_i}}$$

Where sample size = n and the weighting factor of the i^{th} observation $i = 1 \dots \dots \dots n = w_i$.

Shu-Ping (2011) believed weighted averages are based upon the "correct math" and should be applied accordingly.

Food Security using Food Security Index (FSI)

FSI was used to measure how food secures is the cat fish farmers in the study area. The food security index as used by Ohajianya *et al*., (2011); Adio and Olarinde, (2020) was adopted. The Food Security Index (FSI) calculates the per-capita food expenditure of households (including both cash and farm produce consumptions) in monetary (Naira) terms. If a household spends at least two-thirds of the average food expenditure of the sampled households, it is regarded to be food secure; otherwise, it is deemed to be food insecure. Thus, the FSI is given as:

$$\mathrm{F_i} = \frac{\text{per capita food expenditure for the ith households}}{{}^{2}/_{3}\ \text{mean per capita food expenditure in all households}}$$

Where:

$$F_i = Food\ security\ index$$

When

$$F_i \geq 1 = food\ \text{sec}ure - ithhousehold$$

$$F_i \leq 1 = foodin\ \text{sec}ure - ith - household$$

$$F_i \geq 1 = food\ secure\ ith\ household$$

$$F_i \leq 1 = food\ insecure\ ith\ household.$$

Result and Discussion

The summary statistics of the socioeconomic characteristics of catfish farmers were presented and discussed according to their sex, age, marital status, education, household size, years of fishing experience and membership of association, Table 1. The distribution of the farmers by age showed that the mean age for farmers was 42 years with a standard deviation of 10.69. The implication of this is that the catfish farmers were still within their fruitful age and can still take on proficiently in catfish production. Fish farming is a labour intensive occupation and exerts energy for pond maintenance, cleaning, fertilization, feeding and harvesting. The findings are similar to those of Olajide and Omonona (2019) who reported that the mean age of fish farmers in Osun State was 49 years. The results of the study on distribution of the fish farmers by sex revealed that male dominated the enterprise with a mean of 0.76 and a standard deviation of 0.43. This also shows that fish farming activities is carried out by both male and female. The average years spent in school was 13 years. This results indicated that the fish farmers in Ondo State were open-minded and also imply that the fish farmers will be more open to extension agents for information and embracing other best practices for improved species and harvesting techniques that would control the quality of fish. Findings on the marital status of catfish farmers revealed that majority were married with mean of 2.00 and a standard deviation of 0.622.

The result of years of fishing experience showed that catfish farming has been a long time practice among the respondents in the State. The average fishing experience was 11 years with a standard deviation of 7.74. This is consistent with the findings of Adeleke, Ajibefun and Famofo (2016). The result of the findings also revealed that some of the indicators which were reported as climate change in catfish farming in the study areas included among others flooding (Mean 1.42, SD 0.90), long harmattan period leading to fish production increase (3.03, 1.37), precipitation increase resulting to increase in production of fish (2.47, 0.95), long period of hot season resulting to decrease in production of fish (2.13, 0.85), long period of hot season resulting to decrease in production of fish (2.03, 0.56), Situation of drought resulting to decrease in production of fish, decrease in fish farming, and decrease in quality of fish (2.03; 056). However, the Standard Deviations (SD) values of change in climate

indicators on catfish production indicated that the catfish farmers varied in their responses. This is in agreement with the work of Egwuonwu, (2022) that noted climate change as variations in rainfall patterns, inconsistencies in precipitation patterns, a reduction of the wet season, droughts, a decrease in volume of river water, and an increase in daytime and nighttime temperatures.

The probable coping strategies as revealed by the respondents were: construct ponds near water sources (1.41; 0.52), digging bore hole and/or wells for alternative water source at dry seasons (1.74; 0.50), time of stocking adjustment (1.89; 0.78), sourcing climate change information (1.73; 0.70), stocking favoured climate change fish species (1.60; 0.68), avoidance leakage of pond (1.62; 0.61), ensuring good water circulating system (1.56; 0.70), purchase of weather monitoring kits (1.69; 0.72), erecting embankments to reduce/prevent flood water (1.64; 0.73), stocking of fingerlings that is healthy (1.72; 0.67), usage of better varieties of fish (1.81; 0.74), clearing pond regularly (1.72; 0.47), ensuring better inlet and outlet (1.75; 0.86), and diverting water ways (1.56; 0.56). The findings of this study are in agreement with Oyebola, *et al.,* (2021)'s work on potential adaptation techniques for climate change impact among flood-prone fish producers in climate hotspot Uganda.

Table 1: Summary Statistics

Variable	Obs.	Mean	SD	Min.	Max.
Sex	231	0.76	0.43	0	1
Age	231	42	10.69	22	78
Marital status	231	2.00	0.622	0	5
Education Level	231	4.02	1.06	1	5
Education	231	13.21	4.89	0	24
Household size	231	4.40	2.37	1	15
Experience	231	11.77	7.74	1	40
Fish association	231	0.59	0.49	0	1
Climatic effects					
Flooding	231	1.42	0.90	1	5
Long period of harmattan season leading to increase in fish production	231	3.03	1.37	1	5
Precipitation increases resulting to increase in production of fish	231	2.47	0.95	1	5
Long period of hot season resulting to decrease in production of fish	231	2.13	0.85	1	5
Situation of drought resulting to decrease in production of fish	231	2.03	0.56	1	5
Decrease in fish farming	231	2.11	0.64	1	5
Decrease in quality of fish	231	2.32	1.00	1	5
Adaptation strategies					
Construct ponds near water sources	231	1.41	0.52	1	5
Digging bore hole and/or wells for alternative water source at dry seasons	231	1.74	0.50	1	5
Time of stocking adjustment	231	1.89	0.78	1	5
Sourcing climate change information	231	1.73	0.70	1	5
Stocking favoured climate change fish species	231	1.60	0.68	1	5
Avoidance leakage of pond	231	1.62	0.61	1	5
Ensuring good water circulating system	231	1.56	0.70	1	5
Purchase of weather monitoring kits	231	1.69	0.72	1	5
Erecting embankments to reduce/prevent flood water	231	1.64	0.73	1	5
Stocking of fingerlings that is healthy	231	1.72	0.67	1	5
Usage of better varieties of fish	231	1.81	0.74	1	5
Clearing pond regularly	231	1.72	0.47	1	5
Ensuring better inlet and outlet	231	1.75	0.86	1	5
Diverting water ways	231	1.56	0.56	1	5

Source: Field Survey, 2023

Climatic effects and Adaptation Measures

The result of climatic indicators as revealed by the respondents in the study areas is in Table 2. The climate change indicators were rated with Likert-type rating scale questions of 4-points rated as Strongly Agreed; Agreed; Undecided and Strongly Disagreed, Strongly Disagreed, with a scale from 5 to 1 respectively. Included among others flooding, long period of harmattan season leading to increase

in fish production, precipitation increase resulting to increase in production of fish, long period of hot season resulting to decrease in production of fish, long period of hot season resulting to decrease in production of fish, situation of drought resulting to decrease in production of fish, decrease in fish farming, and decrease in quality of fish. In ranking, situation of drought resulting to decrease in production of fish rank first, followed by clearing pond regularly, avoidance of leakage of pond and so on (Table 2)

The adaptation strategies employed by the respondents in the study area according to Table 2 were construction of ponds near water sources, digging bore hole and/or wells for alternative water source at dry seasons, time of stocking adjustment, sourcing climate change information, stocking favoured climate change fish species, avoidance of leakage of pond, ensuring good water circulating system, purchase of weather monitoring kits, erecting embankments to reduce/prevent flooding, stocking of fingerlings that are healthy, stocking of better fish varieties, regular pond clearing, ensuring better inlet and outlet and diverting water ways. According to Table 2, digging bore hole and/or wells for alternative water source at dry seasons ranked first followed by

Effect of climate on fish farmers Food Security (Food Security Index)

Food security index which is per capita food expenditure for the *ith* household divided by 2/3 mean per capital food expenditure of all households was used to determine the food security status. Household with Food Security Index (FI) greater or equal to one was considered food secured. The result in Table 3 showed that, the monthly mean per capita food expenditure for the total household was ₦59,065.03 and the 2/3 mean per capital food expenditure for all the household was ₦39375.35. Using ₦39375.35 as the standard, 42.86% of the households was estimated to be food secure (Table 3) while 57.14% of the respondents were food insecure. This probably could be the adverse effects of climate on the cat fish production. This is contrary with the study of Olayiwola, *et al.,* (2017) and Oyekale, *et al.,* (2017) who used 2/3 of average mean per capita expenditure on food as the food secured line and reported that the respondents studied were food secure.

Table 3: Distribution of the Respondents according to Food security Status

Food security status	Frequency	Percentage
Food secure	99	42.86
Food insecure	132	57.14
Total	231	100

Source: Field Survey, 2023

Table 2: Weighted Mean (Derived from Likert Scale)

Variable	N	SA(5)	A(4)	U(3)	SD(2)	SD
Climatic effects						
Flooding	231	48	170	0	9	4
Long period of harmattan season leading to increase in fish production	231	69	35	21	39	67
Precipitation increase resulting to increase in production of fish	231	124	24	36	2	45
Long period of hot season resulting to decrease in production of fish	231	141	42	23	1	24
Situation of drought resulting to decrease in production of fish	231	178	25	25	2	1
Decrease in fish farming	231	180	19	22	3	7
Decrease in quality of fish	231	121	40	33	7	30
Adaptation strategies						
Construct ponds near water sources	231	91	139	0	0	1
Digging bore hole and/or wells for alternative water source at dry seasons	231	165	64	1	1	0
Time of stocking adjustment	231	126	72	20	0	13
Sourcing climate change information	231	113	92	24	1	1
Stocking favoured climate change resistant fish species	231	113	109	4	2	3
Avoidance leakage of pond	231	126	98	4	1	2
Ensuring good water circulating system	231	102	119	3	2	4
Purchase of weather monitoring kits	231	128	92	1	2	7

Erecting embankments to reduce/prevent flood water	231	119	103	2	4	3
Stocking of fingerlings that is healthy	231	138	83	2	1	7
Usage of better varieties of fish	231	124	80	21	2	4
Clearing pond regularly	231	165	65	0	0	1
Ensuring better inlet and outlet	231	21	0	1	101	108
Diverting water ways	231	121	106	1	0	2

Source: Field Survey, 2023
WMS = Weighted Mean Score, MS = Mean Score

Conclusion

It is impossible to overstate how climate change is affecting catfish output though cat fish is quiet, takes up little area and doesn't interfere with other residents' serenity. It must also therefore be noted that a key goal of development policy and a gauge of its effectiveness is food security. However, most households in the study area still struggle to achieve food security. The effects climate change was unfavourable as regards the food security of the respondents in the study area. i.e. it has negative effect on their food security (food insecure). The study's findings have demonstrated that food insecurity is a problem that is both quantified and held by the respondents. Construction of ponds close to water sources, dig bore hole/wells to supply water during dry seasons, adjustment in the time of stocking, seeking/listening to information about climate change, stocking fish species that are more favoured by climate change, among others were the adaptation measures adopted by the cat fish farmers. Based on the findings of the study, the following recommendations are made: The introduction of programmes educating the fish farmers about climate change, boosting adaptive capacity that can increase catfish production, and the introduction of sustainable fishing operations that will improve the quality of life for those at risk from the effects of climate change should all be done by the necessary stakeholders.

Reference

Adebayo O. O, Daramola O. A. (2013). Economic Analysis of Catfish (Clarias gariepinus) Production in Ibadan Metropolis. Discourse Journal of Agriculture and Food Sciences. 1(7):128-134

Adebayo, O. O. (2012). Climate Change Perception and Adaptation Strategies on Catfish Farming in Oyo State, Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary Sciences 12(6). Pp 1-7

Adejuwon, S. A. (2004). Impact of Climate Variability and Climate Change on Crop Yield in Nigeria. Contributed paper to stakeholders workshop on assessment of impact and adaptation to climate change. (AIACC): 2-8

Adeleke, M. L., Ajibefun, I., and Famoofo, A. (2016). Adaptation Strategies to Reduce the Effect of Climate Change (Utilization of Indigenous Systems by the Fisher Folks) in the Coastal Region of Nigeria. International Journal of Fisheries and Aquatic Studies 2016; 4(4): 179-185

Adio, M. O. and Olarinde, L.O. (2020). Effects of Financial Capital on Food Security among Cassava Processors in Oyo and Ogun States, Nigeria. FUOYE Journal of Agriculture and Human Ecology 4(2): 11-28, 2020

Allison, E. H., Adger, W. N. and Badjeck, M. C. (2007): Effects of Climate Change on the Sustainability of Capture and Enhancement Fisheries Important to the Poor: Analysis of the Vulnerability and Adaptability of Fisher Folk Living in Poverty.

Ayanwamide, F.M. (2002) Aquaculture and Aquarree Design it Agricultural Production Methods and Technology. Faniyi, G (ed) Andiran Publication series.

Coulthard, S. (2008). Adapting to Environmental Change in Artisanal Fisheries-Insights from a South Indian Lagoon. Global Environ. Change, 18, 479–489.

Egwuonwu, H. A.(2022). Effects of Climate Change and Adaptation Strategies on Catfish Production in Imo State. Academic Journal of Agricultural and Horticultural Research Vol.2, No.4; October-December-2022

Intergovernmental Panel on Climate Change (IPCC 2007). Climate Change Impacts, Adaptations and Vulnerability. In: Parry, M.C., Canzien, O.F., Palutikot, J.P., vander Linden, Paul, J. and Hanson, C. (eds.). Contribution of Working group II to the 4th Assessment Report of the IPCC. Cambridge: University Press, Cambridge.

Intergovernmental Panel on Climate Change (IPCC, 2011). Climate issues in the 21st century. www.ipcc.com

Kurukulasuriya P and Mendelsohn R (2006). Crop selection: Adaptating to Climate change in Africa CEEPA; Discussion Paper No. 26.)

Lam V., Sumaila, U. R., Dyck, A., Pauly, D., Watson, R. (2011). Construction and Potential Applications of a Global Cost of Fishing Database, ICES Journal of Marine Science. 68:1996-2004.

Likert, R. (1931). A Technique for the Measurement of Attitudes. Archives of Psychology. New York: Columbia University Press, 1931.

National Boundary Commission (NBC) of Nigeria (2020). Boundaries across South east, Nigeria, Retrieved on 10 April from https://nnn.ng/tag/national-boundary- commission-nbc/

Ohajianya, D.O., Enwerem, V.A., Offodile, P.O., Onyeagocha, S.U.O., Osuji, M.N., Nwaiwu, I.U., Henri-Ukoha, A and Echetama, J.A (2011).Optimum Farm Plan for Food Security among Smallholder farmers in Imo State. International Journal of Agriculture Science, Research and Technology Vol. 1(3) Pp 133 -136

Olajide, O. O., and Omonona, B.T. (2019). Productivity of Catfish Production in Osun State, Nigeria. International Journal of Agricultural Research, Sustainability, and Food Sufficiency (IJARSFS). 6(04) Pp. 409-420 www.academiascholarlyjournal.org/ijarsfs/index_ijarsfs.htm

Olayiwola, S. A., Tashikalma, A. K. and Giroh, D. Y. (2017). Analysis Of Food Security Status And Coping Strategies among Rural Households in Oluyole Local Government Area Of Oyo State, Nigeria. FUW Trends in Science & Technology Journal, www.ftstjournal.com e-ISSN: 24085162; p-ISSN: 20485170; April, 2017: Vol. 2 No. 1A pp 28 – 32

Ondo State of Nigeria Digest of Agricultural Statistics (2009). Ondo State of Nigeria Digest of Agricultural Statistics Published By Research and Statistics Department Ministry of Economic Planning and Budget, Akure Edition

Oyebola, O. O., Efitre, J., Musinguzi, L., Falaye, A. E. (2021). Potential Adaptation Strategies for Climate Change Impact Among Flood-Prone Fish Farmers In Climate Hotspot Uganda. Environment, Development and Sustainability (2021) 23:12761–12790

Oyebola, O.O (2021). Potential Adaptation Strategies for Climate Change Impact among flood-Prone Fish Farmers in climate Hotspot Uganda. Environment, Development and Sustainability (2021) 23:12761–12790

Oyekale, T. O., Ayegbokiki, A. O., Adebayo, T. Y. (2017). Analysis of Rural Households' Food Security Status in Ogun State, Nigeria. Journal of Agribusness and Rural Development. 1(43), 163–174. http://dx.doi.org/10.17306/J.JARD.2017.00326

Shu-Ping Hu (2011): Simple Mean, Weighted Mean, or Geometric Mean? Tecolote Research, Inc. Presented at the 2010 ISPA/SCEA Joint Annual Conference and Training Workshop - www.iceaaonline.com

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Risks Management Strategies Among Smallholder Rice Farmers in Nigeria: A Case Study of Ofu Local Government Area of Kogi State, Nigeria

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ABSTRACT
Risk has continued to be one of the challenges facing farmers in the attempt to make the world food secured. It has affected all stages of crops and livestock production. The study assessed risks management strategies among smallholder rice farmers in Ofu local government area of Kogi State, Nigeria. A multi stage random sampling procedure was used to select 120 rice farmers in the study area. The data obtained were analyzed using descriptive statistics and inferential statistics. Major types of risk experienced by farmers were outbreak of disease, market fluctuation, flooding, fire incidence, bad weather, and theft. All the farmers make use of agrochemicals, disease and flood resistant species and early matured species as some of the management strategies adopted Results of multiple regression analysis showed that flood, pests and diseases, drought, and climatic conditions, were statistically significant at 1% and have negative effects on profit. Rice farmers should evolve more strategies to mitigate the adverse effects of risks on their productivity and profitability while government at all levels must initiate more policies to reduce risks associated with agricultural production to in Nigeria.

Keywords: Rice production, risks, productivity, mitigation, profit.

INTRODUCTION
Rice farming is one of the most lucrative farming in Nigeria. Although it is classified as a cash crop for farmers and regarded as one of the most consumed staple food and important cereal in the country. Almost 7 million tons of rice is consumed annually (Jaffee and Howard, 2010). Agricultural activity is risk-prone because farmers hardly manage some part of the production process. As with other types of farming, arable farming is subjected to uncertainties of weather condition, prices, pests and diseases infestation, hired labour availability, machinery and equipment malfunctioning and government policy (Kahan, 2013). These have negative effects on food prices, availability and farm profitability. Agriculture is an inherently risky business. Its biological nature has made economic performance of production very uncertain (Drummond and Goodwin, 2011). These risks factors are not under the control of farmers but they have over the years developed ways of coping and managing them (Food and Agricultural Organization, 2013).
It is evident that risk is a real event or real peril and precisely assessable (Zinn, 2017).

Different scholars have divulged that rice farmers are very conscious of those activities in rice farming which are high in investment and are riskier in expected output and diverge towards failure (Olawoyin Taiwo, 2015). These risks are significantly associated with the price, production, income, finance, and institutions, (Ahmed et al., 2011). It is usually observed that rain at proper time naturally increases crop productivity, but can damage it productivity at the same time of harvesting. Risk is

categorized into two clusters which are Business risk, (comprising of production, market, price, natural, and institutional risk), Personal risk which often affects livelihood of farmers, (Hardqker et al., 2014); (Mochini et al, 2011). Additionally, Turner et al, (2011) stated that agricultural sector is accompanied by irregular climate conditions, insect and pests infestations, and anomaly of prices of commodity. Farmers face numerous risks in copping and income diversification is one of their lead coping strategies, (Ping et al., 2016). Timely and precise discernment of risk may also assist rice farmers to appraise the probability and consequences of risk (Sjoberg et al., 2014).

In Nigeria, rice production peaked at 5.0 million metric tons while its consumption rate was estimated at 6.7 million metric tons (United Nations Development Programme UNDP, 2021). Natural disasters, particularly the severe flood in 2021, caused huge damages on assets and income, with the estimated of total loss in agriculture of 909 Million USD (World Bank, 2021). The flood in 2022 generated severe impact on farmers' livelihood, productivity, income and consumption. The Thai government has always assisted the affected-disaster farmers. On average, the government spends 3,350 Million Baht annually for rice farmers affected by flood, drought and pests (Mochini et al, 2011). Examples of risk prevention or mitigation actions include having savings, income diversification and off-farm activities, building on-farm flood protection, having community flood protection, buying crop insurance, buying more assets, reducing rice planted areas, planting of flood resistance breeds, adjusting farming practices such as choosing short-duration variety or even changing rice cropping calendar.

However, the decision to take risk prevention actions depends on households' characteristics, risk attitudes and subjective expectation of the flood risks. Therefore, it is interesting to study factors affecting rice farming households to undertake flood risk prevention or mitigation actions following annual incidences of flood disasters in Nigeria. Rice production is integrally risky, which at the end puts small-scale farmers into excessive loss due to flooding and other natural disasters in many part of the country, as it is cultivated in low land areas (Hurly, 2021). Empirical evidence remains scanty and lacked in-depth analysis of risk management strategies and types of risk management strategies especialy among small scale rice farmers. It is against this background and dearth of empirical literature that this study assesses risk management strategies among rural rice-based farmers. The broad objective of this study is to assess risk management strategies among smallholder rice farmers in Ofu Local Government Area of Kogi State, Nigeria while the specific objectives are to identify the types of risk among small scale rice farmers in the study area, examine the farmers' risk management strategies and the effectiveness of the strategies in mitigating the impact of risks on farmers' productivity

Theoretical Frame work: Risk sources comprise of all the factors and variability that produces a risk. In line with Laurence et al., (2013), there are five main roots of agricultural risk namely; production, marketing, financial, legal and social risks. Production risk is any occurrence or activity connected to manufacturing which comprises of various possible results. Theory of risk prevention actions (RPA) was adopted for this work. In this theory, farmer has two choices to select which is either taking or not taking risk prevention or mitigation strategies (RPA). RPA will take only two values, say, 1 if farmers take RPA and 0 if not. According to the rational choice theory, the risk prevention actions can be assessed by comparing the neoclassical random utility model for individual choice (Greene, 2003) thereby the random utility functions of those two choices are described as follows.

Utility of taking RPA $URPA = X'\beta 1 + \varepsilon RPA$

Utility of not taking RPA $UNRPA = X'\alpha 1 + \varepsilon NRPA$

Thereby the measurable vector of characteristics of the farmer is shown by X. This might include gender, age, income and other demographics, risk attitudes and subjective expectation of the flood risks and εi for i=RPA and NRPA is the error term.

The rational farmers will take an action if his or her utility function is greater than the utility of not taking (URPA> U NRPA) or the utility from benefits of prevent income or asset losses due to flooding

are higher than the cost of doing RPA. On the other hands, those who will not take any actions, his or her utility function of taking any actions is less than the utility of not taking. . However, the observed choice only reveals which one provides the higher utility but the magnitudes of the utilities are unobserved.

MATERIALS AND METHODS

Study Area

The study area is Ofu Local Government Area of Kogi State. Ofu Local Government Area (LGA) has its headquarters in Ogwolawo. Major communities that make up the LGA include Ajoda, Ogwolawo, Walawo, Ogwa, Itobe, Utagidi, Okotete, and Olofu. The population of Ofu LGA is put at 247,930 (NPC 2006 Census), while the major ethnic groups are Igala ,Ebira, Basa and Yoruba minorities. Ofu LGA occupies a total area of 1,680 square kilometres and has an average temperature of 29 degrees centigrade. The LGA lies off the shores of the Niger River and has an estimated total precipitation level of 1800 mm of rainfall per annum. Ofu LGA witnesses two major seasons which are the dry and the rainy seasons. Ofu LGA has a rich agricultural heritage and is known for the cultivation of a number of crops such as rice, yam, and maize. Trade also blossoms in Ofu LGA with the area hosting several markets which provide platforms for the exchange of a variety of goods and services. Ofu LGA is also popular for the rearing of a number of domestic animals such as cows and rams. .

Sampling Procedure

A three -stage sampling procedure was used in the selection of rice farmers for this study. The first stage was purposive selection of Itobe and Ugwa-Lawo districts from the four districts of Gwalawo, Itibe, Ugwa-Lawo and Ogwa because of the concentration of rice farming in the district area. The second stage was random selection of four rice farming communities from each district including Adumu, Elele, Ukpo and Allo. The villages that were selected from Ugwa-Lawo districs are Umomi, Aloji, Ejule and Offabo. The third stage was random selection of 15 rice farmers from each community which gave a total of 120 respondents.

Method of Data Collection and Analysis

Primary data were used for this study and were collected through structured questionnaire and interview schedule. Data collected were analyzed using both descriptive and inferential statistics such as frequency, percentage, mean and mode and regression analysis. 3-point likert scale was used to analyze constraints faced by farmers which was graded as: Serious Constraint (SC) = 3, Moderate Constraint (MC) = 2, Not a Constraint (NC) = 1. The mean score of respondents on the bases of 3-point likert scale was computed as: 3+2+1/3 = 6/3 =2. On this bases, mean score below 2.0 (i.e. MS<2.0) was ranked as not a constraints. Mean score greater than 2.0 (i.e.MS>2.O) w ranked very constraints. 3-likert scale was used for effectiveness of risk management strategies, graded as very effective (VE) = 3, effective (EF) = 2, not effective (NE) the mean score of respondent on this bases of 3-point likert scale well be computed as: 3+2+1/3 = 6/3 = 2

Multiple regression analysis was employed to analyze the effects of risks on rice production. The implicit equation is given as;

$Y = F(X_1, X_2, X_3, X4, X_5, X_6, X_7, X_8, X_9)$……(4)

Where the explicit equation is given as;

$Y = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 + a_6x_6 + a_7x_7 + a_8x_8 + a_9x_9 + et$…… (5)

Where; Y = Profit (₦)

X_1= Flooding

X_2= pest and diseases (affected in Ha)

X_3= Birds infestation (losses in Ha)

X_4= fire incidence (losses in ₦)

X_5= drought (losses in ₦)

X_6= market fluctuations (losses in kg)

X_7 = rice processing (losses in ₦)

Et= error term

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Rice Farmers

Table 1 presents the socio-economic characteristics of the rice farmers. The age distribution of the rice farmers in the study area as shown on Table 1 indicates that 60% of the respondents fall between the age ranges of 19 - 40 years. The mean age of the respondents is 40 years. This implies that rice farmers in the study area were in their active and productive age capable of helping them to manage the farm effectively against risk. This is in agreement with the work of Usman *et al.,* (2017) who reported a mean age of 41 years among farmers in Niger State. able1 also shows that 60% of the respondents were males while 40% were females. This clearly shows that male dominated rice farming in the study area. This conform the study of Chikezie *et al.,*(2016) who noted that the majority of rice farmer in Ebonyi State were males indicating that male are more risk takers and absorber than females.

Results in Table1 also indicates that majority (83.33%) of the respondents were married, while few (5.83%) were single. This implies that majority of the rice farmers in the study area were married and responsible which has great influence on risk management. This findings conforms the work of Chikezie *et al.,* (2016) who noted that majority (83.3%) of rice farmers in the state were married. Result on Table1 shows that the mean household size of the rice farmers was 6 persons. This is similar to the finding of Aminu *et al* (2017) who found mean household size of 6 among farmers in Odogbolu local government Area of Ogun State, Nigeria**.** The small household size will helps the farm households to adjust to sudden and seasonal changes in labour. This goes against Osuji *et al.,* (2017) who argued that more people in the family means more people to feed and less money to move to the higher level of choice of risk management strategies.

Table1 indicates that the mean years of rice farming experience was 14 years. This implies that rice farmers in the study area had long period of farming experience and would have managed various risks in the past. This result is in agreement with the work of Ibeagwa *et al.,* (2016) who found mean farming experience of 14 years among farmers in Mbaise Local Government Area of Imo state, Nigeria. Table1 also shows that the mean farm size of the respondents was 2 hectares. This shows that rice farmers in the study area are smallholder farmers. This was in line with the findings of Ojo, (2012), who recorded 2.84 ha and 2.42 ha farm size in Niger and Kogi States respectively. Results on Table 4.8 indicate that all farmers in the study area had one form of formal education or the other. The different educational status of farmers accounts for the differential risk managerial ability which also determines to some extent the overall success of the farm business. The level of education contributes much for productivity, adoption of new technology and farming techniques. This agrees with the findings of Nmadu, *et al,* (2012). Results on Table1 show that the mean annual income of the farmers was ₦350, 650.00 which implies that rice farming in the study area was a profitable venture indicating the farmers' ability to effectively manage risks in recent years.

Table 1: Socio-economic Characteristics of the Rice Farmers

Characteristics	Frequency	Percentage (%)
Age		
19-40	72	60
41-60	45	37.50
61-80	3	2.50
≥ 50	61	40.7
Mean = 40.0		
Sex		
Male	72	60
Female	48	40
Marital Status		
Married	100	83.33
Single	7	5.83
Divorced	2	1.67
Separated	2	1.67
Widow	8	6.67
Widower	1	0.3
Household Size		

1-5	55	45.83
6-10	51	42.50
11-15	14	11.67
Mean = 6.0		
Farming Experience		
1-10	63	52.50
11-20	37	30.83
> 20	12	10.00
Mean = 14.0		
Farm size (hectares)		
1-2	24	20.00
2.1-3	42	35.00
3.1-4	42	35.00
4.1-5	7	5.83
>5	1	0.83
Mean = 2		
Educational level		
Primary	33	27.50
Secondary	56	45.67
Tertiary	6	5.00
No formal education	23	19.17
Others	2	1.67
Educational level		
Primary	33	27.50
Secondary	56	45.67
Tertiary	6	5.00
No formal education	23	19.17
Others	2	1.67
Mean = ₦350,650		

Source: Field Survey Data, 2023.

Risk Experienced by Rice Farmers

The result in Table 2 indicates that disease (97.50%); market fluctuation (96.67%) and flood (89.17%) were the dominant risks affecting rice production in the study area. The least risk experienced by the respondents was fire incidence (0%). This finding agrees with the work of Kamoru *et al.,* (2014) who discvered that majority (90.8%) of the farmers in Kwara State consider flood to be an important source of risk in rice farm.

Table 2: Types of Risk Experienced By Rice Farmers

Types of risk	Frequency *	Percentage	Ranking
Flood	107	89.17	3rd
Weather	92	76.67	4th
Disease	117	97.50	1st
Drought	34	28.33	7th
Heavy rain	46	38.33	6th
Family ill heath	25	20.83	8th
Theft	57	47.50	5th
Market fluctuation	116	96.67	2nd

Source: Field Survey Data, 2023.

* = multiple responses

Risk Management Strategies Adopted

Table 3 presents the risk management strategies adopted by rice farmers. Table 3 indicates the various risk management strategies adopted by the rice farmers in the study area. All (100%) the respondents adopted the use of agrochemicals as the management strategies. Also, the use of fertilizer, herbicides and pesticides was adopted by majority (99.17%) of the rice farmers. This finding agrees with the work of Aminu *et al.,* (2017) who noted that the major preventive strategy adopted by the farmers were the

use of agrochemicals. It was evident from the findings that farm insurance was least employed to prevent risk, this could be as a result of awareness and absence of formal insurance institutions in the study area, as reported by Shaibu *et al.,* (2022) that all farmers in Kogi Agricultural Zone B were aware of agricultural risk but there is low level of agricultural insurance in the study area.

Table 3: Risk Management Strategies Adopted

Strategies adopted	Frequency	Percentage	Ranking
Use of agrochemicals	120	100.00	1st
Use of fertilizer	119	99.17	2nd
Mixed cropping	56	46.67	7th
Non-farm business	101	84.17	6th
Cooperate farming	04	3.36	8th
Input-output storage	116	96.67	5th
Farm insurance	01	0.83	10th
Forward contracting	04	3.36	8th
Use of herbicides	119	99.17	2nd
Use of pesticides	119	99.17	2nd

Source: Field Survey Data, 2023.

Effectiveness of Risk Management Strategies Adopted

Table 4 shows the effectiveness of risk management strategies adopted by rice farmers in Ofu local government. The use of agrochemicals, fertilizers, non-farm business, input-output storage, herbicides and pesticides, with mean score of (MS = 2.06), (MS = 2.84), (MS = 2.47), (MS = 2.65), (MS = 2.90) and (MS = 2.08) respectively were perceived as the most effective risk management strategies adopted by the respondents. This agrees with the work of Olawoyin Taiwo, (2015) who noted that application of fertilizer was one of the effective management strategies used by the farm households who had risk aversion attitude in Abuja Area council.

Table 4: Distribution of the Effectiveness of Risk Management Strategies Adopted

Strategies adopted	VE	E	NE	MS	Remark
Use of agrochemicals	11	105	04	2.04	Effective
Use of fertilizer	105	11	04	2.84	Effective
Mixed cropping	20	65	35	1.88	Not effective
Non-farm business	66	44	10	2.47	Effective
Cooperate farming	12	55	53	1.66	Not effective
Input-output storage	84	30	06	2.65	Effective
Farm insurance	16	40	64	1.60	Not effective
Forward contracting	02	47	71	1.43	Not effective
Use of herbicides	111	06	03	2.90	Effective
Use of pesticides	10	109	01	2.08	Effective

Source: Field Survey Data, 2023.

VE= Very Effective, E= Effective, NE= Not Effective MS= Mean Score

Effects of Risk Strategies on Rice Profitability

Table 5 presents the results of regression analysis to determine the influence of risk on rice profitability. The results in Table 5 showed a R^2 value is 0.633 which indicates that the explanatory variables explained 63.3% of the total variation in the dependent variables implying a good fit. The result showed that flood (β=-0.016), pests and diseases (β=-0.013), drought (β=-1.013) and climatic conditions (β=-0.654) was negative and statistically significant to profit realized from rice production. This indicates that a unit increase in these risk strategies will cause a corresponding decrease in the profit realized. This is because all this are production risk and may affect the output of rice. For instance, invasion of pests can damage crops and reduce output, the same can be attributed to flood, drought and adverse climate change.

Rice processing (β=0.056) was positive and significant to rice profitability. This implies that a unit increase in rice processing will result in 0.056 increase the profit realizes from rice production.

This is because processing rice is a way of adding values which in turn will result in more income (production and processing).

Table 5: Regression Analysis on risk strategies on rice profitability

Variables	B	Std. Error	T	Sig.
Constant	-1.952	0.354	7.835	0.005***
Flood	-0.016	0.023	4.324	0.002***
Pest and diseases	-0.013	0.020	-3.629	0.022**
Fire incidence	-0.621	0.017	-0.143	0.867
Market fluctuation	0.032	0.201	0.985	0.426
Drought	1.013	1.965	2.925	0.031**
Rice processing	0.056	0.021	6.214	0.000***
Climatic conditions	-0.654	1.024	3.056	0.015**
R^2	0.633			
Adj. R^2	0.598			

Source: Field Survey Data, 2023.

***Significance at 1% , **Significance at 5%, *Significance at 10%

CONCLUSION

It was observed that most of the rice farmers experienced various degree of risk such as flooding, pests and diseases, birds infestation, disease, market fluctuation, bad weather, among others, and adopt several management techniques to mitigate these risks. The farmers also use agrochemicals, fertilizers non-farm business, input-output storage, the use of herbicides and pesticides as risk management strategies while mixed cropping, cooperate farming, farm insurance and contract farming were not popular in the study area. Since disease was ranked as the major type of risk experienced by rice farmers in the study area; high disease resistant varieties of rice should be introduced while Rice Farmers Association of Nigeria (RIFAN) should develop a strong and smooth market system to protect the interest of the farmers during on and off season of farming. Pest's invasion, flood, and climatic problem have negative impacts profit of rice. Rice breeders should intensify efforts in introduction of drought resistant varieties in order to assist the rice farmers in mitigating the risks in rice production. Value addition in rice processing has positive influence on profit in rice cultivation. Therefore, it is imperative for rice farmers to improve on their level of rice processing along the value chain in order to increase profit level in production. Government intervention on rice production should reach the genuine farmers while farmers should make use of various insurance policies to mitigate adverse effects of risks confronting them.

REFERENCES

Ahmed, A. E. (2011). "Risk sources and attitude among the tenants of the Gezira Scheme Sudan," J. Saudi Soc. Agric. Sci. 10 (2): 71–75.

Bello, K. A, Ayinde, O.E. and Omofaiye, A.M. (2020). "Analysis of Risk Management of Rice Farmers in Kwara State," Journal of Multidimensional Research and Review (JMRR).1 (2): 72-79.

Chikezie, C1.,Chidiebere-Mark, N.M., Maduike, I. A., Ibeagwa, O. B. and Onyekachi E. U. (2009). Department of Agricultural Economics, Federal University of Technology, Owerri Imo State;

Drummond, E. H. and Goodwin, J. W. (2011). Agricultural Economics (3rd edition). Pearson Education Incorporated p.156.

Edeh, H.O., Eboh, E.C. & Mbam, P.N. (2011) Analysis of Environmental Risk Factors Affecting Rice Farming in Ebonyi State, Southeastern Nigeria, World Journal of Agricultural Science. 7 (1): 100 – 103.

Food and Agricultural Organization (2013) Managing risk in farming E-ISBN 978-92-5 107544-9 (print)

Greene, W. H. (2012) Econometric analysis, Seventh ed., 1231. New York University.

Hardaker J.B., J. W. Richardson, G. Lien, and K. D. Schumann. (2014). "Stochastic efficiency analysis with risk aversion bounds: a simplified approach," Aust. J. Agric. Resour. Econ., 48 (2): 253–270.

Hurley T.M.,(2021). A Review of Agricultural Production Risk in the Developing World, Technical Report, International Food Policy Research Institute (IFPRI), Harvest Choice.

Jaffee, D. and Howard, P. H. (2010). Corporate cooptation of organic and fair trade standards. Agriculture and Human Values. 27 (4): 387-399.

Kahan, D. (2013). Managing risk in farming. Farm management extension guide. Food and Agriculture Organization of the United Nations, Rome.

Laurence C., Gene G., Steve I., Doug J. and Rod S.,(2013). Introduction to Risk Management: Understanding Agricultural Risks, 2nd Ed., Extension Risk Management Education and Risk Management Agency, United State Department of Agriculture

Moschini G. and D. A. Hennessy, D.A. (2011). "Uncertainty, risk aversion, and risk management for agricultural producers," Hand b. Agric. Econ. 1: 87–153.

Ojo, M.A (2012). Analysis of Production Efficiency among Small Scale Yam and Cassava Farmers in Niger and Kogi States, Nigeria. Thesis submitted for the Partial Fulfilment of the Award of Doctor of Philosophy. Department of Agricultural Economics and Extension Technology. Federal University of Technology, Minna. Pp-74-120

Olawoyin Taiwo (2015) "Analysis of Farm Risk and Management Strategies among Households in FCT, Abuja, Nigeria ". Department of Agricultural Economics and Rural Sociology, Faculty of Agriculture Ahmadu Bello University, Zaria Nigeria.

Osuji, E. E., Ehirim, N. C., Rahji, M. A. Y.,Awoyemi, T. T., Salman, K. K., Odii, M. A.C. A., Onyemuwa, S. C., Ibeagwa, O. B.,Chikezie, C. and Okwara, M. O .(2017).Farming risks and security Challenges in Vegetable Production in Orlu Imo State Asian Development PolicyReview5(1).37-42 ISSN (e): 2313-8343 ISSN (p): 2518-2544

Ping Q., M. A. Iqbal, M. Abid, U. I. Ahmed, A. Nazir, and A. Rehman, (2016). "Adoption of Off-farm Diversification Income Sources in Managing Agricultural Risks among Cotton Farmers in Punjab Pakistan," J. Appl. Environ. Biol. Sci. 6 (8): 47–53 .

Sjöberg L., B.-E. Moen, and T. Rundmo(2004). "Explaining risk perception. An evaluation of the psychometric paradigm in risk perception research," Trondheim, Norw.

Usman, J., Jirgi, A.J., Ojo, M.A. and Tiamiyu, S.A. (2017). Sources of risk and management strategies among farmers in Rice post-harvest management in Niger State, Nigeria. International Journal of Environmental & Agriculture Research. 3 (7): 60-66. .

Zinn J. O. (2009)., "The sociology of risk and uncertainty: A response to Judith Green's 'Is it time for the sociology of health to abandon "risk"? Health. Risk Soc. 11 (6): 509-526.

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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Strategic Plans for Enhancing Competitiveness in Nigeria Agribusiness Firms

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Abstract

This paper reviewed empirical literature and theory on competitiveness and highlighted strategic plans that enhance competitiveness in Nigeria agribusiness firms. The three theories of competitiveness adopted in this paper include theory of effective (workable) market competition, entrepreneurship and innovation theory and Porter's theory of competitiveness which are driven by product innovation and quality service delivery system. But porter's theory of competitiveness, amplified more on all the strategic plans discussed in this paper. To harmonize the underline theories and strategic plans highlighted, this paper developed two models, the conic market model and big market model to provide explanations on the complexities surrounding the Nigeria agribusiness firms. From the models, it was established that strategic plans require effective management system by Nigeria agribusiness firms and competitiveness requires good government policy needed for agribusiness firms to compete with other rivals operating in the same market. For effective management system influences strategic plans, strategic plans enhance competitiveness and government policy influences competitiveness and competitiveness enables agribusiness firms to compete with other rivals both at domestic and the global market level.

Keywords: Strategic plans competitiveness and Agribusiness Firms

Introduction

Agribusiness firms are scattered all over the country but are concentrated in four main industrial clusters in Nigeria; Kano- Kaduna - Jos in the north; Lagos - Otta -, Ibadan in the south west; Port Harcourt-Delta- Edo in the south - south; Aba,-Nnewi - Onitsha in the south - east. In general, the Lagos-Otta- and Ibadan axis accounts for 44 percent of the registered industries and roughly 52 percent of the employment in the country (Marchet *et al.*, 2001). Based on the average number of employees per industry, the largest industries are also located in the Lagos area ((Marchet *et al,* 2001). While most of the subsectors are made up of small-scale enterprises (about 60 percent of the industries have between 20 and 49 employees), these account for 12 percent of industrial employment. With a few exceptions, agribusiness firms with more than 500 employees provide the bulk of sectoral employment across the country. As a whole, they account for 53 percent of total employment in the manufacturing sector (Marchet *et al,* 2001).

However, Olayide, & Heady (1982) defined these agribusiness firms as a backward and forward business linkages associated with agricultural production, provision of finance, machinery, fertilizers, seeds, etc at the input end and marketing of food/ foodstuff and agricultural primary commodity and processed food at the output end. Downey & Erickson, (1987) and Achojia (2011) regarded agribusiness firms as a modern form of business strictly operated for profit. Chukwuma (1999) and Aguanor (2017), suggested that agribusiness firms in Nigeria can be structured into small, medium and large-scale enterprises which comprises of food distribution, animal health, grain marketing, fertilizers, seed, and livestock feed Firms. Others include; agribusiness consulting, agricultural cooperatives, equipment manufacturing, food processing and equipment hiring firms. These agribusiness firms face huge challenges in Nigeria. The survival and growth of the agribusiness firms are highly constrained by the physical, institutional and economic environment. Such constraints include continuous importation of high quality processed agricultural products abroad where Nigeria has become a dumping ground for other Nation's manufacturing goods, rejection of over 70% agricultural foodstuff exported from Nigeria to Europe and USA due to low quality and improper application of chemicals and preservatives additives making Nigeria to loses about 2.9 billion USA dollar only on beans ban (NAFADC, 2023 and The Gurdian Newspaper, 2023). Other factors include lack of innovative products to compete globally, poor quality product due to low level of technological advancement, high production costs, overestimating of market size, ignored or misinterpreted market research, inflationary pressure, unstable exchange rate, poor infrastructural development, multiple taxation, inconsistent government policy, and lack of policy direction that encourages growth in agribusiness firms (Adebayo *et al*., 2004; Opeolu & Oluwalana, 2004; Oluwalana *et al.*, 2004, Adebayo *et al.,* 2004; Abba and Mustapha, 2004; Kolter and Keller, 2013 & Aguanor, 2017). Like many other sectors, management and marketing theorists argued that to meet these challenges, there should be strategic plans that will enhance competitiveness of agribusiness firms in Nigeria. Agribusiness firms should develop strategic plans that would enable the industry as an organization respond to the challenges in the global marketplace. And one of the approaches used by several industries is the application of strategic plans that enhance competitiveness both at the domestic and global level. Strategic plans are useful in the revitalization and sustainability of agribusiness firms because it provides unique benefits for agribusiness firms involved in the effort of producing innovative products that will compete with other firms at the global level (Conrad, *et al.*, 2002). Strategic plan is a documents used to communicate with the organization the organizations goals and critical element developed during the planning process and the actions needed to achieve those goals and all the critical elements identified in order to enhance competitiveness of agricultural firm (Balanced Scorecard Institute, 2023). United Nation (2023), defined strategic plans as a process of looking into the future and identifying trends and issues aligning with organization priorities. The first step in strategic planning is to gather the information needed to understand and identify the issues, challenges and trends that will shape and affect agribusiness firm and enhances competitiveness.

On the other hand, Adamkiewicz (2002) defined competitiveness of agribusiness firms as a means of adapting its products to the market and competition requirements, particularly in terms of product range, quality, price as well as optimal sales channels and methods of promotion. Ajitabh (2004) relates competitiveness of agribusiness firms as part of its share in the competitive market. Buckley (1988), maintained that agribusiness firm's competitiveness means its ability to produce and sell products and services of superior quality and lower costs than its domestic and international competitors, while Ajitabh and Momaya (2004), on their part defined agribusiness firm competitiveness as the ability of agribusiness firm to design, produce and or market products superior to those offered by competitors, considering the price and non-price qualities. To enhance competitiveness in agribusiness firms, there should be well coordinated strategic plans put forward by agricultural entrepreneurs. These coordinated strategic plans include investment in Research and Development (R&D), product innovation and new product development, training and 're-training of staff to enhance skilled manpower that will handle the challenges in agribusiness firms, adoption of biofuel technology to cushion the effect of subsidy removal from fuel and reduce production costs, investment of modern technology to produce high quality product, adoption of market orientation strategies, product and service quality that will enhance customer satisfaction, innovative ideas to come up with radical innovative products that will compete with the imported goods both at the domestic and international level.

In Nigeria there are abundance of research and publications on firm competitiveness but there is scarcity of empirical and conceptual literature in the area of strategic plans that would enhance competitiveness of agribusiness firms. Most of the researchers who have undertaken studies on competitiveness failed to give satisfactory strategic plans that will enable agribusiness firms in Nigeria compete globally. This forms the research gap. To achieve objectives of the study and fill identified knowledge gaps, this paper would address the following research questions. What combination of strategic plans that would enhance competitiveness in agribusiness firms? What model would agribusiness firms adopt to enhance competitiveness in agribusiness firms? What are the factors limit strategic plans and competitiveness of agribusiness firms in Nigeria?

Literature Review

To address these research questions, this paper argued that, is it within the focus of agricultural economists to suggest reasons for failure in agribusiness firms in Nigeria and point out way forward that would enhance competitiveness in the future. For it has been suggested by scholars that the inability of politicians and policymakers to formulate appropriate policy measure to enhance competitiveness in agribusiness firms is due to their inadequate knowledge of the complexity of the macroeconomic situation around agribusiness firms. To formulate appropriate policy, there is need for systematic guide which meet the complexities of the real world to be understood and be interpreted. This systematic guide is the study of the existing theory and literatures to develop model appropriate that would provide explanation to the research questions and the complexities surrounding agribusiness firms in order to formulate good policies and programmes that would drive competitiveness in agribusiness firms. To this effect, this paper adopted the following theories such as the theory of effective (workable) competition, entrepreneurship and innovations theory and Porter's theory of competitiveness to develop models that would provide explanations on the complexities and challenges that hindered agribusiness firm development in Nigeria.

a. The Theory of Effective (Workable) Competition

This theory of effective (workable) competition postulated by John Maurice Clark in 1940, stated that competition advantage is driven by innovations introduced by agribusiness firms. Innovations motivate agribusiness firms to compete aggressively in order to obtain competitive advantage, which in turn leads to technological progress and economic growth at the macro-level.

b. The Theory of Entrepreneurship and Innovations

This theory of entrepreneurship and innovations developed by Joseph Schumpeter 1950, stated that the agribusiness firms' ability to innovate is a key for achieving competitive advantage over its rivals. This ability will create a new solution(s) and predisposition to take risks associated with testing the innovative products in the market underline the competition process and entrepreneurship.

d. Porter's Theory of Competitiveness

One of the most prominent and widely respected researchers in the area of competitiveness is Michael Porter. According to Porter (1998), a firm's competitiveness refers to the competitive advantage over its rivals in a particular industry. Agricultural industry has competitive advantage when it is able to differentiate itself in market place, generate greater revenues and operates at lower costs than its competitors. In addition, innovation is the application of new ideas to the products, processes or any other aspects of firms activities has become one of the key drivers for firms to operate profitably and compete sustainably in the globally linked economies (Rogers, 1998).

Porter & Stern, (2002) asserted that firms operating in advanced nations whose economies were innovation based would not option sustained competitive advantage, if they were not able to create and then commercialize new products and processes and shift the technology frontier as fast as their rivals can catch up. This implies that innovation is a key to obtaining a sustained competitive advantage. However, Porter, (1980) proposed three general types of strategies that are commonly used by business: they are cost leadership strategy, differentiation strategy, and focus strategy. Cost leadership strategy

refers to the extent that the firm operates at low cost in an industry, for a given degree level of quality compared to its rivals. If the price war takes place in the industry, the firm can remain profitable, yet their competitors suffer losses. When the firm develops a product or service with unique attributes which are perceived or valued by customers to be better or different from the same products offered by the rivalry in the industry, the firm is said to employ differentiation strategy. The firm employs the focus strategy to concentrate on a narrow market segment, and with that particular segment the firm attempts to obtain either a cost advantage or differentiation. Cost focus strategy refers to cost competitive strategy that focuses, on a particular buyer group or geographic market and attempts to serve only this niche, to the exclusion of others.

Strategic Plans that Enhances Competitiveness

Haven't highlighted three theories in this paper, it is imperative also we discuss some of the strategic plans in line with these theories that enhance competitiveness of agribusiness firms in Nigeria.

1. Research & Development (R&D)

Agribusiness firm can develop a strategic plan of engaging postgraduate students and professors in the university to design and carry out project. In this case the agribusiness firm can sponsor a research competition such as innovation challenge, where top postgraduate students and professors compete in teams. The payoff to the students and professors will be experience, visibility, and ability to solve problems that are challenges and come out with innovative products design to capture new opportunity in the domestic and global market. In other word, agribusiness firm can sponsor PhD and Post-Doctorates programmes with the goal of engaging the students for 3 to 4 years in a specific field to carry out research in line with the company goal in order to dominate the market with innovative products.

2. Product Innovation/New Product Development

New product can create a new market opportunities or revive existing product in the market. According to Kolter and Keller (2013), new product activity is devoted to improving existing products. Kolter and Keller (2013), further maintained that about 10% of all the new products are truly innovative and new to the world. These products incur greater cost and risk. Although, product innovations can hurt agricultural industry's bottom line in the short-run, if they succeed they can create a greater sustainable competitive advantage over others. Agricultural industry must create a strong research and development together with marketing partnership to pull off a radical innovation. Agricultural industry must be prepared to cannibalize existing products, tolerate risk and maintain a future market orientation. Agribusiness firms in Nigeria should seek radical innovation because they face a number of product launch challenges such as high technological uncertainty, high market uncertainty, fierce competition, high investment costs, short product lifecycle, and scare funding for risky products.

In Nigeria with rapid changes and high demand of imported quality product overseas, which is a big threat to agricultural domestic industries, product innovation is a

necessary and required condition to compete with these rivals. agribusiness firms should be innovative enough to identify and quickly seize the new market opportunities with their innovative and superior products. This strategic plan is in line with the theory of effective (workable) competition, entrepreneurship and innovation theory and Porter's theory of competitiveness. For market analysts Kolter and Keller (2013), maintained that a unique and superior product has 98% market success, a moderate advantage product 58% success and 18% success of minimal innovative product in the market. So agribusiness firms, in Nigeria should map out strategic plan that would encourage product innovation in order to compete with rivals in the same market.

3. Product and Service Quality

According to Kolter and Keller (2013), satisfaction depends on product and service quality, because higher level of product and service quality results to higher level of customer satisfaction. This will

enable agribusiness firms compete both at domestic and global level. Various studies have shown a high correlation between relative product quality and agribusiness firms competitiveness (Kolter and Keller, 2013). Product quality is key to value creation and customers' satisfaction. So agribusiness firms should strategize means of offering product and service quality that will satisfy customers' needs as they compete with other firms who are offering the same products in the same market.

4. Adopting of Biofuel Technology

Nigeria is greatly endowed with abundant renewable energy resources capable of meeting the country's needs such as biomass- raw materials for biofuel technology (Yusfu, 2018). Biomass consists of agricultural raw materials, which are available on a renewable basis and its prospects has a high-level contributions to Nigeria's energy mix. Biomass has been the dominant traditional source of energy for household needs in the country. For instance, the total primary energy consumed in Nigeria in 2013 was estimated by the U.S. Energy Information Administration at about 4.8 quadrillion British thermal units. Out of this amount, traditional biomass and waste accounted for 74 percent (U.S. Energy Information Administration, 2016). The spectrum of biomass resources in Nigeria covers trees, crops, forage grasses and shrubs, animal wastes, industrial wastes, biodegradable component of municipal solid waste and other wastes from forestry that serve as raw materials for biofuel technology (ECN & UNPD, 2005).

Nigeria's biofuels potentials are primarily embedded in Biomass feedstock, from which biofuels are derived; principally consist of conventional agricultural products and lignocellulosic products and residues. It is from these biomass feedstock that bio-oil, bioethanol, biohydrogen, biogas, syngas and biodiesel among others are derived (Kumar and Sharma, 2017). Scholars have emphasized that lignocellulosic biomass is a promising renewable source for biofuels because of its cheapness and abundance (Bosh and Hazen, 2017; Simonyan and Fasina, 2013 and Kurma and Sharma, 2017). This contrasts sharply with conventional agricultural products as sources of biofuels. This is so because lignocellulosic feedstockare not resource- demanding as they can be produced on marginal and poor lands (Simonyan and Fasina, 2013). Despite the promise of biomass contribution in catalyzing and revolutionizing the Nigeria energy sector, there still no investment to harness the potential (Agaptus *et al.*, 2021). Now that fuel subsidy has been removed and production costs per unit have increased, it is the right time agribusiness firms in Nigeria harness the opportunities offered by biofuel technology and reduce production cost which support the cost leadership strategy of porter's theory of competitiveness.

5. Training and Retraining of Employee to Drive Competitiveness

Jackson *et al* (2004) and Noe *et al* (2011), defined training as an awareness and planned efforts aim to assist, encourage and motivate employees to acquire knowledge, skills, capabilities, attitudes and new behavior and their application both now and in the future in order to aid organization, achieve its goals and competitive advantage. Training and development are vital tools for any organization in developing technical, management, leadership and technical skills that will enhance competitiveness in agribusiness firms. Physical, intellectual and mental training are essential in facilitating not only the level of productivity but also the development of personnel in any organization. However, human resources are the most valuable assets of any organization. With the machines, materials and even the money, nothing is done without man-power. In order to ensure that employees are equipped with the right skills, knowledge and technicalities required to perform their assigned tasks, training and development plays its crucial role towards the growth and success of agribusiness firms. Specifically, by investing in employee through sound training and retraining programme, agribusiness firms will be able to develop innovative products, high quality service delivery, biofuel technology, market orientation and comparative advantage that will enhance and guarantees competitiveness. The process of employee development should be unfolded in the manner that would stimulate creativity and inventiveness that shapes the entire organizational knowledge. For this will unify agricultural industry and makes it different from any other industry. In order to maintain its position and increase competitive advantage, agricultural industry needs to be able to create new knowledge that would develop into radical innovative products instead of relying on the existing knowledge with old products which support the theory of workable competition, entrepreneurship and innovation theory and porter's theory of competitiveness. This implies that only training and retraining of employees will enhance

competitiveness in agribusiness firms that will make their products compete in the global markets. In order to stay ahead of competition, training and development plan must in corporate innovation and reinvention and this is only possible when training encompasses a wide range of learning actions. Therefore, an ideal training should become part of a agricultural industry strategic plans which must be linked to business goals and organizational performance to enhance competitiveness.

6. Saving certain percentage (%) of Sales Revenue to Acquire Modern Technology To fund a radical innovative product or acquire more sophisticated machinery and plants in order to compete in the global marketplace funds are needed by agribusiness firms. Agribusiness firms should be able to strategize means of saving certain percent of it's sales revenue monthly or yearly in order to mop up funds to acquire technology and technical manpower to drive competitiveness and compete both domestic and global Market.

7. Market Orientation

Kohli, Jaworski, & Kumar, (2010) defined Market orientation as the organization-wide generation of market intelligence pertaining to current and future needs of customers, dissemination of intelligence horizontally and vertically within the organization, and organization-wide action or responsiveness to market intelligence. Market orientation is an organizational culture where employees are committed to continuously creating superior customer value, or as a sequence of marketing activities that lead to better performance (Grönroos, 2006). So agribusiness firms, in Nigeria should see market orientation as a culture to enable it become more market oriented and provides services that meet market latent needs and compete favourably with rivals operating in the same market.

Finally, haven't reviewed empirical literature, theory on competitiveness and highlight strategic plans that enhance competitiveness, this paper observed that effective strategic plans enhance competitiveness and competitiveness allows agribusiness firms to compete both at the domestic and global market level. The three theories of competitiveness adopted all driven by R&D, product innovation and quality service system which are the key strategic plans this paper identified. But porter's theory of competitiveness, amplified more on all the strategic plans in this paper. To harmonize the underling theories and strategic plans highlighted, this paper developed models that provide answers to the research questions and explanations of complexities surrounding the agribusiness firms in Nigeria

The Model of Strategic Plan and Competitiveness

a. The Conic Market Model

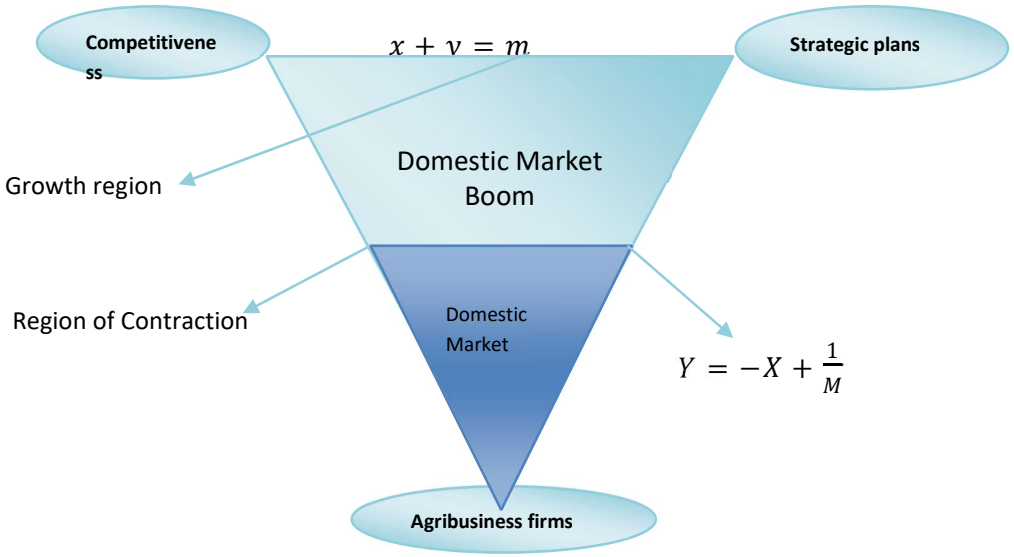


Figure 1: The Conic Market Model

This model shows the market operation of agribusiness firms. The model has a conical shape with two cones, in which the smaller cone with unstable market operation embedded in the larger cone with stable market operation. The smaller cone signified contracted region (i.e., the unstable market region), where the agribusiness firms are trapped inside the cone in the domestic market due to poor product design, poor service delivery system, inefficient management and poor government policy making it difficult to compete with rivals in the domestic market. This operation result to low GDP, high unemployment, and extreme poverty. While the larger cone signified growth region (i.e., stable market region), where there is a boom in the domestic market due to innovative products, high quality service delivery system, effective management and good government policy making agribusiness firms compete, favourably at the domestic market. This operation will result to high GDP, increase in employment, wealth, high purchasing power of the economy, etc.

Mathematical Derivation of the conic market Model

To give more meaning to the conic model, let us derive mathematical equations related to surface area of a cone to explain the conic market model. The curve surface area of the cone is the market competition region (the base of the cone), where strategic plan is sum up with competitiveness ($x + y = m$). In this model, agribusiness firms are able to compete with rivals favourably, if market competition (curve surface area) is the sum of strategic plans and competitiveness as shown below.

$x + y = m$ (1)

Just as curve surface area of cone is equal to the area of a circle plus area of the cone

Where m = Market Competition

x = Strategic Plans

y = Competitiveness

So $x + y = m$

Dividing both sides by m we have

$$\frac{X}{M} + \frac{Y}{M} = \frac{M}{M}$$

$$\frac{X}{M} + \frac{Y}{M} = 1$$

Make m the subject of the formula

$$\frac{X}{M} = -\frac{\frac{Y}{M}}{M} + \frac{1}{M}$$

$$X = -Y + \frac{1}{M} \quad (2)$$

$$Y = -X + \frac{1}{M} \quad (3)$$

From equation 1, strategic plans and competitiveness will increase economic activities that will enable agribusiness firms to compete with rivals both at the domestic and global market levels.

$x + y = m$, implies that a well properly implemented strategic plans with competitiveness will move agribusiness firms to market competition region of the larger cone in figure 1 characterized by high GDP, high purchasing power of the economy, employment opportunities and wealth creation. In addition, equations 2 and 3, implies that strategic plans without competitiveness and competitiveness without strategic plans respectively have an inverse (1/m) effect on market operation of agribusiness firms. This will affect agribusiness firms negatively in competing with other rivals in the same market.

$X = -Y + \frac{1}{M}$ Implies that strategic without competitiveness will result to lack of

competitiveness ($-Y$) as result of lack of government policy support and inverse market competition ($\frac{1}{M}$) which will hinder agribusiness firms to compete favourably with rivals at the global market.

$Y = -X + \frac{1}{M}$, implies that competitiveness without strategic plans will result to poorly

strategic plans executed by inefficient management system and inverse market competition (1/m) will also hinder agribusiness firms to compete favourably with rivals at the global market. All these activities will trap agribusiness firms inside the smaller cone in figure 1, marking it so difficult to compete with other rivals in the same market resulting to low economic growth characterize with underutilization of resources, unemployment, extreme poverty, low GDP and poor purchasing power of the economy.



Figure 2: Big Market Model

b. The Big Market Model

Rotating the conic market model, we can construct a bigger model to explain strategic plans and competitiveness in agribusiness firms. As noted in figure 1 that the model has a conical shape with two cones. Also this model has two cones with smaller cone embedded in the bigger cone just as the first model but in rotated form. The base of the bigger cone establish the market competition region with economic boom connected with four variables via strategic plans, competitiveness, industrial management and government policy that create another economic boom at the top region before the global market in the model. This implies that agribusiness firms, which is at the center of the model is well equipped with these variables that enable its, compete at the global market as a result of economic boom. But if peradventure, there is lack of strategic plans with ineffective management system, the agribusiness firms will fail and collapse then lock insider the smaller cone, a region of low economic growth, where it becomes so difficult to compete with rivals in the domestic market, more or less to

compete at the global market. To reinforce agribusiness firms and create economic boom, strategic plans should be supported with effective management system, with strategic plans and effective management system put in place, agribusiness firms will be able to compete at the global market.

Similarly, at the right wing of the big market model, competitiveness should be supported with good government policies and programmes. For effective competitiveness coupled with good government policy, agribusiness firms will be able to compete at the global market. If competitiveness is supported with poor government policy, agribusiness firms will fail and collapse inside the small cone, a region of low economic growth to contracted region of low economic growth, where it becomes so difficult to compete with other industries in the same market.

Also, at the base of the bigger cone, there are two springs serving as a pillar, one spring connecting strategic plans to industrial management at the left wing of the model, while at the right wing, the second spring connects competitiveness to government policy. The two springs cause a spring effect in agribusiness firms and spring out growth that will leads agribusiness firms to the region of economic boom at the top of the model, making it easy to compete at the global market. But if the springs collapse, it forces agribusiness firms downward to the region of low economic growth where agribusiness firms are trapped inside the smaller cone making it difficult to compete with rivals.

Mathematical Derivation of the Big Market Model Equation

Prove that Effective Management (a) of agribusiness firms and Good Government

Policy (b) result to Market Competition (m)

$a + b = m$ (4) recall that

$x + y = m$

Dividing both si zes by m we have

$$\frac{x}{m} + \frac{y}{m} = \frac{m}{m}$$

$$\frac{x}{m} + \frac{y}{m} = 1$$

$$\frac{x}{m} = 1 - \frac{y}{m}$$

Make m the subject of the formula

$$x = -\frac{\frac{y}{m}}{m} + \frac{1}{m}$$

$$x = -y + \frac{1}{m} \quad (3)$$

From equation 4 $a + b = m$. So substitute equation 4 into 3 to have

$$x = -y + \frac{1}{a+b}$$

$$x = -\frac{y(a+b)+1}{a+b}$$

Cross multiple

$x(a + b) = -y(a + b) + 1$

Divdie both side by a+b to have

$$x\frac{(a+b)}{(a+b)} = -y\frac{(a+b)+1}{(a+b)}$$

$$x = -y + \frac{1}{(a+b)} \quad (5)$$

Recall $x = -y + \frac{1}{m}$

Substitute into the equation to have

$$-y + \frac{1}{m} = -y + \frac{1}{(a+b)}$$

collect the like terms

$$-y + -y + \frac{1}{m} = \frac{1}{(a+b)}$$

$$\frac{1}{m} = \frac{1}{(a+b)}$$

Cross multiple

$$a + b = m$$

From the equation is can be concluded that for agribusiness firms to compete it require the combination of effective management system and good government policy.

Finally, Strategic plans and competitiveness couple with industrial management and good government policy will allow agribusiness firms offer innovative products and quality service delivery system so as to compete with other industries at the global market level which is in line with the three theory of effective (workable) competition, entrepreneurship and innovative theory and Porter's theory of competitiveness. Strategic plans couple with effective management system and competitiveness with good government policy will cause spring effect that would suddenly arise in agribusiness firms which will in turn cushion the linger underdevelopment in agricultural sector of the economy, crashing-out poverty, unemployment, under-utilization of resources and spring up growth from poor economy state to more efficient economy boom and prosperity. This will cause multiplier effect that will lead to the following:

1. increase in food security
2. increase in GDP
3. high purchasing power of the economy
4. wealth creation
5. increase in employment opportunities
6. effective and efficient management of resources
7. increase in foreign exchange earnings resulting from the exportation of high quality agricultural produce due to competitiveness in the industry.
8. increase in international trade as more agricultural firms begin to roll out high quality products that can compete in the global market
9. attraction of foreign direct investment as agribusiness firms become highly competitive and ensuring perfect competition in the market economy.

Conclusion

From this paper it can be said that strategic plans require effective management system by agribusiness firms and competitiveness requires good government policy needed for agribusiness firms to compete with other rivals operating in the same market. Effective management system influences strategic plans, strategic plans enhance competitiveness and government policy influences competitiveness and competitiveness enhances agribusiness firms to compete with other rivals both at domestic and international market.

References

Abba A., Mustapha A. (2004): developing farmer's financial management in Okuneye.
In: Evbuowan P.B., Evbuowan G.O. (eds.): Agribusiness in the African century.
Proceedings of the African farm Management Association, p. 128–139.

Achoja F.O. (2011). "Growth and survival of small-scale agribusiness firms in Delta State, Nigeria". *Agricultural Tropical et Subtropical*. 44 *(2)*.

Adamkiewicz-Drwiłło H.G. (2002). Uwarunkowania konkurencyjności przedsiębiorstw. PWN,Warszawa.

*A*debayo O.A., Ayinde I.A., Agbonlahor M.U., Mafimisabi T.E. (2004): Assessment of the use of information communication technologies on the economic performance of agro based food industries in south-west, Nigeria in Okaneye. Agribusiness in the African Century. Proceedings of the African Farm Management Association, p. 111–121.

Admasu, M, Kelbessa, W. (2018). Food safety knowledge, handling practice and associated factors among Food Handlers of Hotels/Restaurants in Asosa Town, North Western Ethiopia. *SM J Public Health Epidemiol*. 4(1):1051.

Aguanor, B. (2017). *Effect of market orientation of selected agribusiness firms Edo State, Nigeria*. Unpublished M.Sc Dissertation Department of Agriculture Economics University of Nigeria Nsukka). Agaptus, N. Gbeng. O. Olankunle.O. Modupe.A. Solomon.A and Oluwaseun. O. (2021).Nigeria's quest for alternative clean energy through biofuels: an assessment. IOP Conference. Series Earth Environmental Science. Doi:10.1088/1755-1315/655/1/012054.

Ajitabh, A. Momaya K. (2004). Competitiveness of Firms: Review of Theory, Frameworks and Models. Singapore Management Review 26(1), 45–6

Bosch, M and Hazen. S.P. (2013).“Lignocellulosic feedstocks: Research progress and challenges in optimizing biomass quality and yield,” *Front. Plant Sci*., vol. 4, Pp. 1–4,

Buckley P.J., Pass C.L., Prescott K., 1988. Measures of International Competitiveness: A Critical Survey. Journal of Marketing Management 4(2), 175–200.

Chukwuma E.M. (1999): Small business management. Adson Educational Publishers, Onitsha.

Conrad, P. Lyford, H. Christopher, P and James, A.S. (2002). Industry strategic planning: keeping supply chain competitive. *Research in Agricultural and Applied Economics.*

Downey W.D., Erickson S.P. (1987): Agribusiness Management. McGraw Hill Inc., New York. EDADP, 1991. Edo State Agricultural Development Programme. Internal Implementation Completion Report: National Agricultural Technology Support Facility Loan No. 3483-UNI. p 1-4.

ECN & UNDP, (2005). “Renewable Energy Master Plan (REMP),”

Grönroos, C. (2006). On Defining marketing: *finding a new roadmap for marketing. Management theory*, 6 *(4);* 395-417.

Jaworski, B., & Kohli, A. (1993). Market orientation: Antecedents and consequences. *Journal of Marketing, 57*, 53-70. Retrieved from http://dx.doi.org/10.2307/1251854.

Keller, K.L and Kotler, P. (2014). Marketing management, Pearson education limited, England.

Kestin, H. (2006). Market orientation, learning orientation and innovation capabilities in SMEs; An extended model”. *European journal of innovation management, 9(4): P. 396-417.*

Kohli, A., & Jaworski, B. (1990). Market orientation the construct, research propositions, and managerial implications. *Journal of Marketing,* 54, 1-18. http://dx.doi.org/10.2307/1251866

Kumar, A.k, and Sharma. S. (2017). “Recent updates on different methods of pretreatment of lignocellulosic feedstocks: a review,” Bioresour. Bioprocess., vol. 4, no. 1.

Marchet, J.M. Nasir, J. Ramachandra, V. Shah, M.K. Tyler, G & Zhaol (2001). “Results of theNigerian firm survey; regional program on enterprise development, African Region”, The World Bank, Draft for Review.

NAFDAC, (2023). Over 70% Nigerian food exports rejected in foreign countries. https://dailytrust.com/over-70-of-nigerian-foods-rejected-abroad-nafdac/.

Olayide S.O., Heady E.O. (1982): Introduction to agricultural production economics. Ibadan University Press, Ibadan, p. 26–46.

Oluwalana E.O.A., Okuneye P.A., Sokoya G.O. (2004): Micro-credit for agricultural development: a study of women groups in Ogun State, Nigeria. In: Okuneye P.B., Evbuomwan G.O. (eds.): Agribusiness in the African century. *Proceedings of the Africa Farm Management Association,* p. 254–264.

Opeolu B.O., Oluwalana E.O.A. (2004). Environmental health and economic assessment of small and medium scale cassava processing industry in Ogun State, Nigeria. In: Okuneye P.B., Evbuomwan G.O. (eds.): *Agribusiness in the African Century. Proceedings of the African Farm Management Association,* pp. 313–327.

Simonyan, K.J and Fasina. O. (2013) "Biomass resources and bioenergy potentials in Nigeria.," African J. Agric. Res., vol. 8, no. 40, Pp. 4975–4989.

Salih, A. J. (2015). Impact of training and development function on enhancing competitiveness capacity: An Empirical study of Jordanian industrial companies from managers perspective. *Business Management and Strategy* Vol. 6, No.1 Porter, M. E. (1980). Competitive strategy: Techniques for analyzing industries and competitors. NewYork, : free press.

Porter, M. E. (1998). Clusters and the new economics of competition, Harvard Business Review, 76(6), 77 – 90

Rogers, M. (1998). The definition and measurement of innovation. Melbourne, Australia: university of Melbourne, Melbourne Institute.

Schmitz M., De Clercq M., Fidora M., Lauro B., Pinheiro C., 2012. Revisting the Effective Ex- change Rates of the Euro. ECB Occasional Paper 134, European Central Bank, Frank- furt.

Schumpeter J. (1950). Capitalism, Socialism and Democracy. Harper & Row, New York.

Schwab, K. Sala-i-Martin, X. (2013). The Global Competitiveness Report 2013–2014. World Eco- nomic Forum, Geneva.

U.S. Energy Information Administration, (2016). Country Analysis Brief: Nigeria, 2016

Yusuf, M.T. (2018). Opportunities in Nigeria's Bio-fuel Industry. Ambassador of Nigeria to the Federal Republic of Germany at the 12th German-African Energy Forum 2018 Hamburg 24 – 25 April.

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Profitability Analysis of Apple Fruits Marketing in selected Markets in Abuja, Nigeria

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ABSTRACT

The study analyzed profitability of apple fruits marketing in selected markets in Abuja, Nigeria. The study described the socio-economic characteristics of respondents, examined market structure, estimated costs and returns, determined factors affecting their profitability and identified constraints faced by them. A purposive sampling technique was adopted in selecting 120 respondents. The data were analyzed using descriptive statistics, gini coefficient, gross margin analysis, multiple regression analysis and factor analysis. The results revealed that most (76.67%) of the respondents were male with a mean age of 39 years. Majority (83.33%) of the respondents were married with average of 6 members/ household. The result revealed that the market structure tends toward perfect competition market (0.798). The results also revealed a gross margin of ₦4,240.19 per carton (45kg) while the benefit cost ratio was 1.20. Level of education and marketing experience were the determinants of apple fruit profitability in the area. Furthermore, poor pricing (0.5260), perishability (0.6106), inadequate extension services (0.9395) were the constraints facing the respondents. Thus, apple fruit marketing was profitable business in the area. Therefore, more women should be encouraged to join the business, while those already in the business should collaborate to generate fund to purchase storage and transport facilities.

Keywords: Determinants, Constraints, Costs, Returns, Marketers

Introduction

Apple fruits (Malus domestica) is a nutritious fruit which offers multiple health benefits to humans. It is rich in dietary phytochemicals such as flavonoids which are necessary for optimal health (Ferretti *et al.,*2014) . The antioxidants in apple have many health promoting and disease prevention properties. Over hundred (100) varieties of apples are grown in North America and there are different varieties which are a bit bigger than the size of a cherry to as big as the size of a grape fruit. Dietary fibres are found in the skin and core apple. It is consumed by humans and it is rich in nutrients with significant bioactive compounds (Bastein *et al*., 2022). There are many who delight in apple fruit consumption

(Abdullahi *et al*., (2017). In Nigeria, apple hardly grows because it requires cold weather for optimal growth and production, but cold region in Nigeria, such as Jos, Mambila and Obudu Plateau support it growth. According to Kughur *et al.* (2015), fruits and vegetable production are cultivated in some specific locations in Nigeria and are prominent in Plateau and Kaduna States from where supply are made to local markets and neighboring States of the country such as Lagos State, Oyo State, Abuja and other States. Apple, strawberries, grapes and others are the temperate fruits whose demand are on the increase as postulated by Osadebamwen *et al. (*2022). However, to an average Nigerian, the cost of apple fruit is highly expensive and this actually restricts its consumption coupled with poor attitude of many Nigerians toward fruit consumption Belewu *et al* (2020). The health benefit and change in orientation of many, especially among the elites is making apple fruit a prominent business among fruit sellers.

The land area where apple was cultivated globally was 4,904,305 ha with total production output of 86,142,197 tons in 2018 (FAO, 2020). FAO (2020), also stated that China is the greatest apple producer in the world with over 39.2 million tons production volume. According to Shah (2020), apple farmers sell their products directly to middlemen (assemblers, wholesalers and retailers) who eventually sell apple fruits to the ultimate consumers. Agricultural commodities marketers usually operate within and without their geographical areas. Apple fruit are among fruit crops that are exported and imported across nations of the world.

Natalia and Harvey (2021) stated that the awareness of consumption of healthy food, increased income and population growth, especially in urban area resulting into global demand for fruits, where the second position goes to apple, necessitate efficient and profitable marketing. In Nigeria, the efficiency of fruits and vegetables marketing has been a great concern as observed by Kughur *et al.* (2015).

However, agricultural marketing helps in sustaining produce/ product in the market due to the prevalence of open competition both in the present global and liberal world (Ibeawuchi *et al.,* 2015). Apple fruit production is beneficial in agriculture and food markets due to its health benefits aside its social and economic benefits (Senchi and Malami 2015). Many studies have been conducted on apple fruit by several authors (Abdullahi *et al* (2017), 2015; Muraki *et al.,* 2013) and few others like Abdullahi *et al*. (2017) and Belewu *et al*. (2020) in other parts of Nigeria. Other authors (Ojo *et al*, 2016 and Ajibade *et al*, 2021) have conducted studies on tomato fruit, but paucity information exists, especially, on apple fruit . Therefore, the focus of this study is on analysis of profitability of apple fruits marketing in Abuja, Nigeria. The specific objectives of the study were meant to describe the socio-economic characteristics of apple fruit marketers, examine the structure of apple fruit market in the study area, estimate apple fruit marketers' costs and returns, identify factors that determine apple fruit profitability and identify constraints faced by apple fruit marketers in the study area.

Methodology

Study Area

The study was conducted in Abuja, Nigeria with an estimated population of 2.5 million. Abuja is the 4th biggest metropolitan population after Lagos, Kano and Ibadan in Nigeria. It consists of six area councils with total land area of approximately 7.290 km^2. The climate is tropical with mostly warm weather coupled with normal bright sunny days. Abuja being the Federal Capital Territory of Nigeria is blessed with markets where various commodities are sold. Due to its urbanization fruits marketing especially apple fruit and others are common in some of the markets within Abuja metropolis which many elites preferred to junks.

Sampling technique

Purposive sampling technique was used to select respondents from three main markets in Abuja (Zuba Market, Wuse market, and Deidei market), based on high level of involvement in fruits and vegetables

marketing. One hundred and twenty respondents were randomly selected across the three markets with respect to the lists of apple fruit marketers obtained from their associations.

The study used a well-structured questionnaire coupled with personal interview as an instrument for collection of primary data from the respondents. The analytical tools employed in the study were descriptive statistics, gini coefficient, gross margin analysis, multiple regression and factor analysis

Gini- coefficient.

The Gini-coefficient is a measure of statistical dispersion most prominently used as ameasure to show the degree of income distribution or inequality of wealth distribution between different households in a population (Ehinomowo, *et al.,* 2017). According to IMA (2008), Gini-coefficient is defined as a ratio with values between zero and one (0 - 1). A low Gini-coefficient indicates more equal income or wealth distribution, while a high Gini-coefficient indicates more unequal distribution. Zero (0) corresponds to perfect equality while one (1) corresponds to perfect inequality.

Gini Coefficient is mathematically represented

$G.C. = 1 - \sum XY$

Where; G.C. = Gini-coefficient, and

$\sum XY$ = the summation of cumulative proportion of the apple fruits marketers (X) and the cumulative proportion of their sales earnings (Y).

Gross Margin Model Specification

Gross margin shows the difference between total revenue (TR) and the total variable cost (TVC). Gross margin analysis was used as proxy for apple fruit profitability. it is the best method in profitability analysis due to its accuracy and simplicity (Konsoga, 2018)

$GM = TR - TVC$ (i)

$Profit\ (\pi) = TR - TC$ (ii)

$TC = TFC + TVC$ (iii)

Benefit Cost Ratio of the respondents was calculated using the following formular

$$Benefit\ Cost\ Ratio\ (BCR) = \frac{TR}{TC} \quad \text{(iv)}$$

Where;

GM = Gross Margin (₦ / 45kg)

TR = Total Revenue (₦ / 45kg)

TVC = Total Variable Costs (₦ / 45kg)

TC = Total Costs (₦ / 45kg)

Multiple Regression Analysis

It is a statistical tool used for estimating the relationship among variables with reasons and results for relationship. Multiple regression model has one dependent and many independent variables. This study determined the factors affecting profitability of apple fruit marketers following empirical studies of Luroczy and Liviu (2012) , Nguyen and Nguyen (2020) and others . The model was specified as follows:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + e_t \quad \text{(v)}$$

Where;

Y = Average Return (₦)

X_1 = Age of marketers (years)

X_2 = Household size (numbers)
X_3 = Education level (number of schooling years)
X_4 = Marketing experience (years)
X_5 = Transportation cost (₦)
X_6 = Access to credit (1=Yes; 0=otherwise)
X_7 = Co-operative society (1 = member, 0 = non-member)
a = constant intercept
b_1= the coefficient corresponding to X_1… X_9
e_t = error term

Factor *Analysis*

The possible constraints confronting apple fruit marketing was captured using factor analysis.

Factor analysis is a method for investigating whether a number of interests C_1, C_2, C_3, C_4 are linearly related to a smaller number of unobservable factors F_1, F_2, F_3, F_4 Equamax with Kaiser Normalization was the rotation method used to examine constraints confronting marketing of apple fruits following the study of Ali *et al (*2013). It is mathematically represented as;

$C_1 = \beta_{10} + \beta_{11}F_1 + \beta_{12}F_2 + e_1$ vi
$C_2 = \beta_{20} + \beta_{21}F_1 + \beta_{22}F_2 + e_2$ vii
$C_3 = \beta_{30} + \beta_{31}F_1 + \beta_{32}F_2 + e_3$ viii
$C_4 = \beta_{40} + \beta_{41}F_1 + \beta_{42}F_2 + e_4$ ix

Where:
C_1 toC_4 are unknown factors or component
β_{10} to β_{42}-Factor loadings
e_1 to e_4 - error variance

Results and Discussion

The results in Table 1, showed the socio-economic characteristics of respondents. Majority (76.67%) of the respondents who engaged in apple fruit marketing were male. The implication is that the apple fruit marketing was a business majorly embraced by men, who have the ability to on-load and off-load apple fruits especially in carton. Also, apple fruit could be a business mostly engaged in by men because it does not requires further processing apart from cleaning and little or no packaging before marketing, which can easily be done by men. This result agrees with the findings of Naqash *et al.* (2017), who ascertained the dominance of men in apple production in Kashmir Valley of Jammu & Kashmir state, India. The study also showed that the respondents' mean age was 39years. This implies that the respondents were still active to carry out most marketing activities required in apple fruit enterprises. Belewu *et al* (2020) also reported 35.5years as the mean age of apple fruit sellers in some selected markets in Lagos State, Nigeria. This study also revealed that most (83.33%) of the apple fruit marketers were married, while others were either single, separated and widow. The implication of the findings is that the apple fruit marketers were responsible, dedicated and committed to caring for their family members. Since marriage confers responsibility to an individual, the apple fruit marketing could serve as a source of income for the family. The findings of Belewu *et al.* (2020) affirmed high percentage of married respondents among apple fruit sellers in selected markets in Lagos State. Pavlović *et al.* (2020) findings also discovered more (90%) married respondents. The results in Table 1, showed also that over 86% of the apple fruit marketers were formally educated. The results indicated that the respondents were well informed and were fully informed on the health benefit of apple fruits and are ready to engage in such enterprise that would enhance wellness of their customers profitably. Also, their exposure educationally would help them to adapt and adopt new marketing strategies that will enhance their efficiency in their business. In addition, the educational composition of the respondents is a clear indication that they were knowledgeable enough to provide reasonable answers to issues related to apple fruits marketing. The study agrees with the findings of Pavlović *et al.* (2020), where they asserted high level of their respondents. The mean household size in this study is 6 persons. This implies that members of the household who were within the reach of the marketers could be of

help in apple fruit related activities marketing. Thus, the respondents household is not too big but moderate and the marketers may have less distraction from family tie. The study is almost similar to the findings of Reshi *et al.* (2010) in which they reported an household size of not more than 5 members. This study discovered that apple fruit marketers in the study area have been in the business for an average of eleven (11) years. The implication is that the apple fruit marketers are highly experienced and this made them to remain in the business because it is profitable and viable, since no one will continue investing in an unprofitable venture and the more years they spent in the business the better their performance and more market entry opportunities could be discovered. Majority (70.8.3%) of the respondents sourced fund or capital from their personal savings and re-invested their profit from precious sales to their business, while others borrowed from cooperatives and less than 5% got loan from bank. This implies that the respondents may not be able to expand the size and scope of their business beyond their means, since they probably lack collateral security for bank loan or probably they didn't desire operating beyond small to medium scale. The results is in line with the findings of Ajani (2007), who asserted that personal savings, cooperative societies and friends were the sources of capital for the start-up of fruit and vegetable business, which have the tendencies to impede their business expansion. Majority (94.17%) of the respondents had no access to extension services, no wonder they recorded high perishability of their products, since they have little or no knowledge on modern way of apple fruit preservation and other necessary marketing information on their venture. The results further showed that majority (92.50%) of them were members of cooperative, it is obvious that the society is benefitting the marketers in one way or the other, no wonder almost every apple fruit marketer was a member. Thus, large number of apple fruits marketers being a member of cooperative society could be attributed to the benefit enjoyed such as access to credits facilities, access to first-hand information among others. The provision of credits by the cooperatives could drive development among farmers (Kehinde and Ogundeji, 2022). Thus, membership of cooperative could enhance better performance than non-membership due to economies of scale.

Table 1: Socio-economic Characteristics of Apple Fruit Marketers

Variables	Percentage(n=120)	Mean
Sex		
Female	23.33	
Male	76.67	Male
Total	100	
Age		
20-40	63.33	
41-60	35.00	39 years
61-80	1.67	
Total	100	
Marital status		
Single	8.33	
Married	83.33	Married
Separated	6.67	
Divorced	1.67	
Total	100	
Education		
No formal education	5.83	
Primary education	7.50	
Secondary education	56.67	Secondary education
Tertiary education	30.00	
Total	100	
Household size		
1-5	41.67	
6-10	50.67	
11-15	6.66	6 persons
Total	100	
Marketing experience		
1-10	56.67	
11-20	34.17	
21-30	7.50	11 years
31-40	0.83	
41-50	0.83	
Total	100	
Source of credit		
Bank loan	3.3	
Personal savings	58.3	Personal savings
Cooperatives	25.8	
Profit investment	12.5	
Total	100	
Extension Service		
Access to extension service	5.83	
No access to extension service	94.17	No access
Total	100	
Cooperative society		
Non-member	7.50	
Member	92.50	Member
Total	100	

Source: Field survey, 2022

Structure of Apple Fruit Market

The results in Table 2 showed that the Gini Coefficient was 0.798, which was close to one (1). It implies that there were very high variation of sales and revenue generated among the respondents because the value was approximately one which reflects unequal distribution value. Thus, the market is tending towards a competitive or perfect market structure which is characterized by large number of buyers and large number of sellers. The results also revealed a significant inequality in income distribution among the respondents. This further indicated that the concentration of apple fruit marketing is in the hand of few apple fruit marketers due to their high level of income.

Table 2: Market structure for apple fruits marketing

Sales (weekly)	No. of Sellers	Prop of Sellers (x)	Cumm. Freq.	Total Sales	Prop. Of Sale (y)	Cumm Prop of Sales	Xy
1000 – 10,000	16	0.133	16	90,950	0.027	90950	0.004
11,000 – 20,000	23	0.192	39	401,500	0.121	492450	0.023
21,000 – 30,000	41	0.342	80	1,050,000	0.316	1542450	0.108
31,000 – 40,000	22	0.183	102	814,000	0.245	2356450	0.045
41,000 – 50,000	12	0.100	114	585,500	0.176	2941950	0.018
51,000 – 60,000	02	0.017	116	120,000	0.036	3061950	0.001
61,000 – 70,000	04	0.033	120	260,000	0.078	3321950	0.003
Total	120			3,321,950			0.202

Source: Field Survey, 2022

GC = 1 – ΣXY

= 1 – 0.202 = **0.798**

Costs and Returns of Apple Fruits Marketing

The results in Table 3 revealed the average return from apple fruit marketing as ₦24, 030.83 per carton. The average variable cost incurred by the apple fruit marketers was ₦19, 979.17 per carton. The Gross margin was ₦ 4,240.19 per carton, while the profit was ₦4, 051.66 per carton. Apple fruit marketers were able to recover the variable costs invested into the business, thus, it is possible to continue the business in the short run (Senchi and Malami, 2015). The profitability ratio estimated revealed 1.20 as the benefit cost ratio (BCR), which implies that 20 kobo accrued to the apple fruit marketer on every one naira invested into the business. Therefore, the results corroborate with the findings of Belewu *et al.* (2020) in their study on market analysis of apple fruit in selected markets of Lagos State, Nigeria.

Table 3: Average Costs and Returns of Apple Fruit Marketing per Carton (45kg)

Items	**Value (₦)**
A. Return	24,030.83
Variables Costs	
Purchase	17,779.17
Transportation	822.59
Loading	82.76
Offloading	67.75
Levy	19.72
Polythene bag	161.37
Labour	857.28
B. Total Variable Costs, TVC	**19,790.64**
C. Gross Margin, GM = A – B	4,240.19
D. Depreciation on fixed items	188.53
E. Total Costs, TC = B + D	**19,979.17**
F. Profit = A – E	4,051.66
G. Benefit Costs Ratio, BCR = A/E	1.20

Source: Field Survey, 2022

Determinants of Apple Fruits Profitability

The results in Table 4 shows that the adjusted R^2 value of 0.6924 indicated that 69.24% of the variation in the average return accrued to apple fruit marketers were as a result of the effects of all the explanatory variables (transportation cost, household size, education, marketing experience, age and membership of cooperatives) while 30.76 % unexplained may be embedded in the error term. The results show that apple fruit marketers' level of education and experience in apple fruit marketing were the determinants of their average return which were significant at 1%. Thus, education would enhance better performance of the respondents in terms of getting new market information, quick discovery of the customers' apple fruit varieties preference, new entry to other markets, quick link to elites who could demand home/office delivery of apple fruits and many more. Also, years of experience in apple fruit marketing could increase marketers' skills with its multiplier effect on higher return. It is a common knowledge that no one will remain in an unprofitable venture for a long period of time (Ajani, 2007).

Table 4: Determinants of Apple Fruits Profitability

Variables	Coefficient	Standard error	T	P> | t |
Transportation cost	-0.000994	0.0022714	-0.44	0.663
Household size	0.000045	0.000117	0.38	0.701
Education	0.5744486	0.0516706	11.12	0.000***
Marketing experience	0.4630999	0.1491957	3.10	0.002***
Age	0.1010807	0.1056696	0.96	0.341
Cooperative	0.537225	0.5735535	0.09	0.926
Constant	-17.93092	3.609954	-4.97	0.000***
Number of obs	= 120			
F (7, 112)	= 39.27			
Prob > F	= 0.0000			
R^2	= 0.7105			
Adjusted R^2	= 0.6924			
Root ME	= 4.4973			

Source: Field survey, 2022

Note: *** = Significant at 1%

Constraints Confronting Apple Fruits Marketers

The results in Table 5 identified the constraints facing apple fruit marketers in the study area. These include poor pricing (0.5260), perishability (0.6106), inadequate extension services (0.9395), inadequate technical know-how on packaging and preservation (0.6222), lack of credit facilities (0.5400),poor transportation system (0.8932) and lack of storage facilities (0.5112). These were classified as marketing, institutional, economic and infrastructural factors respectively. The perishable nature of the product in most cases has forced the marketers to offer their apple fruits to buyers at low prices. Inadequate extension services, inadequate technical-know-how on packaging and preservation were the institutional factor affecting apple fruit marketing in the study area. Inadequate credit facility was an economic factor that constrained apple fruit marketing. The study deduced that apple fruits marketers do not have adequate access to capital to expand their business ventures. This affirms the Kaka *et al*. (2020) findings, which postulated access to credit as a constraint to marketers. Poor transportation system and lack of storage facilities were the institutional factor that affected apple fruit marketing in the study area. This denotes poor transport facilities in the study area, thus, placing marketers at a disadvantage when buying and selling apple fruits leading to increase transportation costs. The resultant effect will lead to increase marketing costs which will eventually lower marketers' total revenue and profit. Poor transport facilities could lead to produce losses as a result of perishable and bulky nature of apple especially if the commodity is going to be transported to distance place (Al-Dairi et al., 2021; Okwuokenye and Onemolease, 2011). In addition, inadequate storage facilities were rated as serious constraint facing apple fruits marketing in the area. This may bring about considerable losses of apple fruits which invariably may reduce marketers' profit (Mohammed *et al*, 2021).

Table 5: Constraints Confronting Apple Fruits Marketers

Constraint	Mkt. 1	Inst. 2	Eco. 3	Infra. 4
Inadequate source of information	-0.0996	0.0217	0.1121	-0.0240
Lack of credit facilities	0.1337	0.3208	0.5400	0.1763
Poor marketing	-0.0591	0.2083	0.2896	-0.1981
High cost of Packaging materials	0.2132	0.3066	-0.6308	0.2368
Poor transportation system	0.2014	-0.2116	0.0107	0.8932
Lack of storage facilities	-0.0022	0.3321	-0.0438	0.5112
Lack of processing technology	0.0667	0.3032	0.1032	0.2092
Inadequate extension services	-0.2440	0.9395	0.0731	0.0643
Availability of many retailers	0.2789	0.3853	-0.6165	-0.1990
Labour shortage	0.1038	0.0676	-0.0527	-0.2514
Inadequate technical know-how on packaging and preservation	-0.0827	0.6222	0.1625	-0.0611
Poor Communication facilities	0.1604	0.0815	-0.0144	-0.0315
Poor pricing	0.5260	0.4215	0.3447	-0.1831
Seasonality	-0.0045	0.3531	-0.1384	0.4582
Bulky nature of fruits	0.0242	0.2618	-0.1695	0.3894
Theft and pilfering	0.1618	0.3173	0.1325	-0.4424
Perishability	0.6106	0.3946	0.2841	0.1574
Low patronage	0.0121	0.2614	-0.0241	-0.0685
Losses resulting from fruits spoilage	0.2027	0.1578	0.2841	-0.0116
The packaging material is not of standard quality	0.3042	0.2281	0.0752	-0.0640
Losses resulting from pests attack	0.0714	0.3589	0.3962	-0.0320

Source: Field survey, 2022

Note:

Mkt.(1) = Marketing Factor, Inst.(2) = Institutional Factor, Econ.(3) = Economic Factor, Infra. (4)= Infrastructural Factor

Conclusion and Recommendation

Men dominate apple fruit markets with few women in Abuja metropolis. They were majorly responsible married individuals with few single, divorced and separated individuals.. Apple fruit marketers in Abuja metropolis were well educated ranging from primary to tertiary level. Apple fruit marketing was a profitable business in the study area. Educational status and marketing experience were the determinants of apple fruits marketers' profitability. The constraints facing apple fruit marketing were poor pricing and perishability (marketing factors), inadequate technical-know-how on packaging and preservation (institutional factors), lack of credit facilities (economic factor), poor transportation system and lack of storage facilities (infrastructural factors). Therefore, apple fruit marketers in the study area should also collaborate to purchase adequate transportation and good storage facilities, visit the extension agents to learn modern ways of preserving and prolonging apple fruit shelf life. They should endeavor to buy apple fruits in bulk as a group to reduce transportation costs and other associated problems. Women should be encouraged to engage in the sales of apple fruits in the study area.

References

Abate, T.M., Mekie, T.M. and Dessie, A.B. (2019). Determinants of marketing outlet choices by smallholder Teff farmers in Dera District, south Gonder Zone, Amhara National Regional State, Ethopia: a multivariate Probit approach. Journal of Economic Structures, 8:39.https:doi.org/10.1186/s40008-019-0167-x.

Abdullahi, A., Ja'afar-Furo, M.R. & Yahya, H. (2017). Analysis of socio-economic determinants of apple fruits (Chrsophyllum Albidum) Demand among consumers in Mubi metropolis, Adamawa State, Nigeria. international Journal of social sciences, 3(3):61-67. doi: 10.23918/ ijsses.v3:3p61.

Ajani, O. I. (2007), Economic analysis of the marketing of fruit inLagos State of Nigeria (A case study of Oyingbo, Oshodi andIkotun markets). *Nigerian Journal of Horticultural Science,* 10(1): 38-46. Doi.10.4.3314/njhs.vioi1.3407

Ajibade, Y.E., Oyibo, F.O., Ameh, O.E. and Enimola, M.O. (2021), Analysis of gender roles in tomato production in Municipal Area Council, Abuja, Nigeria. journal of Agricultural Science and Practice, 6(1): 1-12. https//doi.org/10.31248/JASP2020.237.

Al-Dairi, M., Pathere, P.B. and Alyahyai, R. (2021). Effect of post harvest transport & storage on color and firmness quality of tomato. Horticulturae 2021,7,163. https>//doi.org//10.3390/horticulturae7070163.

Ali, A.J., Hooman, D.M., Mirza, H.H. and Zanol, A.R. (2013). Afactor analysis of identifying the customer behavior pattern: A case study of Tehran. European online Journal of Natural and Social sciences, 2(3): 1347-1353.www.european-science.com.

Aliyu, A., Shelleng, B.A., Hadddeb, A.S. and Abubakar, A. (2020). Analysis of fresh tomato marketing in Mubi metropolitan Area, Adamawa State. International Journal of Science Academic Research,1(3):067-081.https://www.scienceijsar.com

Bateuen, V.M., Marie Verheyde, Sonia Ponerleau, Alan Doyen and Charles Couillard (2022). Health benefits of apple juice consumption: A review of international trials in humans nutrients, 2022.14.821.http://doi.org//10.3390/nu14040821.

Belewu, K.Y., Akinsola,ag.o., Osasona, K.K., Baba, H.S. and Adisa, Q.B. (2020). Market Analysis of apple fruit in selected markets of Lagos State, Nigeria. International Journal of Agriculture

and Rural Development, 23(2):5255-5264. https:uilspace.unilorin.edu.ng/handle/20.500.12484/6942

Ferretti, G. Turco, J., Bacchetti, T. (2014). Apples as a source of dietary phytonutrients, bioavailability and evidence of protective effects against human cardiovascular disease. A food and Nutrition Science. 5 :1234-1246. http://dx.doi.org/10.4236/fns.2014.513134

Ishfaq, A.S. (2020). An analysis on marketing problems of apple fruit growers in Jammu and Kashmir. Journal of Postharvest Technology, 08(2), 43-53. www.jpht.in

Kaka, Y., Sahabi, H., Auwal, A.G. and Umar, H.S. (2020). Analysis cowpea (Virgna unguiculata) marketing and price trends in selected markets of Argungu Local Government Area, Nigeria. Equity Journal of Science and Technology,7(2):125-130. www.equijost.com

Kasonga, F.C. (2018). Gross margin analysis of irrigated beans: A case of Khosolo Extension Planning Areas. Adv. Crop Science Tech.,6:402.doi:10.47172/2329-8863.1000402.

Kehinde, A.A. and Ogundeji, A.A. (2022). The simultaneous impact of access to credit and cooperative services on cocoa production in South- western, Nigeria. hhtps//doi.org/10.1186/s40066-021-0035-4.

Kughur, P.G., Iornenge, G.M., Ityonongu, B.E. (2015). Effects ofpost-harvest losses on selected fruits and vegetables among smallscale farmers in Gboko local government area of Benue State,Nigeria. *International Journal of Innovation. Scientific Research.* 19(1): 201-208.https://www.ijisr.issr-journals.org/

Mohammed, S.Y., Onwuarah, A.S., Panwal, e.f. and Iroegbute, U.K.(2021). Assessing the marketing channels of sweet melon and water melon in Bauchi and Gombe States, Nigeria. Dutse Journall of Pure and Applied Sciences (DUJOPAS), 7(1): 288-297. https://fud.edu.ng.2021_MAR_Vol_7_Issue_1PDF

Mosisa, C.A (2018). Constraints, Challenges andOpportunities of Horticultural Crops Marketing in Ambo Town,Ethiopia. *International Journal of Innovative Research and Development*, 7(5):29-35. https://doi.org/10.24940/2018/v7/i5/APR8030

Muraki, I., Imamura, F., Manson, J.E., Hu, F.B., Willett, W.C. Dam, R.M and SunQ (2013). Fruit consumption and risk of type 2 diabetes: Results from three prospective longitudinal cohort studies. BMJ, 2013 August 28:347:f5001. doi:10.1136/bmj.f5001

Natalia, V., and Harvey, J. (2021). Product and trade patterns in the world apple market. Journal of innovative marketing, 17(1): 16-25. doi:10.21511/im.17(1).2021.02.

Nguyen,T.N.L and Nguyen, V.C. (2020).determinant of profitability in listed enterprises: A study from Vietnamese stock exchange. Journal of Asian Finance, Economics and Business, 17(1):47-58.10.13106/jafeb.2020.v17.no1.47

Ojo, A.O.,Mustapha, A.and Ojo, M.A. Nigerian Journal of Scientific Research, 15 (2): 2016; May-August; njsr.abu.edu.ng.

Okwuokenye,G.F and Onemolease,, E.A. (2011). Influence of socio-economic characteristics of yam sellers on marketing margin among yam wholesalers in Delta State, Nigeria. Journal of Agricu)ture and Social Research (JASR),11(1):81-90. https://www.ajol.info>jasr>article>view.

Osadebanwen, U.G., Adekoya, A.E. and Akintunde, E.A. (2022). Baseline study of growers constraints in the production of apple(Malus domestica) in Plateau State, Ngeria. https: //doi.org/10.1186/s40066-022-00354-9

Pavlović M., Radoičić, J. and Milanović M. (2020). Profitability Analysis of Apple Production in the Republic of Serbia. Journal of Economics of Agriculture, 7(3), 817-830. https://doi.org/10.5937/ekopolj2003817P.

Reshi, M. I., Malik, M. A., & Vijay, K. (2010). Assessment of problems and prospects of apple production and marketing in Kashmir valley, India. Journal of Environmental Research and Development, 4(4), 1077-1082. https://www.jerad.org.

Senchi, A.A. and Malami, A.A. (2015). Profitability of non-timber forest product (NTFPS) production and marketing in Zuru Local Government Area, Kebbi State. A case for honey. Journal of sustainable Agricultural Research, 2 (2): Doi:https://doi.org/10.18488/journal.70/2015.2.2/70.2.55.65.

Shah, I. A. (2020). An analysis on marketing problems of apple fruit growers in Jammu and Kashmir. Journal of Postharvest Technology, 08(2), 43-53. www.jpht.in

Turocz, Z, Liviu. M. (2012). Enmerging markets queries in finance and business. multiple regression analysis of performance indicators in the ceramic industry. Procedia Economics and Finance, 3 (2012); 509-514.doi:10.1016/52212-5171(12)00188-8.

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Climate-related Shocks and Management Strategies among Crop Farmers in Ogun State,

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Abstract

An understanding of the management strategies adopted by farmers in dealing with climate-related shocks and factors affecting the choice of such strategies are crucial for designing actions that would enhance food systems performance (including farmers' competitiveness) in Nigeria. Consequently, the study examined the climate-related shocks experienced, the management (response) strategies employed, and factors influencing choice of the strategies among crop farmers in Ogun State. Data collected by means of a questionnaire from 240 crop farmers selected through a multistage sampling procedure were used for analysis. Descriptive statistics and multivariate probit regression were the tools for data analysis. Considerable (above 39%) of the farmers reported they have experienced prolonged low rainfall that resulted in drier than usual soil conditions, pest and disease attacks, and reduced yield (crop loss) attributable to climatic shocks. More than 65% of the farmers adopted planting of improved crop varieties, soil and water conservation mechanisms, and use of inorganic fertilizer to manage the adverse effect of climatic-related shocks and raise productivity. Over 50% also diversified into non-farm businesses. While cooperative membership enhanced the likelihood of planting improved crop varieties, and use of soil and water conservation mechanisms, contact with extension agents lowers the chance of using inorganic fertilizer and diversification into non-farm enterprises. Hence, efforts to promote agricultural extension services and participation in cooperatives are suggested, among others, to stimulate the adoption of strategies that will enhance crop productivity, abbreviate movement away from the farm sector, reduce farmers' vulnerability to climatic shocks (especially drought spells) and enhance competitiveness and food systems sustainability.

Introduction

Agriculture in Sub-Saharan Africa is highly dependent on climate conditions, especially rainfall. Due to this high level of reliance on rain-fed agriculture, farmers are more likely to become victims of climate change when it occurs. Sub-Saharan African countries, such as Nigeria, have suffered seasonal and yearly unpredictability in rainfall and temperature in recent years, leading to a number of negative effects on the agricultural sector's sustainability (Sousa *et al*., 2018). Consequently, agricultural production suffers leading to a decrease in food supply and a rise in poverty. One of the crucial factors which have threatened the agricultural sector for decades is climate change and the sector is more sensitive to climatic conditions (Menikea and Keeragala, 2016). There is a global increase in the risk of instability in rainfall, temperature, and other climate parameters as a result of natural hazards caused by climate change. The consequences of climate change are real and are being felt globally, with poor rural households in developing countries bearing the brunt of the burden (Asfaw *et al*., 2018; Omerkhil *et al*., 2020).

Having a great impact on different aspects of domestic life, agricultural productivity, and food security, climate change has been a continuous threat to global economic development (Bakht *et al*., 2020). As climate change offers a terrible danger to rural areas where agricultural production is largely practiced by smallholder farmers who rely heavily on rainfall for water, sustaining rural households' food security in the face of climate change becomes a critical challenge (Shisanya *et al*., 2016). The vulnerability of smallholder farmers to climate change effects is intense due to their reliance on rain-fed agriculture, insufficient access to land, high poverty, and poor education levels, limited access to extension training, and lack of financial support to adopt adaptive measures (Harvey *et al*., 2018). In order to mitigate the risks and eliminate the negative effects of climate change on agricultural production and food security, a study that focuses on understanding the factors that influence smallholder farmers' decision to adopt climate change management strategies is important (Wiebe *et al.,* 2019; Ojo *et al*., 2021). Farmers who respond to climate change through various management measures are more likely to boost agricultural productivity and improve their livelihood (Fadina *et al*., 2018), food security, and household welfare (Kogo *et al.*, 2021).

The adverse impacts of climate change have been significantly reduced by adaptation strategies such as planting of improved crop variety and early maturing crops and agrochemical application, livelihood diversification, among others, leading to increased smallholder farmers' net income and improved farmers' food security (Asare-Nuamah *et al*., 2020; Ojo and Baiyegunhi 2020). Response strategies can also involve mixed cropping, mono-cropping, water and soil conservation practices, livestock rearing, application of agrochemicals, varying land size, mulching, and sales of crops, among others (Asfaw *et al*., 2018). Through appropriate strategies, the vulnerability of the agricultural sector to climate change can be greatly reduced (Gbetibouo, 2009; Below *et al*., 2012).

Although a number of empirical studies have assessed farmers' strategies for addressing the negative consequences of changing climatic conditions in many parts of the world (Donkor *et al*., 2018; Asfaw *et al*., 2019; Soglo and Nonvide, 2019) and/or related drivers such as education and extension visits (Adeagbo *et al*., 2021), among others, the dynamic context climatic change, and its implications for farm production, food security require frequent investigation of the strategies being adopted to deal with the associated shocks (negative consequences) and factors influencing the choice of such strategies. This is very important especially in order to offer up to date evidence-based interventions/actions that could be sensitively guided to enhance food security, reduce vulnerability to climate shocks, and robust performance of the food systems. The above highlighted concerns provide the motivation for farmer's response to climate-related shocks experienced and their determinants in Ogun State where limited empirical documents on drivers of choice have been underexplored.

Methodology

Study Area

Ogun State is located in the Southwest corner of Nigeria and was created in 1976. It is located within latitudes 3°30'N - 4°30'N and longitudes 6°30'E-7°30'E. The state covers a land area of 16,762 square kilometres with a population of 3,728,098 in 2006. The climate of the state follows a tropical pattern with the rainy season starting around March and ending in October, followed by the dry season. The mean annual rainfall varies from 1,050 mm in the northern areas which has derived savanna vegetation to 1,280 mm in the southern parts of the state which has mangrove swamp vegetation. The average monthly temperature ranges from 23°C in July to 32°C in February. The state has fertile soil that supports the growth of rice, cowpea, yam, cassava, plantation, banana, citrus, vegetables, cocoa, kola nut, rubber, oil palm and sugarcane. Some farmers in the state also engage in livestock production such as poultry, cattle, goat and sheep.

Sampling Procedure

The multi-stage sampling procedure was employed in selecting 252 farming households from two Agricultural Development Program (ADP) zones out of the four (4) zones of Ogun State Agricultural Development Program (OGADEP). The first stage involved the selection of the two largest zones out

of the four zones of the Ogun State Agricultural Development Program (OGADEP). Thus, Egba and Ijebu were selected from the four (Egba, Ijebu, Ikenne and Ilaro) OGADEP zones. The second stage involved simple random sampling of 50.0% of the blocks in each of the selected zones since they have the same number of blocks (i.e. 6 blocks each). The selected blocks from the Egba zone were Opeji, Ilugun, and Ilewo while Isoyin, Ago-Iwoye, and Ijebu-Ife were selected from the Ijebu zone. The third stage involved a proportional sampling of cells from selected zones based on the number of cells in each zone. This involved the selection of one cell from Ago-Iwoye (Ago-Iwoye); two cells each from Ilewo (Obada-Oko and Ishaga-Orile), Opeji (Alabata and Opeji), Isoyin (Isoyin and Ijebu-Ode) and Ijebu-Ife (Ijebu-Ife and Itele) while three cells were selected from Ilugun (Odeda, Olodo, and Osiele). This gives a total of twelve (12) cells. At the final stage, using convenience sampling, twenty-one (21) arable crop farmers were selected from each of the selected cells to make a total of 252 farmers. However, 12 observations could not be used for analysis and were removed, leaving a total of 240 for the analysis.

Data Collection

The data were collected using a semi-structured questionnaire on the socio-economic characteristics of arable crop farmers, climatic shocks experienced by farmers in the past 5 years based on their perception, and the management strategies employed to the climate shocks experienced.

Analytical Techniques

Descriptive statistics (mean, frequency, and percentages) were used to summarize data on management strategies and climatic shocks while a multivariate probit regression model was employed to examine socioeconomic drivers of the management strategies.

Econometric Model

Following Lin *et al*. (2005), the multivariate probit regression model specified for this study is characterized by a set of '*m'* binary dependent variables Y_{hpj} such that:

$$Y^*_{hpj} = X'_{hpj}\beta_j + U_{hpj} \quad j = 1,2,\dots m \ \ and \tag{1}$$

$$Y_{hp} = \begin{cases} 1 \ if \ Y^*_{hpj} > 0 \\ 0 \ otherwise \end{cases} \tag{2}$$

Where j=1, 2 …m denotes the climatic shocks related management strategies available; X'_{hpj} is a vector of explanatory variables, β_j denotes the vector of the parameter to be estimated, and U_{hpj} are random error terms distributed as a multivariate normal distribution with mean value of zero and unitary variance. It is assumed that a rational h^{th} farmer has a latent variable, Y^*_{hpj} which captures the unobserved preferences for the choice of management strategy. Y_{hpj} is the observed choice which indicates whether or not a household adopts a specific climate change management strategy. The adopted strategies include (1) planting of improved crop varieties (pest and disease-resistant and drought-tolerant crops) (2) soil and water conservation related strategies which include avoiding eroded and erosion-prone areas for farming, making of ridges across farmland to avoid the effects of soil erosion, and increased mulching to conserve soil moisture, (3) use of inorganic fertilizer to raise boost crop production and (4) non-farm enterprise diversification. Since the adoption of several management strategies is possible, the error terms in equation (1) are assumed to jointly follow a multivariate normal distribution, with zero mean value and variance normalized to unity. These assumptions mean that equation (2) gives a multivariate probit model that jointly represents a decision to adopt each of the strategies.

Results and Discussions

Socio-economic characteristics of crop farmers and their households

The results of the socio-economic characteristics of farmers and their households are presented in Table 1. The average age of the farmers is approximately 49 years and the majority (57.08%) of them were between 41 and 60 years of age. This was close to Oluwasanya *et al.* (2020), who reported an average age of 41 years and affirmed that rural farmers in Ogun state were within the age category of 30 and 50 years. Approximately 80% of the farmers were males and at least 42% of them had secondary education. It can be inferred from findings that most of the farmers were in their economically active with a level of educational attainment achieved capable of helping them make investment decisions that can enhance their productivity and profitability as better management of risks and uncertainties. Most (84.58%) of them were married. This is in line with Achike (2015) and Oluwasanya *et al*. (2020) who reported that at least 80 per cent of household heads in rural areas were married in Ogun State. The average household size was 8 which is close to the average of 6 reported by Oluwasanya *et al*. (2020) and Otunaiya *et al*. (2019). This high household size may imply increase access to family labour for farming activities. Most of the farmers were smallholders. The average farm size was approximately 2 hectares and the majority (about 71 per cent) cultivated less than 2 hectares of land. Over 65% had more than 10 years of farming experience. The average is 19 years. This suggests that most of the farmers would have had close to 2 decades or more of crop production which could have imparted their ability to devise strategies for combating the adverse effects of climatic shocks. Approximately 60% are engaged in ventures outside crop production enterprises. This finding is in line with Otunaiya et al. (2019) who reported that most (about 71%) farmers engage in other enterprises to enhance their livelihoods.

Table 1: Socio-economic characteristics of farming households

Variables	Frequency	Percentage	Mean
Age of household head (years)			
≤30	10	4.17	49
31-40	54	22.50	
41-50	72	30.00	
51-60	65	27.08	
>60	39	16.25	
Sex of household head			
Male	191	79.58	
Female	49	20.42	
Level of education of household head			
No formal education	30	12.50	
Primary school	26	10.83	
Secondary	101	42.08	
OND/NCE	39	16.25	
HND/BSC and above	44	18.33	
Marital status of the household head			
single	14	5.83	
Married	203	84.58	
Divorced	9	3.75	
Others	14	5.83	
Household size			
≤3	15	6.25	8
4-7	96	40.00	
8-11	83	34.58	
≥12	46	19.17	
Farm size under cultivation (hectares)			

≤2.00	171	71.25	1.79
2.01-3.00	50	20.83	
3.01-4.00	13	5.42	
>4.00	6	2.5	
Farming experience (years)			
1-10	76	31.67	19
11-20	74	30.83	
21-30	52	21.67	
31-40	28	11.67	
>40	10	4.17	
Have enterprise aside arable crop production			
No	95	39.58	
Yes	145	60.42	
Total	240	100	

Climatic shocks experienced by households in the study area

The result of climate shocks experienced in the past five years by farming households in the study area is presented in Table 2. The climatic shock experience reported in this study was based on the perception of respondents. While a considerable proportion (approximately 35% or more) of the farmers reported they have experienced increased cases of drought, pest and diseases, and crop yield reduction in the past five years, some others noted late rainfall and increased flood and erosion. The impacts of changing climate are often first felt through their effect on ecological disturbances such as flood, drought and insects and disease (Falola and Achem, 2017), which could in turn result in reduced output or yield (Muhammad *et al*., 2012; Falola and Achem, 2017; Borgomeo *et al*., 2018). Farmers' perceptions (views) about fluctuations (increase or decrease) in the onsets of early rainfall appear to diffuse fairly in the same fashion among most farmers as the percentage who noted an increase (32.5%) or decrease (31.25%) in onsets of early rainfall are not radically different. Falola and Achem (2017) reported fluctuations in rainfall patterns as some of the climate-related experiences of farmers in Nigeria.

Table 2: Self-reported perception of climate-related shocks experienced by farmers

Climatic shocks experienced	Increase	Decrease	Cannot really tell
Dry spell (drier than usual soil condition) due to low rainfall	**42.09**	17.08	40.83
Flood and erosion	35.41	23.75	40.84
Early rain	32.5	31.25	36.25
Late rain	34.58	22.92	42.5
Reduced crop yield	**43.33**	27.92	28.75
Temperature	32.08	17.5	50.42
Pest and disease	**39.58**	24.59	35.83
Windstorm	27.08	23.33	49.59

Source: Field survey, 2020

Management strategies employed by households in the face of climatic shocks

The result of management strategies employed by the crop farmers is presented in Table 3. There are various management strategies employed. These strategies include (1) planting of improved crop varieties (pest and disease-resistant and drought-tolerant crops) (2) soil and water conservation related strategies which include avoiding eroded and erosion-prone areas for farming, making of ridges across farmland to avoid the effects of soil erosion and increased mulching to conserve soil moisture (3) use of inorganic fertilizers and (4) livelihood diversification.

At least 70% of the farmers employed planting of improved crop varieties, and soil and water conservation respectively, followed by those that used applied inorganic fertilizers. A non-trivial percentage of farmers are also diversified into non-farm businesses to cope with the negative effects of climatic shocks. This finding is supported by Falola and Achem (2017) who stated switching to other sources of income among important livelihood strategies among farmers. It is worth mentioning that diversification into non-farm income sources may also have a competing role in farm production among affected households.

Table 3: Farmers response strategies to climate-related shocks

Response strategies	Number of farmers who adopted strategies	Percentage of the farmers
Agroforestry and planting of improved crop varieties (pest and disease-resistant and drought-tolerant crops)	172	71.67
Soil and water conservation	168	70.00
Use of inorganic fertilizer	159	66.25
Non-farm enterprise diversification	125	52.09

Source: Field survey, 2020

Determinants of Response Strategies Employed

The results of the multivariate probit analysis of the determinants of response strategies employed are presented in Table 4. Variables with statistically significant coefficients are discussed. As noted earlier, the response strategies are grouped into four main categories: planting of improved crop varieties, soil and water management approach, use of inorganic fertilizer and non-farm income diversification. The likelihood ratio test from the multivariate probit model showed the overall significance of the model at a 1% probability level and supports that choice of strategies is not mutually independent. The results showed that advances in the age of farmers can considerably reduce selection of the strategies. Findings aligned with the findings by Huang et al. (2019) which revealed an inverse relationship between ageing and farmers' adoption behaviour of soil and water conservation technology. Female farmers tend to have a higher propensity to cultivate improved crop varieties than their male counterparts. This is in line with the findings of Nhemachena *et al*., (2014).

An increase in education reduces the probability of using inorganic fertilizers. This indicates the role of education in the adoption of more environmentally friendly agricultural production practices in the study area. Farmers with larger household sizes tend to adopt soil and water management approaches, technology, and the use of inorganic fertilizer to enhance production and diversify into non-farm business compared to those with smaller sizes. This may be motivated by the need to adopt strategies that can help satisfy the food security and welfare pressing needs of household members amidst various climatic shocks limiting farm production. This result is in consonance with the findings of Sani *et al*. (2016). An increase in farming experience reduces the probability of adopting non-farm enterprise diversification. This agrees with the report by *Ping et al*. (2016) which documented a negative and statistically significant relationship between farming experience and participation in off-farm activity. Membership of cooperatives enhanced the likelihood of planting improved crop varieties and employing water conservation mechanisms. This underscores the significant role cooperative organizations could play in stimulating the adoption of eco-friendly strategies that could help mitigate exposure/risk of climatic shocks. Besides, cooperative membership also increases the chance of using inorganic (chemical) fertilizer particularly to raise crop productivity, whereas formal education gains and increased contacts with agricultural extension agents could lower the rate of use. Findings have implications for promoting the use of organic fertilizer (manures) and guided application of inorganic fertilizer in the right amounts (quantities) and manners that will pose less threat to soil fertility and the environment, without losing sight of farm productivity improvement. On this, the role of education and synergies between agricultural cooperatives and extension organizations/agencies cannot be overemphasized. The current reality in Nigeria today suggests that a farmer should be able to use both fertilizers for economic purposes in a sustainable fashion. In addition, increased contact with agricultural extension agents reduced the likelihood of diversification into non-farm enterprises,

indicating the unique role of extension services in promoting and keeping the stayers (farming population) in the farm sector. Hence, efforts to promote formal education, agricultural extension services, cooperative membership and/or strengthening the existing ones, among others, are suggested to promote the adoption of strategies that will enhance crop productivity, abbreviate movement away from the farm sector, reduce farmer's vulnerability to climatic shocks (especially drought spells) and enhance food systems sustainability.

Table 5: Factors influencing farmers' response strategies to climate-related shocks

Variables	Planting Improve crop varieties	Soil and water conservation management	Use of inorganic fertilizer	Non-farm enterprise diversification
Age	-0.029***	-0.034***	-0.021**	-0.018**
Sex	-0.387*	-0.047	0.264	-0.058
Education	-0.024	-0.022	-0.032*	-0.01
Household size	0.042	0.054*	0.088***	0.112***
Farming experience	0.007	-0.001	-0.012	-0.015*
Farm Size	-0.013	-0.011	-0.008	0.109
Extension Visit	-0.302	-0.309	-0.556***	-0.352*
Cooperative association	0.659***	0.661***	0.562***	0.189
Constant	1.262**	1.107*	0.364	0.171
	Rho1	Rho2	Rho3	
Rho2	0.913***			
Rho3	1.127***	1.235***		
Rho4	0.971***	0.736***	0.739***	
Observations		240		
Log likelihood		-438.902		
Wald chi2(32)		69.72		
Prob>chi2		0.0002		

Likelihood ratio test of rho21 = rho 31 = rho41 = rho 32 = rho 42 = rho 43= 0.00. Chi2(6) = 315.277. Prob > chi2 =0.000. Note: *, **, *** implies that coefficient is significant at 10%, 5% and 1% respectively.

Conclusion and Recommendation

The study examined the farmers' response strategies to climate-related shocks and factors influencing the choice of such strategies with the view to recommending actions that could promote sustainable food systems and food security in Nigeria. Data were collected from crop farmers in Ogun State to gain perspective on key climate-induced shocks experienced, response strategies employed, and factors affecting the selection of the strategies. Farmers reported they have experienced instances of drier than usual soil conditions (drought spells), flood and erosion (due to excessive precipitation), increased pest and disease attacks, and reduced yield (crop loss) associated with climate variability/change. As a way of responding to climate-related shocks, most farmers have employed a number (and combination) of strategies which include, among others, planting of improved crop varieties, soil and water conservation management, and use of inorganic fertilizer to raise productivity and diversification into non-farm enterprises. Adoption of these strategies is strongly positively influenced by membership of cooperatives. However, contact with extension agents lowers the likelihood of the use of inorganic fertilizer and diversification into non-farm enterprises. Hence, efforts to promote agricultural extension services, more cooperative membership and/or robust functioning of existing ones are suggested to reduce movement away from the farm sector and stimulate use of strategies that will reduce farmer's vulnerability to climatic shocks and enhance food systems sustainability.

References

Adeagbo, O.A., Ojo, T.O., and Adetoro, A.A. 2021. Understanding the determinants of climate change management strategies among smallholder maize farmers in South-west, Nigeria. *Heliyon* 2021, 7, e06231.

Asare-Nuamah, P. and Mandaza, M.S. 2020 Climate change management strategies and food security of smallholder farmers in the rural Adansi North District of Ghana. In Handbook of Climate Change Management: Research, Leadership, Transformation; Springer International Publishing: Berlin/Heidelberg, Germany, 2020; pp. 1–20. 22.

Asfaw, A., Simane, B., Bantider, A. and Hassen, A. 2019. Determinants in the adoption of climate change management strategies: Evidence from rainfed-dependent smallholder farmers in north-central Ethiopia (Woleka sub-basin). *Environmental Development Sustainability*, 21, 2535–2565.

Asfaw, E., Suryabhagavan, K.V., Argaw, M. 2018. Soil salinity, modelling and mapping using remote sensing and GIS: the case of Wonji sugar cane irrigation farm, Ethiopia. *Journal of Saudi Society of Agricultural Science,* 17(3), 250-258.

Bakht, S., Safdar, K., Khair, K.U., Fatima, A., Fayyaz, A., Ali, S.M., Munir, H. and Farid, M. 2020. The Response of Major Food Crops to Drought Stress: Physiological and Biochemical Responses. In Agronomic Crops; Springer: Singapore, 2020; pp. 93–115.

Below, T.B., Mutabazi, K.D., Kirschke, D., Franke, C., Sieber, S., Siebert, R. and Tscherning, K. 2012. Can farmers' management to climate change be explained by socio-economic household-level variables? Glob. Environ. Chang., 22, 223–235.

Borgomeo, E., Vadheim, B., Woldeyes, F.B., Alamirew, R., Tamru, S., Charles, K.J., Kebede, S., et al., 2018. The distributional and multi-sectoral impacts of rainfall shocks: evidence from computable general equilibrium modelling for the Awash Basin, Ethiopia. *Ecol. Econ*. 621–632

Donkor, E., Owusu, V., Owusu-Sekyere, E. and Ogundeji, A.A. 2018. The adoption of farm innovations among rice producers in Northern Ghana: Implications for sustainable rice supply. *Agriculture*, 8, 121.

Fadina, A.M.R. and Barjolle, D. 2018. Farmers' management strategies to climate change and their implications in the Zou department of South Benin. *Environments* 2018, 5, 15.

Falola, A. and Achem B. A. 2017. Perceptions on climate change and management strategies among sweet potato farming households in Kwara State, Northcentral Nigeria. *Ceylon Journal of Science* 46(3), 55-6

Funk, C., Sathyan, A.R., Winker, P. and Breuer, L. 2020. Changing climate – Changing livelihood: Smallholder's perceptions and adaption strategies. *Journal of Environmental Management*, 259, 109702.

Gbetibouo, G.A. 2009. Understanding Farmers Perceptions and Managements to Climate Change and Variability: The Case of the Limpopo Basin Farmers South Africa. IFPRI Discussion Paper 2009. Available online: https://www.ifpri.org/publication/ understanding-farmers-perceptions-and-managements-climate-change-and-variability.

Harvey, C.A., Viguera, B., Vignola, R., Viguera, B., Chain-Guadarrama, A., Vignola, R. an Alpizar, F. 2018. Climate change impacts and management among smallholder farmers in Central America. *Agriculture, Food Security*, 7, 1–20.

Huang, X., Lu, Q., Wang, L., Cui. M and Yang, F. 2019. Does ageing and off-farm employment hinder farmers' adoption behaviour of soil and water conservation technology in the Loess Plateau? *International Journal of Climate Change Strategies and Management* 12 (1): 92-107

Kogo, B.K., Kumar, L. and Koech, R. 2021. Climate change and variability in Kenya: A review of impacts on agriculture and food security. *Environmental Development Sustainability*, 23, 23–43.

Lin, C. T. J., Jensen, K. L., & Yen, S. T. (2005). Awareness of foodborne pathogens among US consumers. *Food Quality and Preference*, *16*(5), 401-412.

Lokonon, B. O. K. 2019. Farmers' vulnerability to climate shocks: Insights from the Niger basin of Benin. *Climate and Development*, *11*(7), 585-596.

Menikea, L.M.C.S. and Keeragala Arachchib, K.A.G.P. 2016. Management to climate change by smallholder farmers in rural communities: Evidence from Sri Lanka. *Procedia Food Science*, 6, 288–292.

Muhammad-Lawal, A., Salau, S.A. and Saka, A.Y. 2012. Assessment of Vulnerability of Farming Households to Climate Change in Ekiti State, Nigeria. *Ethiopian Journal of Environmental Studies and Management* EJESM Vol. 5 No. 2.

Nhemachena, C., Hassan, R., and Chakwizira, J. 2014. Analysis of determinants of farm-level management measures to climate change in Southern Africa. *Journal of Development and Agricultural Economics*, *6*(5), 232-241.

Obayelu, A. E. 2012. Households' food security status and its determinants in North-Central Nigeria. *Food Economics*, *9*(4), 241-256.

Obayelu, O.A., Adepoju, A.O. and Idowu, T. 2014. Factors influencing farmers' choices of management to climate change in Ekiti State, Nigeria. *Journal of Agriculture, Environment and International Development* JAEID, 108, 3–16.

Ogunmefun S.O. and Achike A.I. 2015. Socioeconomic Characteristics of Rural Farmers and Problems Associated with the Use of Informal Insurance Measures in Odogbolu Local Government Area, Ogun State, Nigeria. *RJOAS*, 2(38), February 2015

Ojo, T.O. and Baiyegunhi, L.J.S. 2020. Determinants of climate change management strategies and its impact on the net farm income of rice farmers in southwest Nigeria. *Land Use Policy* 2020, 95, 103946

Ojo, T.O., Adetoro, A.A., Ogundeji, A.A. and Belle, J.A. 2021. Quantifying the determinants of climate change management strategies and farmers' access to credit in South Africa. *Science Total Environment*, 792, 148499.

Oluwasanya O.P., Nwankwo F.O., Aladegoroye O.R and Ojewande A.A. 2020. "Socio-Economic Factors of Cooperative Farmers and their Food Intake in Yewa North Local Government Area of Ogun. *Acta Scientific Agriculture* Volume 4 Issue 8.

Omerkhil, N., Chand, T., Valente, D., Alatalo, J.M.and Pandey, R. 2020. Climate change vulnerability and management strategies for smallholder farmers in Yangi Qala district, Takhar, Afghanistan. *Ecol. Indicat*. 111, 105863.

Otekhile Cathy-Austin and Verter Nahanga. 2017. The Socioeconomic Characteristics of Rural Farmers and their Net Income in Ojo and Badagry Local Government Areas of Lagos State, Nigeria. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 65(6): 2037 – 2043.

Otunaiya A. O., Adeyonu A. G. and Ajiboye B. O 2019. Determinants of Food Demand among Rural Farming Households in Ogun State, Nigeria. *Ibadan Journal of Agricultural Research* Vol. 12(1)

Ping, Q., Iqbal, M. A., Abid, M., Ahmed, U. I., Nazir, A. and Rehman, A. 2016. Adoption of Off-farm Diversification Income Sources in Managing Agricultural Risks among Cotton Farmers in Punjab Pakistan. *Journal of Applied Environmental and Biological Sciences* 6(8): 47-53

Sani, S., Haji, J., & Goshu, D. 2016. Climate change management strategies of smallholder farmers: The case of Assosa District, Western Ethiopia. *Journal of Environment and Earth Science*, *7*, 9-15.

Shisanya, S. and Mafongoya, P. 2016. Management to climate change and the impacts on household food security among rural farmers in uMzinyathi District of Kwazulu-Natal, South Africa. *Food Security*, 8, 597–608.

Soglo, Y.Y. and Nonvide, G.M.A. 2019. Climate change perceptions and responsive strategies in Benin: The case of maize farmers. *Climate Change*, 155, 245–256.

Sousa, P.M., Blamey, R.C., Reason, C.J., Ramos, A.M. and Trigo, R.M. 2018. The 'Day Zero'Cape Town drought and the poleward migration of moisture corridors. *Environ. Res. Lett*. 2018, 13, 124025.

Wiebe, K., Robinson, S. and Cattaneo, A. 2019. Climate change, agriculture and food security: Impacts and the potential for management and mitigation. *Sustain. Food Agric*. 2019, 55–74.

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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Empirical Review of Youth Entrepreneurship Skills in Fishery Project in Kwara State : A Logical Framework Approach

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Abstract

This study aims to conduct an empirical review of youth entrepreneurship skills within the context of fishery projects in Kwara state. The study will focus on assessing the knowledge, skills, challenges and outcome of youth entrepreneurs engaged in fishery project. It also assessed the level of entrepreneurship skills among youth in fishery project, identify challenges faced by youth entrepreneur in fishery enterprise, design a methodological approach using the logical framework. The study made use of descriptive statistics to profile the socioeconomic characteristics of 120 youth who have engaged in capacity building in youth entrepreneurship scheme on fishery enterprise in Kwara sate. The logical framework matrix indicated that 20% increase in income of youth within year 2019- year 2024) 5 years of the fishery project implementation The study contributes to a better understanding of the effectiveness of youth entrepreneurship programme in fishery, insight on empowerment of youth for a virile agribusiness and finally provide recommendations for improving youth entrepreneurship programme in the study area.

Keywords: Entrepreneurship, Skill, Fishery, Project Logical Framework

Introduction

Nigerians are large consumers of fish and it remains one of the main products consumed in terms of animal protein. Only about 50% of demand for fish is currently being met by local supply. Adeola in Adebesin (2021) reported that the fisheries sector contributes 3.5% of Nigeria‘s GDP and provides direct and indirect employment to over six million people. Besides, Nigeria has many rivers and water bodies which serve as good locations to set-up fish farms. Nutritionally, fish is preferred to other kinds of meat and this is evident in the ever increasing demand for it. The benefits accruing from fish thus, necessitate its production.

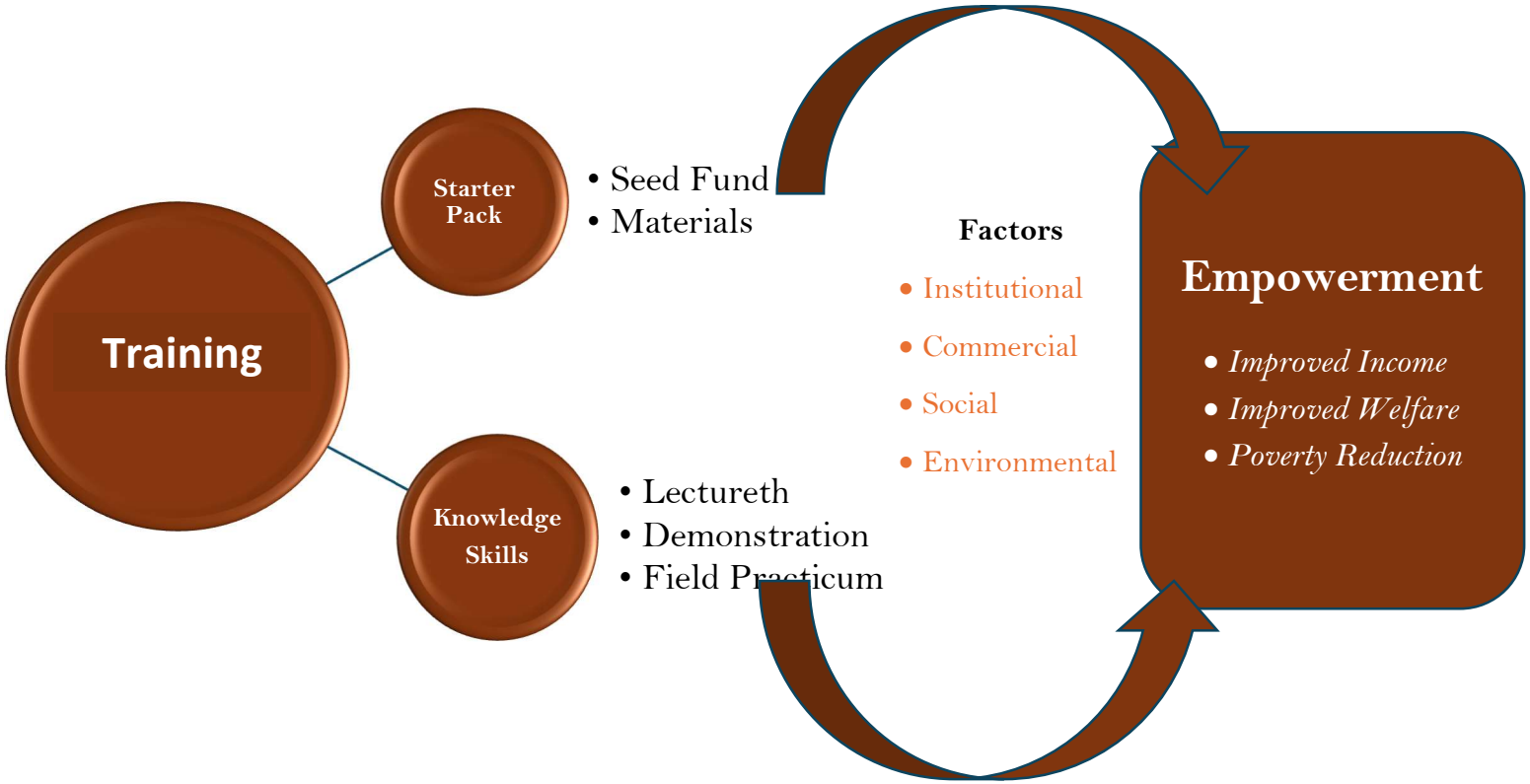
Production in the view of Iwena (2018) refers to all the activities which results in the creation of goods and services. Production is used in this study to mean the various activities involved in the creation of fish as output by youths for reduction of insurgency and economic development of South-South Nigeria. These activities include planning, stocking, feeding/nutrition, health management, harvesting, post-harvest handling and marketing. For all these activities to be effectively carried out individual must consciously venture into fish production as entrepreneurs.

A youth entrepreneur according to Onwuka and Olaitan (2017) is a person between age 18-35years who creates, manages a business undertaking and bears risks for the sake of profit. In the view of Etuk in Alawa and Udida (2015), a youthful entrepreneur is a visioner who must have a clear conception of what he has envisaged and who must be in a position to translate it into a workable project. In the context of this study, an entrepreneur is a young adult who participates in fish production activities and turn them into a profitable venture by harnessing the necessary skills and resources to manage the enterprise for purpose of making profit, poverty reduction and utmost food security in Nigeria. A typical youthful entrepreneur works with the spirit entrepreneurship.

Entrepreneurship according to Agomuo (2012) is a process of bringing together creative and innovative ideas, combining them with management and organization skills in order to combine people, money, and resources to meet an identified need. In the view of Onwuka and Olaitan (2017) entrepreneurship is the process through which individuals combine human and material resources in order to provide goods and services need by man. Entrepreneurship in this study is a process through which youths combine human and material resources and participate in fish production to expand their production capacities and capabilities, increased profit, reduced unemployment rate, reduced poverty, better livelihood and increased national food security. Entrepreneurship in fish production with a myriad of activities cannot be effectively pursued without requisite skills.

Skill according to Osinem (2018) is the expertness, practiced ability or proficiency displayed in the performance of a task. The author explained that it is the ability to perform a task acquired through repetition of the operation. In the opinion of Okorie (2000), to possess a skill is the demonstration of acting, thinking or behaving in a specific activity in such a way that the process becomes natural to the individual through repetition or practice. Skill in the context of this study is the ability of youths to perform the various activities in fish production with maximum proficiency to ensure its steady supply for reduction of insurgency and economic development of South-South.

One of the greatest social problems facing Nigerian Youth is unemployment and low human capacity development. This situation has led to insecurity that exists in an environment arising from individuals or groups that have a feeling of dissatisfaction, marginalization or inequality. The cumulative effect lead to youth unemployment has led to violence and criminality which have come in the form of armed robbery, kidnapping, bombing, ethno-religious militancy, intra and inter party clashes, murder, hostage taking, rape, riot, cultism, vandalism, arson, drug trafficking, arms smuggling, human trafficking among others which have significantly undermined the internal security and economic development of the nation. What informs the active involvement of youths inthese menace is not certain but may not be unconnected with unemployment and absence of viable life engaging alternatives that could guarantee their sustainable existence. Ofem and Ajayi (2008) identify lack of humanitarian and social welfare, good governance, corrupt practices of government officials, inadequate training programmes, inadequate recreational facilities and lack of qualitative education, as the reasons for incessant youth unemployment.



CONCEPTUAL FRAMEWORK OF YOUTH ENTREPRENEURSHIP SKILLS IN FISHERY PROJECT

LOGICAL FRAMEWORK CONCEPT OF YOUTH EMPOWERMENT SCHEME FISHERY ENTREPRENEURSHIP.

1. **Project Goal**: 120 Youth are empowered in the state to become successful entrepreneurs in fishery value chain entrepreneurship this lead to sustainable economic growth and improved livelihood

2. **Project Purpose**: enhance the entrepreneurship skills and opportunities for 120 youth in Kwara state through capacity building, resource and support.

3. **Project Output**: immediate deliverables which include the following
    i. develop and deliver a comprehensive entrepreneurship training curriculum
    ii. establish a mentorship programme connecting experienced entrepreneurship with youth participants
    iii. provide access to microloans and financial resources for start-up venture (starter packs)
    iv. organise networking events and workshops to foster collaboration and idea exchange

4. **Project Activities**: the activities involved the following
    i. Research best practices in youth entrepreneurship programme and tailor to local content
    ii. Design entrepreneurship training curriculum with thematic areas which include business planning, financial management, marketing and interpersonal relationship
    iii. Recruit experience entrepereneurship as mentor and create a platform for mentor-mentee interactions.
    iv. Estalblish partnership with local financial institution to facilitate access to microloan
    v. Plan and organise regular network events, workshop, seminar for youth entrepreneurs

5. **Project Input**
    i. Human resources, Trainers, mentors,program coordinators and support staff
    ii. Funding: budget for curriculum development, course facilitation, mentor stipends and starter pack
    iii. Training facilities: classrooms, training materials and technological resources
    iv. Partnership and collaboration with farms. Financial institution and government agencies
    v. Communication channels: website, social media, webinars and live session, online marketing and community outreach.

Methodology

The study area is Kwara state North Central Nigeria. The study made use of purposeful sampling techniques to select 120 youth entrepreneurs engaged in fishery business and were trained in ARMTI located in Kwara state. Data was collected theotuh a structured survey questionarire and aided by focus group discussions. Secondary data was use to compliment the data from relevant sources such as Nigeria Bureau of Statistics and records of youth participant from ARMTI records. Data was analysed using descriptive statistics to obtain socio economical background from the respondents, qualitative techniques with project Monitoring and Evaluation indicators using a logical framework matrix to monitor the effectiveness and efficiency of youth achievement level.

Results and Discussion

Demographic characteristics of Youth in Fishery Entrepreneurship

The result below shows the socio economic background of the youth involved in fishery entrepreneurship.

Characteristics	Frequency	Percentages	Mean
Age (years)			
18-25	45	37.5	
26-30	41	34.2	28yrs
31-35	30	25	
36-40	14	11.6	
Sex			
Male	95	79.2	
Female	25	20.8	
Education level			
Primary education	31	25.8	
Secondary education	56	46.6	
Tertiary education	33	27.5	
Entrepreneurship experience(Yrs)			
1-3	73	60.8	
4-6	27	22.5	3.5yrs
7-9	20	18.3	
Monthly Income (NGN)			
15,000-30,000	63	52.5	
31,000-45,000	31	25.8	N28,876
46,000- 60,000	20	16.6	
61,000- 75,000	6	0.05	
Employment status			
Employed	11	9.2	
Unemployed	109	90.8	
Total	120	100	

Source: Field survey, 2022

from the table above, it was revealed that majority 45% of the sampled youth fell within the age 18-25yrs with the average age of the youth in fishery entrepreneurship was 28years. This shows that a lot of youth are still actively involved in entrepreneurship in the study area. About 56% of them have secondary education which shows that they are literate are trainable and open to innovative entrepreneurship development in fishery business.

The results also show that the majority of the youth about 63% between N15,000-N30,000 monthly which shows that they are pro-poor are in need of entrepreneurship venture in fishery business that will improve their income level. A lot of youth are unemployed and are therefore in need of entrepreneurship business that will alleviate their poverty level and improved sustainably their welfare in the long run

LOGICAL FRAMEWORK FOR YOUTH ENTREPRENEURSHIP SKILLS IN FISHERY PROJECT IN KWARA STATE **Commencement Date**: Nov. 1st 2019 **Closing Date**: Oct. 31st 2024 **Duration** (5years) **Fund**: 60 million (120 youths) **Beneficiary:** 120 Youth in Kwara State **Stakeholders**: Kwara State Government, ARMTI and Beneficiaries, Service Providers			
NARRATIVE SUMMARY	**OBJECTIVELY VERIFIABLE INDICATORS**	**MEANS OF VERIFICATION**	**IMPORTANT ASSUMPTIONS**
PROJECT GOAL -Improved standard of living -Poverty reduction -Improved livelihood	-25% reduction in unemployment of youth within 5yearsof project implementation -Asset acquisition by beneficiaries	-NBS report - Interview/Success stories	-Political will to continue the project
PROJECT PURPOSE -Financial empowerment -Income level is increased -Self reliance	-20% increase in income of youth within 5 years of project implementation	-Beneficiaries Bank statement of account -Business record -M&E Logbook	-Political stability -Market/price stability -Favourable government policy
OUTPUTS -Youth in fishery entrepreneurship were mobilized and empowered -Capacity of the youth been built fishery entrepreneurship value chain of their choice	-120 youth beneficiaries were empowered in fishery agribusiness within 5 years of project implementation -Capacity building conducted for 120 beneficiaries of the project within 5 years of project implementation	-Group photograph/video coverage -Interview -Certificate of attendance	-youths buy-in into the project -funding is adequately and timely provided MOU strictly adhere to
ACTIVITIES -Disbursement of loan -Mobilization and sensitization of youth in fishery agribusiness -Procurement of workbook manual -Establishment of fishery demonstration farm -Training of youth in fishery production -Procurement of Project starter packs, Tablets, Computers and Printers -Enlistment of Field Officers and Support Staff	**INPUTS** Loanable fund (N500,000,000) - 120 Project beneficiaries - 120 Workbook manual -3 fishery demonstration farms -5 Tablets for record computer -8 Field officers and support staff	-Application forms/ online registration -Training attendance register -Bidding documents	-Timely disbursement of fund -Beneficiaries are willing to be trained -Peaceful coexistence among community members

Source: Field Survey, 2022

The table above is the logical framework matrix which chows the hierarchical ordering of project objectives for 120 youths involved in youth agribusiness. The table indicated the input requirements as well as the objectively verifiable indicators, means of verification and necessary assumption that can may or mar the project achievement level for the youth as they carry out the fishery entrepreneurship venture. The logical work was designed for the 120 youth to span for 5years from project commencement taken from November 2019 to October 2024.

The seed fund for the project was projected N60Million where each of the youth is eligible to obtain N500,000 to carryout in any enterprise of their choice in fishery value chain.

At the end of the project life span, 120 youth are expected to have improved income, increased standard of living and alleviated poverty at the end of the entrepreneurship programme.

Conclusion and Recommendations

The issue of youth unemployment and its attendant consequence has become a recurring phenomenon in Nigeria. The consequences of youth unemployment has led to low economic development and claimed many lives in Nigerian and hence, the need to effectively engage these youths which would go a long way to reducing the menace of unemployment . The identification of entrepreneurial skill required by youth in fishery value chain for reduction of poverty, improved household income, increased standard of living. The study deployed a logical framework as a panacea methodological framework to monitor project and programme successful implementation. The study recommends that the identified skills should be included as content areas into the skill acquisition programme for youths ,youths should be trained using the skills identified with financial incentives to embark on fish entrepreneurship.

The study also recommend that government should encourage more people especially the youths to be involved in fish production to open up agro-business frontiers, satisfy human consumption and develop the economy of the nation.

References

Adebesin, A. A. (2021). Fish production, poverty alleviation and cooperative success of Eriwe cooperative fish farm at Ijebu-Ode, Ogun State, Nigeria. A B. Aquaculture degree report submitted to Department of Acquaculture and Fisheries Management, University of Abeokuta, Ogun State.

Agomuo, L. P. (2012). *Entrepreneurial development in Nigeria: An integrative perspective*. Okigwe: Avan Global Publication.

Alawa, D. A & Udida, L. U. (2015). Entrepreneurial Skills Required By Women Retirees for Success in Melon Production Enterprise in Cross River State, Nigeria. *International Journal of Educational Administration Planning and Research, 7(1), 66-81*

Ali, A. (2006). *Conducting research in education and the Social Sciences,* Enugu: Tian Ventures

Food and Agricultural Organization (2005). Fish pond construction and management. Technological information materials from National Special Programme for Food Security Rural Aquaculture training workshop in Nigeria; 17th -8th April.

Iwena, O. A. (2018). *Essential Agricultural Science for Senior Secondary Schools.* Abeokuta: Tonal Publishers Ltd.

Obi, C. A ((2002). *Elements of Business*. Owerri: Cape Publishers Ltd.

Obiyai, K. K & Ekubo, N. A. (2011). Development of entrepreneurship skills training module on fish breeding and hatching. *Asian Journal of Agricultural Science, 3(2), 111-114.*

Ofem, N.I. & Ajayi A.R. (2008). Effects of youth empowerment strategies on conflict resolutions in the Niger Delta of Nigeria: Evidence from Cross River State. *Journal of Agriculture and Rural Development 6* (12), 139-146.

Ogieva, E. (2003). *Comprehensive Agricultural Science for Schools.* Edo: Johnson Publishers Ltd.

Okorie, J. U. (2000). *Developing Nigerians Workforce.* Enugu: Environs Publishers

Olaitan, S.O & Mama, R.O (2001) *Principle and Practice of School farm Management*. Owerri: Cape Publishers Intl Ltd.

Onwuka, A. U. & Olaitan, S. O. (2017). Entrepreneurship skills required for economic empowerment of youths in broiler production. *Journal of Home Economic Research of Nigeria,* (8), 13-26

Osinem, E.C. (2018).*Managing agricultural education and training: Resources, principles and methods*. Enugu: Belony International Publishers.

Smallholders Foundation (2013). *Fish farming as an enterprise*. Owerri: The Smallholders Foundation.

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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Dimensions of Income Inequalities and Poverty Gaps of Rural Households in Kwara State, Nigeria

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Abstract:
This study looks at the dimension of income inequalities and poverty among rural household of Kwara state, Nigeria. Incidence of poverty among Nigerians kept on growing in spite of all the laudable programmes and interventions that have been put in place by the governmental and non-governmental agencies to alleviate poverty in the country. It was against this background that this study takes the initiative of analysing poverty status and income distribution among farm households in Kwara State. Hence, the study made use of questionnaire to gather data from the households. Findings revealed that the mean households' size is 7 persons which are large enough to attract high dependency burden, the mean age of the respondents is 58 years, most (91.70%) of the respondents had formal education. The result further showed Gini coefficient of 0.19, indicating a low level of inequality in income distribution which suggested homogenous population of the farm households. Theil T (26.7%) of the total inequality is contributed by the overall income while Theil L which measures the mean log deviation indicated 30% of total inequality was contributed by total income. In essence, other factors apart from income contribute more to total income inequality. Decomposing the Gini coefficient, the contribution of agriculture to total inequality was highest (3.271) while secondary economic activities contributed the least in negative effect. It is good to note that agricultural income is highly unequally distributed. Therefore, secondary economic activities which have greater potential impact on income distribution should be encouraged.
Keywords: dimension, income inequalities, poverty, Rural Households

Introduction

The pattern of income distribution has been a concern to economist (Clarke et al, 2003). Measures of poverty focus on the situation of individuals or households who find themselves at the bottom of the income distribution, typically this requires information about the mean level of (say) income as well as its distribution (Gottschalk and Smeeding, 2000). Measuring and the understanding of the level, causes and development of income inequality have received increasing attention. Researches in the 1990's witness a significant shift from the most focused research area of economic growth and convergence in Gross Domestic Product (GDP) per capita across countries to identify factors influencing the distribution of income, and analyzing income distribution and its development over a period of time (Heshmati, 2004). This shift in focus is specifically from the divergence of per capita to the long-term equalization or polarization of incomes across regions or countries, (Quah, 2002). This shift does not only affect the section of technological change but also raised human capacity in order to create growth and wealth. Also, as a matter of intense awareness of growing disparity, there is series of calls for

analyzing different aspects of income inequality such as its measurement, decomposition and factors influencing income inequality (Heshmati, 2004).

In Nigeria, off and non-farm incomes represent an important element in the livelihood of few poor. In several areas, increasing population density and the rapid rate of natural resources depletion have made it difficult for agriculture to remain the only or even the main source of income of rural households in many areas of the country. Following this, it safely said that underdevelopment of rural non- farm sector may, in part explain the increase in the level of poverty in rural Nigeria (Awoyemi, 2004). Income inequality can be harmful to economic growth and development of a country. In one of the macroeconomic objectives, equity in distribution of income and wealth among the citizens is a priority to the government. This act shows the importance and necessity of income inequality or decomposition. Nigeria Economic Report, documented by the World Bank shows that poverty in the country has been reduce contrary to the 2010 estimate of the National bureau of statistics, which shows that the proportion of people living in extreme poverty increases from 51.6% in 2004 to about 62% in 2010. This comprehensive national household survey was argued to have underestimated the consumption level of the people. In more recent household survey conducted by the NBS in 2011 and 2013, the world bank posited that poverty in Nigeria has lowered to 33.1% in 2013 from 35.2% in 2011, compared with 61.2% calculated using the questionable survey. This new poverty estimates are lower than the average for Sub-Saharan Africa. About half of the wealth in the world is owned by few among the population, specifically just about one per cent. In the countries where economic inequality has been on the increase in the last 30 years is where we found out several people lives. The World Economic Forum has recognized economic inequality as one of the most important risk to human progress which impacts social stability within countries and poses threat on security in a global scale (Fuentes-Nieva, 2014). The accumulation and control of economic resources by small population escalate the problem in political and economic system and even add to other form of inequalities especially the one between men and women. In the study of Ogbeide and Agu (2015), the cordial existence of an economy like Nigeria is under a threat due to prevalence of poverty and issues surrounding inequality. These issues have continually received attention of researcher and policy makers in different economies of the world. However, literatures have made clear the existing gap between poverty and inequality and the causal relationship between them. Is there any causal relationship, if there is, then the direction of causality is yet to be identify especially as it pertains to Nigerian economy. In their study which seeks to establish whether or not there is a causal relationship between poverty and inequality in Nigeria, it was established in it that there is an unswerving line of causality between poverty and inequality and also an indirect channels through unemployment and low life expectancy on inequality which worsen poverty in the country.

Objectives

The specific objectives of the study are to: determine key socio - economic and demographic determinants of the earning capacity and livelihood diversity of the farm households, determine the level of income inequality in the rural and urban areas and the contribution of each income source to overall inequality, quantify the share of different income sources in total household income and examine their equity implication, determine the effects of income on levels and distribution of poverty status and the influence of socio economic characteristics of households on the level of inequality.

Methodology

This study was carried out in Kwara State, Nigeria. The state is located in the North Central zone of the country. It lies between latitudes 7045'N and 9030'N and longitudes 2030'E and 6035'E. With a population of about 2.37 million (NPC, 2006), the state is made up of four zones – A, B, C and D, with sixteen Local Government Areas (LGAs). The people of the state comprise the Yoruba, Fulani, Nupe and Baruba. Agriculture is the mainstay of the people of the state with over 80 per cent of the population living in rural areas [National Bureau of Statistics (NBS), 2005]. Data Collection and Sampling Procedure Primary data were used for this study. This involves multistage sampling technique. The Multi-stage random sampling technique was adopted in selecting the respondents for the study. The first stage involves purposive selection of Kwara Agricultural Development Zone because of the existence of arable crop farming among the smallholder farmers in the area. The second stage involves random selection of Six out of the sixteen LGAs (Local Government Areas) The third stage involved

random selection of two communities from each of the chosen six LGAs making a total of twelve villages. Finally, a proportionate sampling of about 1.23% of smallholder farmers was drawn from each village making a total of one hundred and fifty-two (152) respondents for the study. The respondents were selected from the list of households who were into smallholder arable crop production provided by the Agricultural Development Programme (ADP). Income earned both in cash and in kind is recognized and used in the study. So therefore household consumption of crops and livestock produced are given monetary value based on prevailing market prices. There is an increasing need to focus on expenditure rather than income as an indicator of poverty status in poverty studies in Nigeria. This is because; measuring consumption expenditure, especially in rural households whose incomes came largely from self-employment in Agriculture. (Aigbokhan, 2000, Awoyemi, 2004). Moreover, given that annual income is required for a satisfactory measure of living standards, as income-based measure requires multiple visits or the use of recall data, whereas as consumption expenditure measure can rely on expenditure over the previous few weeks (Deaton, 1997). In view of the foregoing, an attempt was made to collect data on both household income and expenditure.

Analytical techniques

Descriptive statistics were employed to illustrate the socio economic characteristics, demographic patterns of the farm households and to show the importance of both non-farm employment and broad pattern of participation in non- farm opportunities across different groups of the population. Other analytical techniques used included FGT poverty indices, coefficient of variation and Gini coefficients of income inequality.

Decomposition Based on Gini Coefficient

Following Pyatt et al., (1980), the Gini -Coefficient can be decomposed as follows:

$$G = 2\frac{COV(Y,r)}{n\,\mu}$$

Where n is the number of observations, Y is the series of total income and r is the series of corresponding ranks. The Gini Coefficient of the ith source of income - can be expressed as

$G_1 = 2\frac{COV(Y,r)}{n\,\mu 1})$

Where Yt and ri refer to the series of income from the ith source and corresponding ranks respectively. Since total income is the addition of all source incomes, the covariance between the total income and its rank can be written as the aggregate of covariances between each source income and rank of total income. The total income Gini can then be expressed as a function of the source Ginis. $G_1 = 2\frac{COV(Y,r)}{n\,\mu} = R_1G_1$

= Where R_1 is the correlation ratio expressed as : $R_1 = \frac{COV(Y,r)}{Y,r}$ Where cov (Y,r) is the covariance of total income and corresponding rank respectively and cov (Y. ri) the covariance of income and corresponding tank

Income Function.

Suppose an income equation is defined as: Y = X+ Where Y is the per capita income in Naira and X is an n x m matrix of independent variables with the first column given by the n vector ei= (1,1,—1). More specifically, the following variable specifications were proposed.

X_1 = Age of respondents in years,
X_2 = Sex of household,
X_3 = Number of persons in the household,
X_4 = Marital status of house head,
X_5 = Years of education of household head in years,
X_6 = Total number of hours of household worked per week in hours,
X_7 = Wage employment dummy (1 for wage employment, 0 otherwise),
X_8 = Farm activities dummy (1 for farmers, 0 otherwise),
X_9 = Nonfarm activities (0 for farm activities, 1 otherwise),
X_{10} = Location dummy (urban 1, 0 otherwise),
X_{11} = Distance to the nearest city (km),
X_{12} = Distance to the nearest market (km),
X_{13} = Amount of credit obtained in naira,

X_{14} = Secondary occupation dummy (1 for yes,0 for no)

Incidence of poverty by major occupations.

In an attempt to answer the question of whether the movement to nonfarm occupation is reducing or not, the link between occupation and poverty will be examined first. At another stage of analysis, the results will be drawn to show how and to what extent participation in secondary economic activities contributed to rural poor's income. The standard Foster - Greer - Thorbecke (FGT) (1984) poverty indices would be estimated for each of the major income - source categories. Here attention is given primarily to the comparison of poverty across various income- source categories over for the study period rather than over time. The FGT can be expressed as;

Where n is the total population (households), q is the number of households with income below the poverty line; z is the poorest household and $\propto$ is a poverty aversion parameter to be chosen in line with a society's sensitivity to deprivation and where $\propto$ = 0, 1 and 2. In this study, the absolute poverty line was adopted. Here, the poverty line was defined as one half of the median income. After all, all poverty lines retain an element of arbitrariness. (Lanjouw, 2000, Awoyemi, 2004).

Results and Discussion

Demographic characteristics of the respondents

Table 1: Socioeconomic characteristics of the respondents

VARIABLES	Frequency	Percentage
Household Head (Gender)		
Male	102	88%
Female	18	12%
Household Head(Age)		
15-30	2	1.7%
31-40	27	22.5%
41-50	41	34.2%
51-65	39	32.5%
Above 65	11	9.2%
Household Head Education		
No formal education	22	18.30%
Primary education	31	25.85%
Secondary education	36	25.85%
Tertiary education	31	25.85%
Household size		
1-3	9	7.5%
4-7	60	50%
8-10	30	28.3%
11-14	10	8.33%
Above 15	7	5.83%
Marital status		
Single	6	5%
Married	104	86.7%
Divorce	4	3.3%
Widow	6	5%
Total	120	100%

Source: Field Survey, 2022

The size of household could provide important information on the income decomposition and poverty level. According to Awoyemi, (2004), evidence abound pointing to the fact that poor people tend to live in small size households while non poor tends to live in large size households. This in turn could be explained in terms of dependency burden and of number of mouths to feed, which are often associated

with household size. The modal household size group is 4-7 persons, large enough to attract high dependency burden, the more a household gravitates towards poverty status and vice- versa. The age of farmer is an important factor influencing the level of output especially in the peasant economy, which is characterized by high labour requirement. Respondents whose age fell within 41 and 65years made up the bulk of the practicing farmers in the study area. They constituted 56.7% of the respondents. Those whose age fell between 41 and 50 were in modal age range of 34.2% followed by 51-65 years having 32.5%. This was quite understandable if one recollects that most people become rightful owners of farmland when their parents have died or transferred the land to them as a result of incapability to manage them due to old age. The uneven distribution had 24.2% of respondents with age bracket 15-40 years. It is a widely accepted fact that the gender relations largely determine household security, well-being of members, livelihood diversification and poverty level. For instance, for a long time, women in Africa have been placed under stress by the gap between their income responsibilities and their access to resources. This in turn is believed to have fee to the feminization of poverty. The study seeks to investigate how gender based differences in access to resources influence how different members of households participate in secondary economic activities. It was found out that majority of farm household heads were male representing 82.5% of the total population, 16.7% were married, 3.3% were divorcee while the singles and widowed were both 5%. The benefits derivable from group action suggest that when man and woman work together, they stand a better chance of success than when each works as an individual. The underlying economics of it ensures spreading of risks among embers, pool of sources and other factors, which could bring about positive synergistic effects on the level of production and earning capacity. The Table also showed that 18.3% of the respondents had no formal education, 25.85% had only primary education, 30.0 % had secondary education only while 25.85% of the respondents had tertiary education.

Inequality Measures the Gini Coefficient

Table 2 Inequality Measures

Variable	Value	Percentage
Gini(Total income	0.1895	18.95
Generalized entropy (α =0)	∞	∞
(α =1)	∞	∞
(α =2)	0.3001	30.01
GE(1)Theils	0.267	26.70
GE(0)Theils L	0.3001	30.00
Decile Dispersion Ratio	41.81	41.81

Source: Field Survey, 2022

For overall income of household heads in Kwara State is computed as 0.19. This shows a low level of inequality in income distribution, which suggests that homogenous population, dominates the farm households. The results of the Generalized Enthropy measures as in Table 2 show that when higher weight is given to distances between income distributions. It takes value of 0.3001 with weight of 2. This 30% corroborated the results of Gini - Coefficient of homogeneity in the farm household population. Using Theils T, 26.7% of total inequality is contributed by the overall income while in Theils L which measure the mean log deviation, 30.0% of total inequality was contributed by the total income. In essence, other factors apart from income contribute more to total income inequality. Also, the Decile Dispersion Ratio of income of the rich to the poor is 41.81%. This shows that the income gap between rich and poor has not widened in farm household despite the low returns to agricultural production and income generally.

Income function of respondents

This involves the use of regression - based methods of distribution by income source. The lead equation was selected based on magnitude of the coefficients of multiple determination, the significance /contribution of the explanatory variables to the distributional changes as adjudged by the F-value, the significance of the t-value and appropriateness of the signs and value of the regression coefficients in line with a-priori expectation. Based on the above-mentioned criteria applied in the regression analysis

of income changes due to changes in the variables, the exponential functional form was chosen as the

Independent variables	Linear Coefficients	Std.Err	tstat	Prob.	Exponential Coefficients	Std.Err	t-stat	Prob.
Age	7831.953	19419.23	0.40	0.69	0.019700	0.007922	2.48	0.01**
Sex	97755.65	57377.63	1.70	0.09*	0.473212	0.186691	2.53	0.01**
Household Size	7302.228	5217.962	1.39	0.16	0.014742	0.016976	0.86	0.38
Marital Status	-74833.76	99292.50	-0.75	0.45	0.282444	0.311403	0.91	0.37
Educational Level	8063.397	5827.52	1.38	0.17	0.042017	0.018852	2.23	0.02**
Labor hours	650.8707	1113.607	0.58	0.56	-0.000484	0.003615	-0.13	0.89
Wage labor	-57058.20	56870.95	-1.00	0.32	-0.300522	0.185267	-1.62	0.11
Farming	70751.69	56492.52	1.25	0.21	0.365314	0.183932	1.98	0.04**
Non-farm	-137434.6	66212.28	-2.07	0.04**	-0.361419	0.215707	-1.68	0.09*
Location	-165353.5	61415.31	-2.69	0.01***	-0.603526	0.200079	-3.02	0.00***
Dist. to city.	-611.7252	5288.599	-0.12	0.91	0.007347	0.017224	0.43	0.67
Dist. To Mkt.	10284.70	11156.16	0.92	0.36	-0.023489	0.036178	-0.65	0.52
Credit Obtained	1.218532	0.413931	2.94	0.00***	0.0000035	0.0000013	2.62	0.01**
Constant	43388.40	441626.6	0.09	0.92	11.32017	0.5058	22.41	0.00***
R^2	0.35667	0.38						
Adjusted R^2	0.270889	0.30						
S.E. of Regression	209238.6	0.68						
F-Stat.	4.158033	4.95						
Prob. (F- Stat)	0.000010	0.000001						

lead equation. The functions are expressed in Table 4 below. The result shows that seven coefficients of the explanatory variables are significant and that any change in any of the variables results in change in income. Positive effect is established by age of respondents, sex, years of education, farming activities and credit availability while non-farming activities and location of the farm are observed to have negative effect. It is evident from the income function results that there seems to be low productivity of labor in economic activities among the respondents. Labor variable shows negative association with level of income decomposition. The effect of age on income function shows that as one gets older, there is a tendency to rationalize income among needs and wants. The result shows that distribution is more egalitarian among male household heads than female. Other variable that shows positive effect on income function are number of persons in the household, marital status of respondents, farming activities, location of the farm and distance to market have negative effect on income distribution. 3.3 Income inequality by income source The issue of income inequality is further discussed because the link between income inequality and poverty has been the focus of discussion on poverty. (Awoyemi, 2004). This is widely believed that reducing income inequality could benefit the poor both immediately and in the long run by facilitating economic growth. (Kimalu et al., 2001) To this end, an attempt is made to decompose coefficient of variation and the Gini coefficient to identify the two ways in which income sources contribute to overall income inequality. First, it can be asked whether an income source serves to increase or decrease overall income inequality? Secondly, is it possible to identify how much of the overall inequality is due to any particular income source?

Table 4 reports the results of the decomposition to identify income-inequality decreasing sources of income. An income source increases overall inequality when Gini coefficient is greater than one i.e. the higher the values of these estimates for a source, the higher will be its contribution 10 total income inequality. As expected, the contribution of agriculture to total inequality to the highest (3.271) while secondary economic activities contributed the least in negative effect. It is good to note that agricultural income is highly unequally distributed, further, it is identified that secondary economic activities is inequality decreasing.

Table 4: Income Functions of Respondents

Source: Field Survey, 2022

The coefficient of variation shows how focus is on the inequality of different income sources namely agricultural activities (primary occupation) and non- agricultural activities (secondary occupation). It was found that agricultural income represented the most important inequality-increasing source of income while non-agricultural income has greater inequality decreasing potential.

Table 5 Decomposition of Gini Coefficient.

Income source	Gini Decomposition Coefficient
Primary income	3.271
Secondary income	-2401.58
Total income	1.428

Source: Field Survey, 2022

Table 5 set out this decomposition and shows that while agricultural income only represents 70.01% of total income in Kwara State, it accounted for about 40% of the inequality. It is clear from these tables that there is a high level of income inequality contribution from the agricultural sector in Kwara State, which in turn could be indicative of what is expected in other states of the country. In line with the thinking of Persson and Tabellini (1994) that hypothesized that higher income inequality would lead to more redistributive public policy in democracies because the median voter increasingly prefers redistributionist public policies as inequality increased. It is expected that equity oriented policies by the present democratic government im the country stand a better chance of wide acceptance by populace.

Table 6 Foster-Greer Thorbecke Poverty Measures

Income sources	**Poverty incidence (P_0)**	**Poverty depth (P_1)**	**Poverty severity (P_2)**
Total Income	0.7167	0.363	0.237
Primary occupation	0.725	0.396	0.268
Secondary occupation	0.650	0.412	0.322

Source: Field Survey, 2022

Table 6 presents the results of the Foster-Greer Thorbecke (FGT) measures of poverty. These measures quantify the three well-known dimensions of poverty, namely the level, the depth and the severity (also known, respectively as incidence, inequality and intensity) of poverty. The headcount ratio (P0) is the most popular FGT measure. It is the ratio of the number of poor individuals to the total population. The results reveal that livelihood solely on primary occupation and 65% of those who are engaged in secondary economic activities were living in absolute poverty as defined by the poverty line for rural Kwara State of Nigeria. Considering the depth of poverty (poverty gap, Pi) that measures the shortfall of the average income of the poor relative to the poverty line.

Conclusion

The analysis has shown that Kwara state is in acute poverty status and needs to be urgently addressed before it becomes politically volatile. The study shows that poverty should not be viewed from income/consumption/expenditure alone but should be addressed from people's perspective as poverty is multidimensional and should be measured in many dimensions. Also, from the respondents' point of view, the preceding analysis has demonstrated that secondary occupation in complementary with agricultural activities in Kwara State, Nigeria is important in terms of both employment rates as well as incomes. Roughly, three quarters of the economically active population in Kwara State, Nigeria is employed in the secondary economic activities. The range of activities in which the rural population engaged extends from trading to services. A considerable number of secondary activities are connected to agriculture, in that they fit into agricultural goods or they supply goods and services for agricultural

households. Encouragement of secondary economic activities which has greater potential to impact on income distribution in that they are inequality decreasing should be practiced. An important challenge is to increase access of the poor to secondary activities that yield high incomes. Creating enabling environment for vigorous growth as well as investing in education and improvement in the asset endowments of the poor will alleviate poverty in the study area.

References

Awoyemi, T.T (2004). "Rural Households Diversification into Secondary Economic Activities: Options for Poverty Alleviation in Oyo State, Nigeria", Issues in African Rural Development, Monograph Series, No 35

Clarke, G., Colin, L., & Zou, X.H. (2003), "Finance and Income Inequality: Test of Alternative Theories". World Bank Policy Research Working Paper 2984, Washington D.C., World Bank. Pp 8-9

Cowell, F.A. (2000), "Measurement of inequality", in Atkinson A.B and Bourguignon F. (Eds), Handbook of Income Distribution, Vol. 1, North Holland, chapter2, 87-166.

Datt, G. & Ravallion, M. (1992), "Growth and redistribution components of changes in poverty measures: A decomposition with applications to Brazil and India in the 1980", Journal of Development Economics 38, 275-295.

Deaton, A. (1997), "The analysis of household survey, Microeconomic Approach to Development Policy, BaltKwarare," John Hopkins University press, for the World Bank. Federal Office of Statistics, Abuja, Nigeria (1999), "Poverty and agricultural sector in Nigeria" Poverty Incidence of Farmers by Region Federal.

Fields, G.S. (2000), "Measuring Inequality Change in an Economy with Income Growth, The International Library of Critical Writings in Economics": Income Distribution,(Edward Elgar).

Foster J. Greer H & Thorbecke E. (1984), "A class of decomposable poverty measures" Econometrica 52 No. 3, Pp761-766.

Fuentes-Nieva R.(2014), "Head of Research, Oxfam GB, Nicholas Galasso", Research and Policy Advisor, Oxfam America pp2 Geweke, J. & Keane, M. (200D), "An empirical analysis of earnings dynamics among men in the PSID: 1968-1989", Journal of Econometrics 96,293-356.

Gottschalk, P. & Smeeding, T.M. (2000), "Empirical evidence on income inequality in industrialized Countries", in Atkinson A.B. and Bourguignon F. (eds), Handbook of Income Distribution, Volume 1, North Holland, Chapter 5, pp.261-308.

Heshmati, A. (2004).," Inequalities and their measurement", Unpublished Manuscript. Institute for the Study of Labor, Bonn, Germany.

Ipinnaiye, A. O. (2001), "A Decomposition Analysis of the sources of income inequality in Ibadan metropolis", Unpublished B. Sc. Project, Department of Agricultural Economics, University of Ibadan, Ibadan.

Jian L.R. & Tendulkar L.(1990), "Role of growth distribution in the observed change of headcount ratio-measure of poverty: a decomposition exercise for India", Technical report no 9004 (Indian Statistical Institute, Delhi).

Kimalu, P. Nafula N. Manda D.K. & Kimenyi, M.S. (2001), "A situational analysis of poverty in Kenya", KIPPRA Working Paper No. 6.

Kuznets, S. (1955), "Economic growth and income inequality". American Economic Review 45 (March) 1 - 28.

Lanjouw, P. (2001), "Non-farm employment and poverty in El Salvador", World Development 29(3), 529-547.

Milanovic, B. (1998), "Income, inequality and poverty during the transition from planned economy to market economy": World Bank Regional and Sectoral Studies. Washington DC. World bank.

Morduch, J. & Sicular, T (2002), "Rethinking inequality decomposition, with evidence from rural China", Economic Journal 112(476), 93-106.

Moffit, R. A & Gottschalk, P (2002), "Trends in the transitory variance of earning s in the United States", The Economic Journal 112, March C68-C73.

Ogbeide, E.N.O. & Agu D.O. (2015), "Poverty and income inequality in Nigeria: Any causality".Asian Economic and Financial Review, 5(3):439-452

Oyekale, A.S., Adeoti, A. I., & Ogunnupe. T.O. (2004), "Sources of income inequality and poverty in rural and urban Nigeria", A proposal presented at the 3rd Pep General Meeting, Dakar (Senegal), 10th-20th June, 2004. Journal of Economics and Sustainable Development www.iiste.org ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online) Vol.8, No.20, 2017 200

Oxford Atlass (1996), "Map of Osun State of Nigeria", Oxford University Press.

Persson, T. & Tabellini, G (1994), "Is inequality harmful for growth"? American Economic Review 84 (3): 600-621.
Pyatt, G. (1976), "On the interpretation and disaggregation of Gini coefficient", Economic Journal 86(342), 243-255.
Quah, D. (2002), "One third of the world's growth and inequality, Economics Department", CEPR Discussion Paper 2002:3316.
Subramaniam, S. (ed), (1997), "Measurement of inequality and poverty", Readers in Economics, Oxford University Press.
Shorrocks, A.F. (1984), "Inequality decomposition by population subgroups", Econometrica 52(6), 1369-1385.
Shorrocks, A. & Kolenikov S. (2001), "Poverty trends in Russia during the transition Unpublished manuscript
Van de gaer D. Funnel, N. & McCarthy, T (1999), "Statistical inference for two measures of inequality when incomes are correlated", Economics Letters 64, 295-300.
World Bank, (1996), "Profile of Poverty". In Poverty and Welfare in Nigeria. Washington D.C.
World Bank, (1999), "Inequality Measurement and Decomposition", World Bank, PovertyNet. Washington D.C.
Zandvakili, S. (2002), "Trends in earnings inequality among young adults". Review of Social Economy 60(1), 93-107.

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Analysing the transition of food loss and waste reduction in the food-security nexus among farming households in Southwest, Nigeria.

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Abstract

The study investigates the dynamics of food loss/waste behaviors and their determinants among farming households in Southwestern Nigeria, within the context of food security. Addressing urgent sustainability concerns, the study delves into the relationship between food loss/waste and food security, aiming to inform micro-policies for reducing household-level food waste. Twelve rural/semi-urban areas were selected across three states, with 300 usable household datasets collected over two periods. The transition from food security to insecurity showed a 9.15% increase, while the reverse had a 4.05% differential. More households achieved food security (16%) during harvest seasons, contrasting the 25.3% food insecurity during off-seasons. Probabilities indicated a 0.23 chance of escaping food security and a 0.37 chance of entering food insecurity. Agricultural harvests witnessed higher food loss/waste (35.5%), notably in fruits/vegetables (29-41%) and tuber crops (33%), surpassing non-harvest rates by 25.5%. Unlike prior studies that separately analyzed food waste/loss, this research innovatively examined their interplay and its nexus with food security over two timeframes. Ultimately, the study's exploration of whether farm households can reduce food loss/waste over time and its connection with food security and harvests is pioneering, albeit as a pilot effort.

Keywords: Panel data, Food insecurity, Food loss/waste transition, Simultaneous equation model, Southwestern, Nigeria

Introduction

The study examines the dynamics of food loss/waste behaviour and its determinants in the food security nexus among farming households in Southwestern Nigeria. Literature contended that food waste/loss is one of the main sustainability issues urgently needed to be contained (Btitean and Angali, 2023, Skawi and Zlewski, 2022). In recent years, food waste and food loss have risen up high on the agenda of policy makers, researchers, business and civil society organizations, internationally and in particular in developing countries like Nigeria (Amaza *et al*, 2008, Akerele *et al,* 2017, Boitean and Pingali, 2022). Many of these studies see a linkage between food waste or food loss on the one hand, and food security on the other (Chaboud, 2017, Zasada *et al*, 2019, Catteneo *et al*, 2021). Literature deduced that Zero Hunger Challenge can be overcome by paying close attention to achieving zero food loss and waste as part of the way of eliminating hunger (Wang *et al*, 2001, UNEP, 2021). Hence, achieving zero hunger would require, among other measures, eliminating/reducing food loss and waste, understanding the causal relationship between food waste/loss and food security called for a deep concern (Delgado 2021, Barrera and Hertel, 2021). Food waste is a global issue that is currently gaining attention in light of food security problems and related environmental issues (Hang *et al*, 2020, Chauhan *et al*, 2021). Studies related to household food waste have looked at consumer behavior in attempting to explain household food waste behaviors, food security and poverty

(Principato, 2018, Galli, *et al*, 2019, Qi *et al*, 2021). Literature have deduced that Food waste and loss has become a persistent issue (Wang et al, 2020, Catteneo *et al*, 2021). This persistence deepening the food security enhancement which shows more orientation toward low-level subsistence than what attained about 20 or 30 years ago should be of great concern. This is the rationale in which this study was undertaken.

The terms "food loss" and "food waste" are frequently used as tantamount, while they refer to different aspects of the same problem (Beausang *et al*, 2017, Cane and Para 2020). Literature contended that Food loss and waste (FLW) is an important topic due to its high socioeconomic costs and the impact that loss and waste have on the status of food security and poverty. Past studies indicated that while the global demand for food grows, millions of people suffer from undernourishment worldwide and in some developed countries food are being wasted in large numbers (Ghosh and Eriksson, 2019, Simms *et al*, 2020). Moreover, it was estimated that about 1.3 billion tons of edible foodstuffs (one-third of the global food production) are lost or wasted along the food supply chain (Alamar *et al*, 2018, FAO, 2022). It is argued that FLW is also a moral issue because almost 12 % of the population in the world is suffering from hunger (Goosseus *et al*, 2019, Williams *et al*, 2020). Despite this awareness and the efforts taken to minimize FLW, it remains excessively high (Devin and Richards, 2018, Vangeffen *et al*, 2020). According to Vishwakarma, *et al*. (2020), nearly half of all root crops, vegetables and fruits across the globe get wasted. Owing to the magnitude of the situation, scholars have conducted several studies concerning FLW in the food supply chain (FSC). Globally, researchers estimate that, in FSCs, the percentage of food loss in production, postharvest and consumption stages are 24, 24 and 35 per cent, respectively (May and Guether, 2020, UNEP, 2021). Thus, where food loss/waste occurs most is at the consumption stages. Hence what are the Factors influencing these losses at the consumption stage. Past studies deduced that food security status, poverty status and agricultural harvest/non-harvest period at the major determinants (Gillman *et al*, 2019).

Mostly economic estimation of household food waste related to food security is done in developed nations, yet, limited data about quantitative estimation of household food waste are available in developing countries like Nigeria (Canovas *et al*, 2018, Buisman *et al*, 2019). Hence, estimating the FLW can help creating awareness among the general public and policy makers on the importance of food which is being wasted due to consumer/household behavior. Studies deduced that the main causes of FLW at household levels were; poor quality food, improper meal planning, food not consumed in time, plate waste, resentment of eating leftovers, improper storage, and lack of awareness about the impact of food waste (Bellamare *et al*, 2017, Chalak, *et al*, 2019). However, reasons for household food waste in developing nations with special reference to Nigeria are lacking. So, discerning the reasons of food waste at household level is indispensable to comprehend food wasting behaviors and to find the options in planning food waste reduction strategies. Policies can be developed from this pilot study in order to understand factors/policies influencing FLW reduction.

Policymakers and social scientists are eagerly interested in understanding the evolution that causes FLW in Nigerian households (Aramolaran, 2009, Amao and Ayantoye, 2015, Akerele *et al*, 2017, Aragie *et al*, 2018). According to these studies, the most challenging ones are poverty status, agricultural harvests and some socio-economic variables. Nigeria, despite its abundant natural resources' bequest, is still classified as the 9th poorest nation in the world that could not meet her food needs (UNEP, 2021, FAO, 2021). Researchers in the country have devoted a vast number of efforts in examining factors influencing food loss/waste in the country and also looked at alternative, consumption-based measures of food consumption (Fami *et al*, 2019, Demoraes *et al*, 2020). Available literature indicated that the dynamic properties of food loss/waste and food security nexus and its determinants were never captured by these studies. Moreover, few studies that examined food loss/waste and food security nexus transition and determinants in developing countries only investigated this concept as static giving a relatively few characteristics of the transitory of food loss/waste and food insecurity problems (Chalak *et al*, 2016, Harvey, *et al*, 2019). Past studies have argued that economic hardship such as food insecurity and food loss/waste often is not static but dynamic (Chalak *et al*, 2018, Khalid *et al*, 2019).

Gundersen and Oliveira (2001) estimated the effects of different economic and demographic variables on food insecurity using national sample data in Mali. The study found out that food insecurity fell with rising income particularly during the crop harvesting period and rises during off harvesting. In the same vein, Serem (2007) using data from Vihiga district, Kenya, discovered that household food security was guaranteed mostly during the farm harvesting period and scarce during the non-harvesting period. Jacobs using data to examine the food security status of South African households found out that food scarcity/poor among rural households is common during the on-farm season, while majority experienced food security during the crop harvesting period. This finding was also evidenced in the work of Labadarios *et al*. (2009) that food insufficiency households in South Africa are common during the off season of agricultural production. Similarly, Devereux (2000) in his analysis of Ethiopian data on Food insecurity revealed in farming households is not static but dynamic. Also, what is common in these studies reviewed that food loss/waste is common during crop harvesting stage.

Amao and Ayantoye (2015) analyzed the correlates of food insecurity transition and its determinants among farming households in North Central, Nigeria. The study discovered that there were movements into and out of food insecurity position during the two seasons. The study depicts that there were, however, more rural households (72 percent) moved into food insecurity situation during the off-farm season. In the long run, 86 percent of households would transit to food insecurity during the on-farm season. Factors influencing movements are as follows: household size, educational status of head, age, asset ownership, remittances, occupational status of head, access to credit and access to extension services. In all these studies reviewed none has ever examined food loss/waste and food security nexus and the effects of agricultural harvest effects on the transition food security and FLW reduction

Past studies deduced that Food "loss" occurs earlier before the food extents into the hand of consumer due to issues bordered by production, storage, processing, and distribution phases. However, Food "waste" denotes food that is appropriate for consumption but deliberately disallowed at the selling or consumption stages (Vangeffen *et al*, 2020, Boitean and Pingali, 2022). Hence, from this scenario the study wants to examine factors influencing the food loss due to issues bordered by production and determining factors swaying food waste. Hence, understanding the dynamics between food loss/waste and food security nexus can enhanced the micro-policy and factors stimulating food waste reduction at the household level (Beretta *et al*, 2013, Aragie *et al*, 2018, Santeranio, 2021). This is the rationale in which this study was undertaken. What are the factors that influencing food loss and waste reduction to improve food security. What is the significant of FLW reduction in food security nexus and what is the position of agricultural harvest. Hence, to have a clear thoughtful of this relationship, the study will examine various factors stimulating food waste at household level and the extent of the economic losses incurred by food waste. Studies deduced that reducing food waste can influence household expenditure reduction on food, emancipating resources for health, education and well-being (Gogo *et al*, 2018, Boiteau and Pingali, 2022). Hence, the study objectives are to determine the transitory of food insecurity nexus, the place of agricultural harvest, household's behaviours connected to Food wasting and how these variables were influenced by FLW. The study was organized as follows, introduction come up in the first section, the theoretical framework driving the motivation of the study in section 2. Methodology in section there, while section four presents the results and discussions and section five concludes the study.

Theoretical Framework.

The most widely mentioned linkage between food wastage and food security is an implicit link between food wastage and food insecurity (Campoy-Munoz *et al*, 2017). The amount of food wasted globally is stated, followed by the amount of people that go hungry in the world, but for the food loss, this cannot be determined at the micro level, except in the macro level (Galli *et al*, 2019, Corrado and Palumbo, 2020). The exact relationship between the two is often not specified. This statement is usually accompanied by an ethical appeal to change this situation. The FAO estimates that roughly one-third of the edible portions of food produced for human consumption gets lost or is wasted globally, which is about 1.3 billion tons per year. It's being hypothesized that food in-secured households being more worried about the financial variability of food prices thus influenced purchasing food constituents

in bulk, which is not consumed in time and resulting in food waste, whereas in rich households, buy and cook more than their actual need which ultimately led to more food waste (FAO, 2019, Fami *et al*, 2019, Demoraes *et al*, 2020). Hence, there is need to determine the linkage between attitude and behavior of consumer which causes food waste from the point of econometrics estimation.

Econometrics estimation of food insecurity transition

Past deduced that household is said to be food secured when members of the household have access to enough and safe nutritious food to maintain a healthy and active life (Bayliss-smith, 1991; Bickel et al., 2000). In this study, food-secured household is conceptualized as "most members in household who always have access to safe nutritious food." The literature has argued that food security is not a static situation but dynamic (Zasada *et al*, 2019, Santeranio, 2021). The study therefore examined food security transition by adopting the framework of the Markov chain model. The Markov chain theory and methodology adopted by Bob-Baulch and McCulloch (1998) and Nord *et al*. (1999) was employed and modified to suit the scope of the study. The Markov chain model used here explored the dynamics of food secured in order to understand the correlates and causes of movement into and out of food security. The food-insecurity transition matrix shows the number of households in and out of food insecured situation in a particular period, broken down by their food-security status.

Thus, it becomes easy to see the number of households who have been in food security situation or otherwise and the number of people who have escaped or entered food insecurity. From the matrix, the probability of entering and exiting between the two periods can then be calculated. Hence, the items in the transition matrix above are converted into probability values of entering and exiting food insecurity situation, and dividing each item by the corresponding row total gives the transition probability matrix shown in Equation (1). The Markov food insecurity transition matrix would be derived as follows:

$$\begin{pmatrix} F_{11} & F_{12} & F_{13} \\ F_{21} & F_{22} & F_{23} \\ F_{31} & F_{32} & F_{33} \end{pmatrix} \quad (1)$$

Also, the vector of initial probability P_H (o) will be obtained by dividing each column total by the grand total. Thereafter, the proportion of households that will be in each category in the subsequent periods can be known by using the following equation:

$$P_H(T) = P_H(0)P^T \quad (2)$$

where T is the time period in years.

Long-term equilibrium (Le) would be derived from:

$$LeP_H = Le \quad (3)$$

As

$$(Le_1 Le_2 Le_3) = \begin{pmatrix} F_{11} & F_{12} & F_{13} \\ F_{21} & F_{22} & F_{23} \\ F_{31} & F_{32} & F_{33} \end{pmatrix} = (Le_1 Le_2 Le_3) \quad (4)$$

The solution to the above matrix produced Le_1, Le_2, Le_3, which are the proportion of households that will be food secured, moderate food insecure and core food insecure at the equilibrium, respectively. Le_1 is the equilibrium state for core food secure; Le_2 the equilibrium state for moderate food insecure and Le_3 the equilibrium state for food secure. From Table I, the simple probability of entry and exit of the food (in) secure are then derived. To obtain the food-secure/-insecure households, food-secure/-insecure line will be constructed to delineate the food secure and insecure status of the households.

Table I. First-order Markov model of food insecurity transition

Period I- early rain	Period II- late rain			Total
	Core Food insecurity	Moderate Food insecurity	Food Security	
Core Food insecurity	CFIS	MFIS	FS	
Moderate Food insecurity	CFIS	MFIS	FS	
Food Security	CFIS	MFIS	FS	
Total				300
Notes: CFIS, core food insecurity; MFIS, moderately food insecurity; FS, food security				

The study used the following specific steps in the delineation of food security/insecurity households (Greer and Thorbecke, 1986):

(1) The value of food ($VFhj^*$) consumed by each household, which is equal to the sum of the value of purchased food (Vhj^*) and the value of own production consumed (Chj^*) was determined by: $VFhj^* = Vhj^* + Chj^*$) (6)

Where Vhj^* is deduced as $Vhj^* = \sum Q_{ij} Ph_{ij}$ (7)

where Vhj^* is the value of purchased food consumed by the jth household; Qij the quantity of the ith food item purchased by the jth household and Phij the local price paid by the jth household for the ith food item. The value of own output or food consumed by the household Ghij is the product of own production (including gifts) (OPi) and the local prices (Pxi). The quantity OPij is the imputed value of consumption:

$$Ghij^* = \sum OP_{ij} Ph_{ij} \quad (8)$$

(2) The adult equivalent Hj for each household was proxy by the household size.

(3) $VFhj^*$ was deduced by

$$VFhj^* = \frac{VFhij^*}{H_i} \quad (9)$$

where $VFhj^*$ is the total value of food consumed by the jth household; Hj the adult equivalent for the jth household and $VFhij^*$) the total value of food consumed per adult equivalent units.

(4) The different types and quantities of foods consumed by the different households were converted to calories Caj using the calorie equivalents.

(5) A regression model was fitted to estimate parameters to be used in determining food insecurity threshold (line): $InTfx_j = a + bCa_j$ (10)

where Tfxj is the total food expenditure per adult equivalent by household j; Caj the total calorie consumption per adult equivalent by household j and a and b are the parameters to be estimated.

(6) The food poverty line Z (which is the estimated cost of acquiring the calorie recommended daily allowance RDA) was estimated as:

$$Z = Le^{a+bRe} \quad (11)$$

where Z is the food insufficiency threshold (line) and the recommended daily allowance of calories per adult equivalent of 2,350 (Scubert, 1994).

(7) The classifications of various measures of food insufficiency households (Pα) were computed using the formula of Foster et al. (1984):

$$Ph_\alpha = \frac{1}{N}\sum_{i=1}^{Qh}\left(\frac{Z-Yi}{Z}\right)^{\alpha} \quad (12)$$

where Z is the food insecurity line; Yi the food expenditure measure in Naira (N)i (i=1, 2, …, q); q the number of households below the food insecurity line (food poverty households); N the total number of sampled households; α the parameters of the Foster Greer and Thorbecke index (Phα). a ⩾0 and it can take three values of 0, 1 and 2. These values give different implications. This formula was therefore used to decompose the farming households into classes of food-security/food -insecurity status.

Calculation of Food Loss and Waste

The value of food lost or wasted annually at the global level is estimated at US$1 trillion. Yet reliable numbers on specific numbers of wastage are absent. Food is lost or wasted throughout various stages of the food supply chain. During agricultural production, crops and harvest can become damaged or spilled, animals may die due to diseases, fish may be discarded during fishing and milk could be lost due to cattle diseases. Crops, animals, fish or milk may be lost during post-harvest handling, storage and in transportation. During processing, food may be lost or degraded during washing, peeling, slicing, canning, packaging etc.; or during slaughtering, smoking, freezing or pasteurizing. During distribution, food may be lost or wasted during transport, at wholesale markets, supermarkets, retailers, etc. Finally, consumers may waste food by throwing it away.

Linkage between food wastage interventions and food security often not explicit in spite of the popularity of food wastage interventions in policy circles, the number of studies and documents on the relationship between food wastage actions and food security is relatively small. FLW influenced hunger index, food quality and safety, food security, economic development, environmental conditions, and social prosperity (Caderia *et al*,2019; FAO, 2020; Fabi *et al*., 2021). FLW negatively impacts food security and the environment, hindering the achievement of SDGs [56]. SDG 1, "No Poverty," and SDG 2, "Zero Hunger", are food security related. There are some reasons why poor countries may have a better environment, for example, lower industrialization and demand for natural resources, which may keep clean environments, but at the same time keep poverty. Depending on agriculture and traditional practices, this tends to be less chemically intensive and more sustainable, but more inefficient in quantity production. Lower consumption results in a lower generation of waste and pollution, but sometimes consumption is below the survival standards (Gokarn and Chadhary 2021). Therefore, considering that in countries with a weak and moderate level of food security, FLW accounted for 21% and 20% as a percentage of the domestic food supply, it is possible to argue that there is a gap contributing to the achievement of SDGs through reducing FLW.

The mass balance method designed by Calderia *et al*, (2019) is used in this research. This method calculates the amount of FLW as the difference between inputs and outputs of food, their stock variations, and weight changes during the process (Hartikainen, *et al*, 2018). This method presents several advantages as it allows calculating the FLW of liquid and solid food at each stage of the food supply chain (FSC), at the national level, or the more specific company level. Moreover, the data required are often easily accessible and readily available, e.g., in national statistics (Endalew *et al*, 2015). For the research scope, the mass balance method is appropriate. It covers the FSC worldwide, in all stages, and includes a wide range of food products. In addition, the amount of FLW estimated for each country was associated with its level of food security, using the four clusters formed by the Global Food Security Index (GFSI) designed by The Economist Intelligence Unit. These clusters are "very good", "good", "moderate", and "weak", and a set of indicators calculates them based on four categories related to food security: affordability, availability, quality, and safety, and natural resources and resilience. The GFSI is calculated for 113 countries, while FLW is estimated for 171; therefore, the rest of the countries were classified in a "without EUI index" cluster. The accounting approach to estimate FLW is described in Figure 1. The following equations represent the estimation of FLW and pooling.

$$FLWxi = \sum_{i=1}^{n} \delta A_{ij}\, x\; ;\; \alpha B_{ij}\, x\; ;\; \beta C_{ij}\, x;\; D\gamma_{ij}\, x\; ;\; E\vartheta_{ijx};\; \varepsilon \qquad (13)$$

$$FLWxi = a_0 + a_1 \delta A_{ij_1} + a_2 \alpha B_{ij_2} + a_3 \beta C_{ij_3} + a_4 D\gamma_{ij_4} + \cdots . a_5\, E\vartheta_{ij_5} + \varepsilon \qquad (14)$$

Where

$$FLWx = FLWxi \qquad (15)$$

Where

1. i is the food group: fruit, cereals, milk, fish and seafood, meat, eggs, starchy roots, oil crops, and vegetables;
2. j is the stage of the FSC: agricultural production, post-harvest, storage, processing and packaging, distribution, and consumption;
3. k is the food insecurity status;
4. l is the level of food insecurity categorize as Chronic, Moderate and Good.

5. δA_{ij} is the domestic food supply quantity, which is the quantity of food available in the food group i in stage j.
6. αB_{ij} is the food loss and waste rate (FLWR) in the food group i in stage j where k, defined as the ratio of food loss and waste to the total amount of food production;
7. βC_{ij} is the allocation factor in the food group i in stage j where k, which defines the proportion of the food meant for human consumption.
8. $D\gamma_{ij}$ is the conversion factor in the food group i in stage j where k, which defines the proportion of edible food;
9. $E\vartheta_{ijx}$ is the conversion factor in the food group i in stage j where k, which defines the proportion of non-edible food;
10. $FLWkl$ is the food loss and waste in the country k with the level l of security.

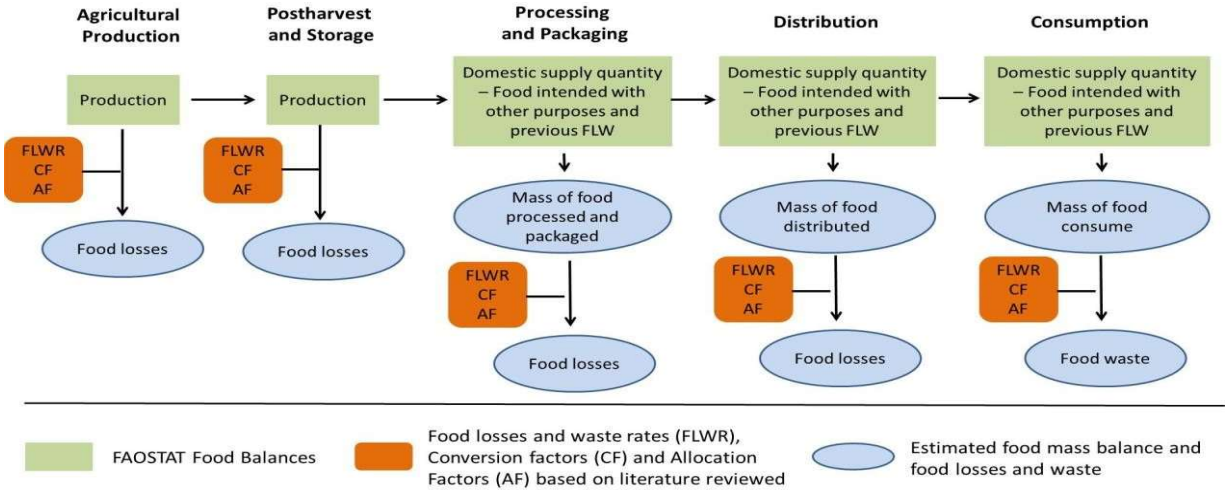


Figure 1. Accounting approach to estimate FLW. (FAO, 2021)

The mass balance method distinguishes between edible and non-edible food. Regarding FLW, quantification only considers edible food and discordance in the FLW estimation. Several causes contribute to decreased edible food mass in FSC stages (Endalew *et al*, 2015). In this sense, food loss occurs at all stages except consumption, when food waste occurs (Harvey, *et al*, 2019). Therefore, the FLW is calculated, multiplying the amount of food available at each step of the food chain by FLWR and the allocation and conversion factors. Finally, the FLW considers the country's level of food security. Then, the following equation was used to calculate the per capita FLW

$$FLW_{PC} = \frac{FLWx}{Ph_n} \qquad (16)$$

Where $FLWPc$ is the per capita food loss and waste and Phn is the population/sample size (n)

Methodology

Area of Study

Southwestern Nigeria is one of the six major zones in Nigeria. This zone has six states in it: Lagos, Oyo, Ogun, Ondo, Osun and Ekiti. Three states were selected out of the six states in Southwestern Nigeria, namely Lagos, Ogun and Ondo. Ondo state was chosen because the state is basically an agrarian state where there are many employment opportunities both with the private and public sectors. Also, the state is known for its conservative when it comes to being careful with FLW. Ogun state was chosen because the state is both an agrarian and commercial town where FLW is common and controlled in some settings. Lagos on the other, the commercial hub of the region and a cosmopolitan city where FLW can be seen almost everywhere. In addition, the selection of Ogun and Lagos states respectively were based primarily as the states known to be in the low poverty status and moderately food security status. On the other hand, Ondo has a high poverty rate among the three states with high food insecurity status (NBS, 2022).

Sampling Techniques

Four rural/semi-urban local government areas (LGAs) were selected from each state, given a total of twelve LGAs. These four rural/semi-urban local government areas (LGAs) were selected based on the information sourced from the Nigeria Bureau of Statistics (State ministries of rural development, 2023). A combination of cluster and systematic random sampling was used to select 40 households from each of the selected twelve rural/semi-urban communities. Thus, a total of 160 households per state and 480 households in all were selected during the first data collection. On visiting the same households during the second data collection, only 300 households' data were useful for data analysis (Table 1). The unused data of 180 households had; incomplete information and missing data in the questionnaire that could not provide sufficient information for data analysis. The needed information was collected through the use of interview schedules/questionnaires. Food price data were obtained through community market surveys. Both primary and secondary data were used for this study. Based on the specific nature of data requirement for this study, panel data were adopted and they were collected in two periods. Data were collected during the late and early rain, respectively, over a period of nine months; first data set was collected in March 2012 and second data set in November 2012.

Primary data were collected with the aid of a well-structured questionnaire, administered on farming households in the area of study. Secondary data came from the Central Bank of Nigeria and National Bureau of Statistics. Food consumption and FLW information/data were collected on individual basis from the households. Magnitudes of daily food intake were collected for each member of the household, using a 48-hour recall method. Each household was visited at least once in two weeks for the months of March and November. Thus, daily food intake quantities for each individual in the household and FLW were collected two times in the month of March and also two times in the month of November. The analysis reported here was based on per capita daily food consumption averaged over the nine months of data collection. This is designed to reduce measurement errors in food consumption by smoothening day-to-day fluctuations in food intake. These quantities were then converted into kilogram units. Income and expenditure information as well as FLW data were obtained on a fortnightly basis for a period of nine months.

Table 2: Semi-Urban/Rural * Local Government Crosstabulation

Count

		Local Government						
		Kosofe	Ikorodu	Abeokuta North	Imeko	Akure North	Ifedore	Total
Semi-Urban/Rural	Isheri	25	0	0	0	0	0	25
	Olowora	25	0	0	0	0	0	25
	Imota	0	25	0	0	0	0	25
	Ijede	0	25	0	0	0	0	25
	Akomoge	0	0	25	0	0	0	25
	Iluguri	0	0	25	0	0	0	25
	Imeko Oke	0	0	0	25	0	0	25
	Ilara	0	0	0	25	0	0	25
	Araromi	0	0	0	0	25	0	25
	Iju	0	0	0	0	25	0	25
	Odo-oja	0	0	0	0	0	25	25
	Amaye	0	0	0	0	0	25	25
Total		50	50	50	50	50	50	300

Source: Results of Data Analysis, 2023.

The study requested information about respondent's amount of food waste generation (order starting from 1= very low less than 5%, to 5= very high more than 50%) in different categories

including fruits and vegetables, tubers, dairy, chicken, meat, sea food, processed food and cooked food among others. Also, .data were collected on household's storage behavior among others. Also, information collected were on the reasons on wrong meal planning, cooked improperly, not consumed in time, looked bad, smelled/moldy, incorrect storage, freeze and store in the cupboard too long, an excess of money. Data were also collected on food preparation and eating habits (eat home to use up leftovers, make too much food, preferred to cook products near expiration, save leftovers in the fridge, discard leftovers because no one wants to eat, forget about food in the fridge until it's too old to use, discard food because it didn't taste good and cooked in careless manner) and various shopping behavior (check fridge and cupboard before shopping, make shopping list, plan meals before shopping, buy too much due to tempting products, pick things from shopping area without need and buy more and extra to try new dishes) of respondents which leads to food waste at household level.

Estimation Techniques

The structural form equation adopted as a framework for this study is the simultaneous equation model. The use of the Simultaneous model enables all the available information from the explanatory variables to be used in the equation as a single model (Simultaneous model) (Olayemi, 1998). The study deduced that the food insecurity gap (which serve as the percentage insecurity gap) as one of the dependent variables have an amended distribution as:

$$\text{The food insecurity gap } (FISG_i) = \left(\frac{Z-Y}{Z}\right) \quad (17)$$

where $FISG_i$ (food insecurity gap) is the latent economic quantity of interest:

(1) If Z > Yi, $FISG_i$ is positive. This means that the household records a food spending level that is lesser to the food security threshold (line) and is regarded as falling into food insecurity situation.

(2) If Z < Yi, $FISG_i$ is negative. It has a superior food spending level to the food insecurity line and is regarded as falling into food security situation

The implication is that for food insecure households, the FISGi's are positive, while for food secured households, they are negative. This situation calls for simultaneous equation. Hence, in our model specification, the percentage food insecurity gap (Z−Yi/Z) × 100 is used as the dependent variable. Hence, the model is expressed as:

$$FHi_j = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + \ldots . a_{20}X_{20} + \varepsilon \quad (18)$$

Where one of the Xi is $FLWxi$ extract from eqn. 18

Hence, the estimating equation is:

$$FHi_j = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + \ldots . a_{20}FLWxi + \varepsilon \quad (19)$$

Where $FHi_j =$ Food insecurity status

$FHi_j = 1, If\ D_i > D_{0i}$

$FHi_j = 0, If\ D_i < D_{0i}$ …. 300

The four categories of food insecurity transitions are as stated below:

1. FH_{11} = 1 if never food insecurity, 0 if otherwise;
2. FH_{12} = 1 if gratifying food insecurity, 0 if otherwise;
3. FH_{13} = 1 if exiting food insecurity, 0 if otherwise;
4. FH_{14} = 1 if always food insecurity, 0 if otherwise;

a = coefficients; β = vector of respective parameters;

X_1−X_{20} = independent variables, while ε = distributed error term;

The independent variables are socio-economic and demographic variables are captured as: X_1 = household size (number), X_2 = level of education (years), X_3 = age (years); X_4 = marital status of

household head; X_5 = gender of household head; X_6 = farming/ fishing experience (Naira); X_7 = hired labor (Naira); X_8 = dependency ratio (No.); X_9 = expenses on food (Naira); $X1_0$ = farming/fishing income (Naira); X_{11} = farm size (Ha); X_{12} = expenses on non-food items (Naira); X_{13} = expenses on inputs (Naira); X_{14} = non-farm rural activities income (Naira); X_{15} = income consumed outputs (Naira); X_{16} = access to extension facilities (dummy), if access = 1, otherwise = 0; X_{17} = access to credit facilities (dummy), if access = 1, otherwise = 0; X_{18} = market facilities (dummy), if access = 1, otherwise = 0; X_{19} = asset status (measures in Naira), ; X_{20} = Estimates of FLWpc (measures in Naira).

Simultaneous Equation Model

To establish linkages (or interactions) between FLW and food insecurity transition nexus, Simultaneous equation model was adopted. The effects of FLW and food insecurity transition nexus on agriculture and other variables on economic growth were examined by regression analysis, where a two-stage methodology is adapted. This is necessary because food insecurity transition nexus and FLW are jointly depended on similar household socio-economic variables (Olayemi, 1998). Moreover, FLW has been used previously as dependent variable in Equation (18). Hence, in equation (19), FLW is then used as part of independent variables that predicted food insecurity transition nexus. Hence, the study used 2-stage least square (2SLS) method. The use of 2SLS has the advantage of estimating all parameters of the structural equation in the model simultaneously (Olayemi, 1998). The objective of using 2SLS is to facilitate the use of Ordinary Least Square (OLS) method to each equation of the structural model.

Econometrics estimation issues

Even though the structural equation presented in expression (19) is theoretically valid, estimating the model by a single equation of ordinary least-squares (OLS) regression procedure would likely result in biased estimates of elasticity coefficients for the food insufficiency status of farm-households (Khalid *et al*, 2019). Theoretically both non-farm income and farm income share are considered endogenous to the food insufficiency model for two reasons. First, since the income variable used in this model is basically labor income (both for non-farm and farm), its value is largely an outcome of labor supply choices. Second, reverse causality is a potential source of bias in the OLS estimate of the coefficients of insufficiency status of farm-household and income share. Furthermore, given the difficulty in getting accurate information on income of individuals and household in developing countries, classical measurement error bias (or dwindling bias) may also be a very important source of bias in this study. Therefore, a number of steps were taken to address the potential biases of the estimates of the insecurity status of farm-household income and non-farm income share elasticity as discussed earlier. First, the study adopted the maximum likelihood estimates (MLE) method on the dependent variable. MLE was used to estimate population parameters from a random sample. Secondly, in order to reduce the classical measurement error bias, per capita income on food expenditures and income data from all sources of livelihood activities, farming households were captured throughout the multiple visits over the period of data collection. Furthermore, the instrumental variable of the two-stage least-squares estimation procedure was used to address the problems of bias due to measurement error, omitted variable and reverse causality, which is likely to occur if the OLS procedure is used to estimate farm's income share and per capita income elasticities. The instrumental variable used was a variable of all income sources data comprising non-farm and farm income variable. This variable is correlated with the endogenous regressor but uncorrelated with the error in the structural equation.

Results and Discussions

Preliminary statistics

The study revealed that the mean age in Lagos is 10.49, Ogun is 47.86 and Ondo is 47.27 (Table 3). This is an active age group that can supports adoption of progressive technology. The study also indicated a fairly literate group where information dissemination can easily be accessed and used appropriately. However, the dependency ratio in the study is 4 and this has an implication on the resources of the household (Table 3). The average monthly income in Lagos is higher by 24% for Ogun state 23.3% and 26.7% in Ondo state. Similarly, sustenance allowance for food in Ogun state is higher by 3.32% in Lagos and 4.42% in Ondo state. Moreover, Table 3 indicated that monthly income was

more during the first data collection with a differential of 30%. Allowances for food upkeep with a differential of 1.2% over 2nd data collection. The study indicated that during the second data collection there were significant contribution of non-farm income to household income, thus increasing disposable income. Moreover, respondents from Ogun and Ondo state consumed more (15.5%) of farm produce than Lagos household. Likewise, farm income increases by 10.01 percent during the second data collection, there are however, a decrease recorded in Ogun 4% and Ondo (4,85%) (Table 3). Thus, sustenance allowances are more in Lagos with a difference of 6.03 percent and 6.46% in Ogun.

Table 3: Fundamental Statistics and Variables that influenced Food security status and FLW transitions matrix

s/n	Selected Household Characteristics	Lagos		Ogun		Ondo		All group	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
1.	Age	46.10	10.49	47.86	12.25	47.37	12.42	47.11	11.74
2.	Household size	6.10	2.51	7.40	1.82	7.13	1.92	6.91	2.16
3	Dependency ratio	3.28	1.73	4.45	1.59	3.75	1.68	3.83	1.73
4.	Educational level	3.29	0.87	2.56	0.61	2.74	0.79	2.86	0.82
5.	Income (Monthly) ₦ (1st Data collection)	394040	155363	301070	118478	211750	57221	302286	138858
6.	Income (Monthly) ₦ (2nd Data collection)	275830	108754	210750	82935	148220	40085	211600	97200
7.	Expenses on food (₦) 1st Data (%)	126090 (32.00)	97160	106343 (35.32)	37913	65759 (31.06)	38857	96732	44434.-
8.	Expenses on food (₦) 2nd Data (%)	104810 (38.00)	41327	80085 (24.03)	31515	56325 (37.97)	15221	80408	36936
9.	Income Monthly (farm) ₦ **1st data**	36.40`		55.38		72.26			
	(%)	38.01		45.49		13.07			
	Non-farm income (%)	10.05		4.00		4.85			
	Gifts income (%)								
	Farm produce (income) (%) consumed at home (%)	15.54		11.00		9.82			
10	Income Monthly (farm) ₦ **2nd- data**	31.82`		43.62		63.06			
	(%)	47.91		34.19		12.34			
	Non-farm income (%)	8.92		11.27		7.22			
	Gifts income (%)								
	Farm produce (income) (%) consumed at home (%)	11.35		10.92		17.38			

Source: Author's calculation from Computer print results

Income distribution and differentials during the transition

The study deduced that income distribution played a significant role in food security and FLW transition. Table 4 revealed that there were more households in low-income category that others income category as the study indicated a differential of 46.43%. Others income categories are Intermediate 19.01% and high-income category 33.67% (Table 4). The income distribution and categorization helped the study in generating chain that aided the use of Makov-Chain model to engage in the simulation of Food security and FLW transition matrix.

Food security status transition matrix from March -November, 2022

The preliminary statistics of households' food security status and food expenses on Table 5 revealed that households spend ₦1,439.38 per person for daily food expenses during the 1st data collection, while 2nd data collection indicated food expenses of ₦1,020.81 per person for daily food expenses. Hence, the

study revealed that Food secured households have usual larger food expenditures per capita than other groups (Table 5), and the minimum food spending needs per capita are relatively lower in the food secured household. Therefore, the ratio of the minimum food spending with usual food expenditure is around unity (0.94) for the food secured household but higher (1.37) for food insecure group (Table 5). This evidence indicates that experiencing greater food insecurity also expected to be significantly higher than their available resources. However, households' ability to manage resources may contribute to differences between food insecurity levels and vice versa. However, there might be other factors responsible for the food insecurity status of the household.

Table 4: Income distribution and differentials during the transition

s/n	Income category	1st Data Collection (n)	2nd Data Collection (n)	Differentials %
1	75,001 – 100,000	0	14	14.0
2	100,001 – 125,000	3	41	93.0
3	125,001 – 150,000	24	54	55.6
4	150,001 – 200,000	51	59	13.56
5	200,001 – 250,000	80	33	58.75
6	250,001 – 300,000	25	36	30.56
7	300,001 – 350,000	16	29	50.0
8	350,000 – 400,000	27	16	40.7
9	400,001 – 500,000	40	18	55.0
10	500,001- 1,000,000	34	0	34.0
	Summary: Lower-income group; (75,001 – 200,000.00) 46.43%			
	Intermediate-income group; (200,000.00 – 350,000) 19.01%			
	High-income group; (350,001 – 1,000,000.00) 33.67%			

Source: Author's calculation from Computer print results

Table 5. Food security status transition matrix from March -November, 2022

1st data collection matrix (March, 2022)	2nd data collection matrix (November, 2022)			Row (Total)
	Food non-poor % (n)	Food poor (moderate) % (n)	Food poor % (n)	
Food non-poor % (n)	18.33 (55)	13.66 (41)	23.67 (71)	55.67 (167)
Food poor (moderate) % (n)	5.67 (17)	7.00 (21)	11.00 (33)	23.66 (71)
Food poor % (n)	7.67 (23)	4.33 (13)	8.67 (26)	20.67 (62)
Column (Total)	**31.67 (95)**	**24.99 (75)**	**43.34 (130)**	

Source: Author's calculation from Computer print-out

The study examined the seasonal variation and influence on food secured households and found out that during the on-farm period (reaping season), 59.1% households are food secured compared to 46% percent during the off-farm season (planting period). Hence, many households progressed into food secured status during the harvesting season with a difference of 12.9%. Therefore, the study deduced the use of probabilities to ascertain the probabilities of households transpiring into food secured (non-poor) or not (Table 6). Hence, the study uses the period between March and November 2022 to examine the probability of households becoming food insecure given that such households were food secure in the first period was 0.23 and the probability of escaping food insecure given that such households were food non-poor was 0.37. Similarly, the earlier methodological discussion showed the relationship between entry and exit probabilities and the steady-state food-insufficient headcount using the Markov model (with the ratio of the entry into and exit probabilities being equal to the ratio of the proportion of

food insecure (food poor) to food secure (food non-poor). The dynamic nature of the food secured status as evidenced with the use of panel data and the results of the analysis revealed the importance to examine factors influencing entries into and exits from food security (non-poor) situation.

Table 6. Modest entry and exit probabilities

Year (2022)	Probability of entering FLW	Probability of existing FLW	Households moving out of FLW	Headcount (%)
March	0.23	0.37	39.6	40.8
November	0.31	0.33	31.7	35.3

Source: Author's calculation
Notes: N= 300
Headcount is for the second data collection.

Categorization differential and transition of food taken across households

The study categorized the transition and differential of food elements taken across income status. The study revealed that low-income group took more of carbohydrate (10%) than any groups. Similarly, this income category (low-income group) took more of fiber (9.33%) (Table 7). Moreover, the high-income group took more of minerals 2.33% more than other groups. However, food taken in the first data analysis but were taken less during the 2nd data collection (this attracts negative as documented in the Table 7). This implies that consumption of carbohydrate by the middle-class group drooped (10%). Similarly, consumption of protein by high-income dropped during the 2nd data collection. Conversely, poor households consumed more of cooked/left-over food by 5.67% more than any other groups. Table 7 further proved of the transition of food dynamics using southwest as a case study (Table 7).

Table 7: Categorization differential and transition of food taken across households

s/n	Food categorization	Income groups		
		High % (n)	Moderate % (n)	Low % (n)
1.	Carbohydrate	6.54 (21)	-11.00 (-33)	10.00 (30)
2.	Protein	8.33 (-25)	-6.34 (-19)	2.00 (06)
3.	Fats and oils	-0.3 (-09)	4.67 (16)	4.33 (13)
4.	Minerals	2.33 (07)	-2.33 (-07)	5.00 (02)
5.	Vitamins	2.33 (07)	1.67 (05)	1.00 (06)
6.	Fiber	567 (17)	2.67 (08)	9.33 (28)
7.	Processed food	-4.33 (-13)	-5.00 (-15)	-3.00 (-09)
8.	Cooked/Left over food	-2.33 (-07)	-6.33 (-19)	5.67 (17)

Source: Author's calculation from Computer print-out

Consumption/Buying behaviour differential and transition of food taken across households

The study categorized the consumptions/buying behaviour of the respondents and the results were presented from Table 8. Table 8 deduced buying excess foodstuffs when there is money/salary paid had the greatest impact on the consumptions/buying behaviour (25%). Similarly, do shopping when there is a need is about 22.67%, make a shopping list priority (20%), female do shop 11.3% among others (Table 8). Moreover, the study indicated that female do shop had priority (41.18%) when it comes to consumption/buying behaviour among the high-income group. However, making a shopping list not a priority (60%) had a priority among the low-income group (Table 8). The implication of this transition can be tied to income status, education and environmental factors, hence, there is a need to examine factors influencing this outcome.

Table 8 Consumption/Buying behaviour differential and transition of food taken across households

s/n	Consumption/Buying behaviour	Income groups			Row Total
		High % (n)	Moderate % (n)	Low % (n)	
1.	Buy excess especially when there is money/salary paid	(24)	(26)	(25)	**75**
2.	Do shopping when there is a need	(18)	(18)	(32)	**68**
3.	Make a shopping list priority	(08)	(06)	(00)	**14**
4.	Make a shopping list not a priority	(14)	(10)	(36)	**60**
5.	Planned meal before shopping	(10)	(08)	(00)	**18**
6.	Female do shopping	(14)	(10)	(10)	**34**
7.	Male do shop	(12)	(12)	(07)	**31**
	Column Total	**100**	**90**	**110**	**300**

Source: Author's calculation from Computer print-out

Determining food waste and factors influencing outcome.

The study categorizes characteristics that can influence food waste and determine factors that triple this effect as well as its implications. The results of this analysis are presented from Table 9. The priority impact determining food waste is keep foodstuffs for long and unfit to eat/expired foodstuff (18.19%). Moreover, other factors determining food waste as follows: Food stored are unfit to eat 26% - 50%, Food stored are unfit to eat 1% - 10%, relying on Food gifts as a coping strategy, storing food cooked manually among others (Table 9)

Table 9: **Determining food waste and factors influencing outcome.**

s/n	Food Waste Characteristics	Classes of Food							Row Total
		Cereals/ Tubers	Protein	Fats &Oils	Minerals	Vitamins	Cooked food	Processed food	
1.	Food cooked and finished with the family	51	33	39	24	45	84	75	**351**
2.	Food cooked, remaining fridged	40	48	25	28	39	23	20	**223**
3.	Food cooked, remaining stored manually	42	34	42	30	42	63	57	**310**
4.	Food stored are available to eat 0%	15	18	26	35	15	35	48	**192**
5.	Food stored are unfit to eat 1% - 10%	26	20	14	29	26	25	37	**177**
6.	Food stored are unfit to eat 11% - 25%	18	14	5	12	12	0	0	**61**
7.	Food stored are unfit to eat 26% - 50%	10	24	11	6	19	0	0	**70**
8.	Food stored are unfit to eat above 50%	18	20	10	0	18	0	0	**66**
9.	Food gifts about 1%- 10%	0	6	18	27	6	22	0	**79**
10.	Food gifts about 11%- 25%	12	10	17	15	8	0	0	**62**
11.	Food gifts about 26%- 50%	15	8	5	12	12	0	0	**52**
12.	Food gifts about above 50%	13	20	6	0	13	0	0	**52**
13.	Food gifts none	4	2	4	9	4	0	0	**23**

14.	Keep foodstuffs for long and unfit to eat/expired foodstuff	36	43	78	73	41	48	63	**382**
	Column Total	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**2100**

Source: Author's calculation from Computer print-out

Food Loss Waste (FLW), Food security status Transition Matrix

The study examines Food Loss Waste (FLW) and Food security status transition matrix in the study areas and the results are presented from Table 10. The study revealed that the category of respondents that is food non-poor and with Low FLW are 13.67%. Similarly, respondents with food poor and with high FLW are 29.67% (Table 10). Hence, this study establishes that there was a relationship between FLW and Food security. High FLW is common among the food poor as 30% in high FLW came from food poor households.

Table 10. Food Loss Waste (FLW), Food security status transition matrix

Food Loss Waste (FLW) Transition Matrix	**Food Security status Transition Matrix**			**Row (Total)**
	Food non-poor % (n)	**Food poor (moderate) % (n)**	**Food poor % (n)**	
FLW Low % (n)	13.67 (41)	7.67 (23)	9.00 (27)	**30.33 (91)**
FLW Moderate % (n)	7.33 (22)	1.67 (05)	4.67 (14)	**13.67 (41)**
FLW High % (n)	10.67 (32)	15.67 (47)	29.67 (89)	**56.00 (168)**
Column (Total)	**31.67 (95)**	**24.99 (75)**	**43.34 (130)**	

Source: Author's calculation from Computer print-out

Determinants of food insecurity

Table 11 reveals that 13 of the 20 independent variables measured had their coefficient values significant at different levels. Fundamental variables that significantly stimulate food insecurity gap are as follows: X_1 = household size, X_2 = level of education (years), X_6 = farming/ fishing experience, X_7 = hired labor, X_8 = dependency ratio, X_9 = expenses on food, X_{10} = farming/fishing income, X_{12} = expenses on non-food items, X_{13} = expenses on inputs, X_{14} = non-farm rural activities income, X_{18} = market facilities, X_{19} = asset status, X_{20} = Estimates of FLWpc. The explaining variables that influence the FLW are as follows: X_1 = household size, X_2 = level of education, dependency ratio, X_9 = expenses on food, X_{10} = farming/fishing income, X_{14} = non-farm rural activities income, X_{18} = market facilities, and X_{19} = asset status. The study deduced that FLW and Food insecurity are jointly depended by socio-economic variables. Thus, implies that the marginal effects of variables that measure well-being (food spending needs) differ among households. Hence, this outcome can be a basis in forecasting the food security risk, particularly those in the moderately and core food poor households. However, studies contended that poor households influenced by FLW either and can also enhanced food insecurity (Goosseus *et al*, 2019, Williams *et al*, 2020). The marginal effects predicting food insecurity and FLW results are presented from Table 12.

Table 11: Results of the Simultaneous equation analysis of FLW transition

Particulars (Variable)	**Estimates**	**t-values**
X_1 = household size (number)	0.043	2.430**
X_2 = level of education (years)	0.004	4.873***
X_3 = age (years)	0.352	0.814
X_4 = marital status of household head	0.583	1.258
X_5 = sex of household head	0.818	0.913
X_6 = farming/ fishing experience (Naira)	0.072	2.143*
X_7 = hired labor (Naira)	-0.053	-2.185*
X_8 = dependency ratio (No.)	-0.002	-5.823***
X_9 = expenses on food (Naira)	-0.018	-3.818***
$X1_0$ = farming/fishing income (Naira)	0.013	2.281*
X_{11} = farm size/fishing pond size (Ha)	0.137	1.673

X_{12} = expenses on non-food items (Naira)	0.037	3.015***
X_{13} = expenses on inputs (Naira)	0.002	7.235***
X_{14} = non-farm rural activities income (Naira)	0.003	6.928***
X_{15} = income consumed outputs (Naira)	-0.081	0.813
X_{16} = access to extension facilities (dummy), if access = 1, otherwise = 0	0.178	0.0738
X_{17} = access to credit facilities (dummy), if access = 1, otherwise = 0	0.083	0.1878
X_{18} = market facilities (dummy), if access = 1, otherwise = 0	0.002	4.836***
X_{19} = asset status (measures in Naira)	0.073	2.328**
X_{20} = Estimates of FLWpc (measures in Naira).	-0.004	-11.853***

Source: Computer generated results.

Model Results of OLS Estimates of the Simultaneous Equation Model

Source	SS	df	MS	Diagnostic
Model	224.819549	4	112.409794	No of Observation = 3
Residual	144.797694	296	314.777896	F(4, 296) = 418.58
Total	**369.617243**	**300**		Prob. > f = 0.000
				R. Squared = 0.6079
				Adjusted r – Square = 0.5836
				Root MSE = 1.7741

In envisioning the marginal effects of FLW in the category of Low, Moderate and high in the food security (Food non-poor) nexus, there is a need to establish this linkage. The results of these analyses were presented from Table 12. The study deduced that an additional increase of 10 percent in household size (X_1) enhanced food poor by 0.73%, and an increase in moderately food poor by 0.18% and food non-poor by 0.007 %, respectively. Similarly, the estimated marginal effects of a 10 percent increase in dependency ratio would enhance food poor by 0.7%, not significant for moderately food poor but enhanced the food non-poor by 0.11%. Moreover, 10% increase in farm/fish income would enhance 0.28% for food poor, 0.12% for moderate food poor and 0.48% 0.12 for food-nonpoor. The estimated marginal effects of a 10% increase in food expenses enhances 0.89% for food non-poor and 0.49% in moderately food nonpoor. In addition, the effects of a 10 percent increase in the income consumed outputs (X_{15}) have an opposite effect to that of an increase in minimum spending needs particularly in the moderately and food poor households. This result is consistent with the earlier findings of past studies (Goosseus *et al*, 2019, Williams *et al*, 2020). These studies argued that the marginal propensity to consumed food marketable outputs at home (that could have earned income) is higher than exchange farm outputs for income. The marginal effects are of larger magnitude for the food poor groups. This result suggests that income earned from the sales of marketable surplus outputs has a relatively larger effect at reducing food-insecure situation among the core food insecure category. The contribution of non-farm income (X_{14}) to food nonpoor is significant at a 1 percent level. Therefore, evidence is being established here that more participation in non-farm activities is a likelihood of being in food nonpoor and Low FLW. The positive correlation indicates that they are affected in the same direction by random shocks. The results also show that household size (X_1), dependency ratio (X_8), income consumed outputs (X_{15}) and farming/fishing income (X_{10}) influenced food insecurity positively, i.e., the higher these variables the poorer the food insecure situation.

Table 12. Marginal effects of selected variables in the Simultaneous equation model of FLW status

Particulars (Selected Variables)	**Estimates**		
	FLW Low (Food non-poor)	**FLW Moderate (Food poor)**	**FLW High (Food poor)**
Constant			
X_1 = household size (number)	0.07*	0.018**	0.031***
X_2 = level of education (years)	0.149***	0.012	0.023

X_6 = farming/ fishing experience (Naira)	0.119**	0.372**	0.475*
X_8 = dependency ratio (No.)	0.018*	0.0341	0.697***
X_9 = expenses on food (Naira)	0.0089*	0.0049***	0.0019
X_{10} = farming/fishing income (Naira)	0.18*	0.12*	0.28**
X_{12} = expenses on non-food items (Naira)	0.013	0.09	-0.037***
X_{14} = non-farm rural activities income (Naira)	0.078*	0.024	0.022**
X_{15} = income consumed outputs (Naira)	0.0018	-0.0185	- 0.0217
X_{18} = market facilities (dummy), if access = 1, otherwise = 0	0.038*	0.0184	0.0241

Source: Computer generated results
Notes: n = 300. ***,**,*Significant at 1, 5, 10 percent, respectively

Hausman Specification Test (HST)
The Hausman specification test was conducted to test the simultaneity in the relationship between the FLW and food insecure (food poor). The endogenous variable in the model, such as compounded Household Income (food insecure) and the FLW are analyzed individually in relation to the rest of the predetermined variable by using Ordinary Least Square (OLS) method. The unstandardized predicted value and residuals are saved. Once this is accomplished, another endogenous variable is created from the residuals and included in the analysis as an explanatory variable. If the t-value for this variable is statistically significant and greater or equal to 2, then it can be concluded that there is simultaneity (Mills & Zandvakili, 1997; and Andersen, 2004).

The following are the results after performing the HST.

$$\Delta V_t = 12.247 - 0.326\Delta G^* + 0.145\varepsilon^* \quad (20)$$
t - value -5.147 2.17

$$\Delta G\{y(t)\} = 28.146 - 1.583\Delta t^* + 0.126\varepsilon^* \quad (21)$$
t – value -5.101 -1.583 2.46

where Δ Vt = FLW reduction, Δ G {y(t)} * = estimated unstandardized predicted value of growth of real output from reduced-form equation by OLS, ε* = saved residual value while estimating unstandardized predicted value of compounded LDI, Δ G {y(t)} = computed household income, Δ Vt * = estimated unstandardized predicted value of compounded Δ Vt from the reduce-form equation by OLS, and ε* = saved residual value while estimating unstandardized predicted value of compounded household income. These estimates coefficient for the ε* variables are statistically significant and greater than 2 in both equations, implying that there is simultaneity between compounded changes in Vt and agricultural/economic growth. Equations 20 and 21 present the results from the reduced-form equation (as in Δ G {y(t)} * and Δ Vt *) express endogenous variables as functions of exogenous or predetermine variables only. Their parameters measure both the direct and indirect influence of exogenous variables on endogenous variables. According to Olayemi (1980) and Paudel (2004), these reduced-form parameters are composed entirely of structural parameters. The reduced-form parameter is a combination of some structural parameters (Anderssen, 2004). This suggests that policy that can influence income increase can also do same to improve FLW reduction. Thus, this finding revealed that reducing FLW has a significant effect on food non-poor (Low FLW). The results suggest that there is a curvilinear relationship between the course of the FLW reduction and food security enhancement.

Description of the Knowledge and Challenges involved in FLW paradigms.
The study deduced level of awareness about FLW to be high with 65.67% among the respondents (FLW food moderation to be 39.6% and FLW food non-poor 33%) (Table 13). According to the respondents, factors influencing food waste are as follows; spoiled food due to poor storage facilities and incessant/poor electricity supply with a difference of 19.5%. moreover, the study deduced from the respondents, knowledge about how to stop/control food waste, the results revealed moderate cooking (28.8%), creating a food recycling culture (20%), a culture of reuse (17.2%) and donate excess food

(14%) among others (Table 13). The study observed that in the study area people know about food waste, it can be speculated that people over there have no time or attention to think about food waste. Hence, there is a possibility that people do not bother about the food waste issue. Hence, it can be deduced that high-income group are wasting food and while people in the low-income group with simple eating routines and habits, hence. throwaway very less food.

The study indicated that lack of knowledge of proper storage, incessant electricity supply enhances food loss, however, culture of food reuse and recycling, meal planning and making shopping list can reduce food waste. Hence, the study suggest that government should introduce environmentally friendly ways to store, transport and handle food and ensure the availability of low-quality food at affordable prices to reduce food waste, poverty and hunger and to improve sustainability.

Table 13: Description of the Knowledge and Challenges involved in FLW Paradigms.

S/N	Description	FLW Low		FLW Moderate		FLW High		Total
	Knowledge about FLW	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	
		65	35	78	22	54	46	300
	Factors Influencing food waste							
1	Spoiled Food	24		32		3		59
2	Spoiled rolls	19		17		1		37
3	Salty foods	16		5		10		31
4	Pepperish food	14		7		13		34
5	No good storage	18		9		26		53
6	Incessant Electricity	8		15		33		56
7	Tasteless food	0		5		6		11
	Causes of Food Waste							
1.	Poor storage facilities	14		12		32		58
2	Poor transportation (poor condition of roads)	1		9		31		41
3	Buying foodstuffs, you do not need at the moment	10		11		5		26
4	Insufficient electricity (incessant power supply)	25		23		7		55
5	No/Poor knowledge of food preservation method	8		8		15		31
6	Excess food cooking	18		18		4		40
7.	Government policies (inability of government to provide basic amenities)	24		19		6		49
	Knowledge of how to stop food waste							
1.	Examine what is left and take account on what to buy on income level	27		26		7		60
2.	Take stock of the food left behind	1		0		0		1
3.	Create a culture of reuse	6		6		40		52
4.	Moderate cooking	25		32		28		85
5.	Create a recycling culture	22		17		21		60
6.	Donate food especially excess food	19		19		4		42

Source: Author's calculation from Computer print-out

Policy implications of the findings and conclusions

The study tried to find answer to the question "do food wastage interventions hold the potential of making an effective contribution to food security nexus"? The study answers this question by analyzing the transition of food loss and waste reduction in the food-security nexus among farming households in Southwest, Nigeria**.** The results of our analyses confirmed that food waste is a huge problem and challenge for households in southwestern, Nigeria. The study revealed that FLW reduction actions may have a direct and short-term impact on micro-scale food security situations. This study is done on pilot, but they only make a significant contribution on their own, but can do so when embedded in a broader

value chain or food system approach. The study deduced that wastage may also be a key reason for food insecurity in some contexts. While reducing food wastage in general, on its own, could not be simply solved by a single solution. Wastage reduction can play a role in the goal to improve food security, particularly in increasing food supply in a relatively efficient way, but complementary measures will be needed. This is also particularly the case because food wastage reduction tends to focus primarily on one dimension of food security, food availability. The dimensions of access, utilization, and stability are relatively overlooked in wastage interventions and the associated literature, this is could be future research.

The findings of this study provide a valuable reference in reducing FLW and the categorization of these factors provides essential information to decision-makers in giving priority to the key factors in accordance with their interrelationships in the given context. Focusing on the nexus between the transition to food security and FLW reduction nexus would help in enhancing food security. Hence, understanding the interrelations between food loss and waste and food security could foster policy that will prove efficient to explore strategic decisions (e.g., policy, investment, technical intervention) planned or adopted to contain food loss and waste. This study has provided evidence-based analyses of the implications of food loss and waste on food security, supported by high-quality and available data. Thus, provide key information to policymakers aimed at promoting environmentally, economically, and socially sustainable development. The study indicated that respondents have high knowledge of waste trend and showed greater knowledge of the problem of food waste, as they were significantly more likely to determine their suitability for consumption and have greater knowledge about proper storage. The results obtained during our research indicated that increasing awareness of the issues related to storage (especially fresh products), making rational decisions during purchases and their planning, and controlling the expiry date are important factors in reducing waste in households. It should be stressed that a key element in reducing food waste is education on how to store food and how to further use leftovers. Hence, a strong advocacy is needed for the people to be aware of the need to “recycle” food to avoid generating unnecessary waste, which has a negative impact on the environment.

This study brought in an innovation to examine the transition between food security status and its linkage to FLW. Hence, a model was then conceptualized that combined food insecurity transition and traditional consumer waste-related behaviors to explains the food waste generation. However, despite the novelty this paper brings to the debate, much remains to be explored in this area. this paper highlights the important link between FLW reduction and food security nexus and also, the incentives to reduce food loss and waste. The study indicated that food poor scenario among farming households in the Southwestern Nigeria is still very high. The factors identified to be responsible for food insecurity transitory include large household size, high dependent ratio, income consumed outputs and expenses on non-food items. Households that had fairly household sizes have food secured (food non-poor). Majority of food insecure households had low education and high dependency ratio and main in farming.

Food insecurity transition households were strongly related to income generation low FLW and seasonal variations of agricultural harvest. Food security (food non-poor) households who lose income generation over time increase FLW and hence fall into food insecurity. Therefore, a more diversified occupational structure that can add value to labor time for reasonable income support is advocated and reduction policy on FLW reduction. Moreover, the food insecure (food poor) households spend less per person in terms of meeting basic needs, have a higher rate of non-participation in non-farm activities, and therefore, experience a greater gap between perceived (subjective) minimum food spending needs and available resources for food than those in the category of food sufficiency class. The marginal effects of the degree of food insecurity and FLW are positively correlated with the likelihood of the number of household size and that increase in educational attainment has a relatively larger effect on changing the status of food insecure. Simultaneous equation was carried on food security status of households and FLW of the identified households and the findings indicated a simultaneity. Hence, policy that can influence income increase can also do same to improve FLW reduction. Thus, this finding revealed that reducing FLW has a significant effect on food non-poor (Low FLW). The results

suggest that there is a curvilinear relationship between the course of the FLW reduction and food security enhancement.

Reference

Akerele D, Afolayan SO, Oyawole FP, Sanusi RA (2017) Socioeconomic determinants of food waste among households in Abeokuta, Ogun State, Nigeria. Nigerian Journal of Agricultural Economics 7(2066-2018-1341), pp.25-35

Alamar, M. del C., Falagan, N., Aktas, E., Terry, L.A., 2018. Minimizing food waste: a call for multidisciplinary research. J. Sci. Food Agric. 98, 8e11. Alexander, C., Smaje, C., 2008. Surplus retail food redistribution: an analysis of a third sector model. Resour. Conserv. Recycl. 52, 1290e1298.

Amao, J.O. and Ayantoye, K. (2015), "Correlates of food insecurity transition and its determinants among farming households in north central, Nigeria", Journal of Economics and Sustainable Development, Vol. 6 No. 24, pp. 230-244

Amaza, P.S., Adejobi, A.O. and Fregene, T. (2008), "Measurement and determinants of food insecurity in Northeast Nigeria: some empirical policy guidelines", Journal of Food, Agriculture & Environment, Vol. 6 No. 2, pp. 92-96, available at: www.world-food.net

Anderssen, C. J. (2004). Making inferences about polarizations, welfare and poverty. A study of 101 countries from 1970-1994. Journal of Applied Econometrics, 19(3), 537–550

Aragie, E., Balie, J., MoralesOpazo, C., 2018. Does reducing food losses and wastes in sub-Saharan Africa make economic sense? Waste Manag. Res. 36, 483e494.

Aromolaran, A.B. (2009), "Does increase in women's income relative to men's income increase food calorie intake in poor households?", Evidence from Nigeria Contributed Paper Prepared for Presentation at the International Association of Agricultural Economists Conference, Beijing, August 16-22.

Barrera, E.L., and Hertel, T (2021): Global food waste across the income spectrum: Implications for food prices, production and resource use. Food policy 98 (2021) 101874

Bayliss-Smith, T. (1991), "Food security and agricultural sustainability in the new guinea highlands: vulnerable people, vulnerable places", IDS Bulletin, Vol. 22 No. 3, pp. 5-11.

Beausang, C., Hall, C., Toma, L., 2017. Food waste and losses in primary production: qualitative insights from horticulture. Resour. Conserv. Recycl. 126, 177e185.

Bellemare, M.F., Çakir, M., Peterson, H.H., Novak, L., Rudi, J., 2017. On the measurement of food waste. Am. J. Agric. Econ. 1148e1158.

Beretta, C., Stoessel, F., Baier, U., Hellweg, S., 2013. Quantifying food losses and the potential for reduction in Switzerland. Waste Manag. 33, 764e773.

Bickel, G., Nord, M., Price, C., Hamilton, W. and Cook, J. (2000), "Guide to measuring household food security", Technical Report, US Department of Agriculture, Food and Nutrition Service, Central Bank of Nigeria, 2010, Statistical Bulletin and Annual Report, Revised, March, Alexandria, VA

Bob-Baulch, B. and McCulloch, N. (1998), "Being poor and becoming poor: poverty status and poverty transitions in rural Pakistan", Preliminary material and interim research results circulated to stimulate discussion

Boiteau, J.M., and Pingali, P. (2023): Can we agree on a food loss and waste definition? An assessment of definitional elements for a globally applicable framework. Global Food Security, 37 (2023) 100677.

Boiteau, J.M., Pingali, P., (2022). Food loss of perishable produce from farm to retail: evidence from tomato Supply chains in South India. Am. J. Clin. Nutr. 115, 1535–1548. https://doi.org/10.1093/ajcn/nqac039.

Bottani, E., Vignali, G., Mosna, D., Montanari, R., 2019. Economic and environmental assessment of different reverse logistics scenarios for food waste recovery. Sustain. Prod. Consum. 20, 289e303.

Buisman, M.E., Haijema, R., Bloemhof-Ruwaard, J.M., 2019. Discounting and dynamic shelf life to reduce fresh food waste at retailers. Int. J. Prod. Econ. 209, 274e284. Cakar, B., Aydin, S., Varank, G., Ozcan, H.K., 2020. Assessment of environmental impact of FOOD waste in Turkey. J. Clean. Prod. 244, 118846.

Caldeira, C., De Laurentiis, V., Corrado, S., van Holsteijn, F., Sala, S., 2019. Quantification of food waste per product group along the food supply chain in the European Union: a mass flow analysis. Resour. Conserv. Recycl. 149, 479e488.

Campoy-Munoz, P., Cardenete, M.A., Delgado, M.C., 2017. Economic impact assessment of food waste reduction on European countries through social accounting matrices. Resour. Conserv. Recycl. 122, 202e209.
Cane, M., Parra, C., 2020. Digital platforms: mapping the territory of new technologies to fight food waste. Br. Food J. 1e29.
Canovas Creus, A., Bernstad Saraiva, A., Arruda, E.F., 2018. Structured evaluation of food loss and waste prevention and avoidable impacts: a simplified method. Waste Manag. Res. 36, 698e707.
Cattaneo, A.; Sánchez, M.V.; Torero, M.; Vos, R. Reducing food loss and waste: Five challenges for policy and research. Food Policy 2021, 98, 101974. [PubMed]
Chaboud, G., 2017. Assessing food losses and waste with a methodological framework: insights from a case study. Resour. Conserv. Recycl. 125, 188e197.
Chauhan, C., Dhir, A., Akram, M.U., Salo, J., 2021. Food loss and waste in food supply chains. A systematic literature review and framework development approach. J. Clean. Prod. 295, 126438 https://doi.org/10.1016/j.jclepro.2021.126438.
Chalak, A., Abou-Daher, C., Abiad, M.G., 2018. Generation of food waste in the hospitality and food retail and wholesale sectors: lessons from developed economies. Food Secur 10, 1279e1290.
Chalak, A., Abou-Daher, C., Chaaban, J., Abiad, M.G., 2016. The global economic and regulatory determinants of household food waste generation: a cross-country analysis. Waste Manag. 48, 418e422.
Chalak A, Abiad MG, Diab M, Nasreddine, L (2019) The determinants of household food waste generation and its associated caloric and nutrient losses: The case of Lebanon. Plos one, 14(12), p.e0225789
Corrado, A.; Palumbo, L. (2022): Essential farmworkers and the pandemic crisis: Migrant labour conditions, and legal and political responses in Italy and Spain. In Migration and Pandemics: Spaces of Solidarity and Spaces of Exception; Springer: Cham, Switzerland, 145–166.
Dal' Magro, G.P., Talamini, E., 2019. Estimating the magnitude of the food loss and waste generated in Brazil. Waste Manag. Res. 37, 706e716.
Delgado, L., Schuster, M., Torero, M., 2021. Quantity and quality food losses across the value Chain: a Comparative analysis. Food Pol. 98, 101958 https://doi.org/ 10.1016/j.foodpol.2020.101958.
de Moraes, C.C., de Oliveira Costa, F.H., Roberta Pereira, C., da Silva, A.L., Delai, I., 2020. Retail food waste: mapping causes and reduction practices. J. Clean. Prod. 256, 120124. DeLorenzo, A., Parizeau, K., von Massow, M., 2019. Regulating Ontario's circular economy through food waste legislation. Soc. Bus. Rev. 14, 200e216.
Devereux, S. (2000), "Food insecurity in Ethiopia", A discussion paper for DFID, Publications Office Institute of Development Studies, University of Sussex, Brighton
Devin, B., Richards, C., 2018. Food waste, power, and corporate social responsibility in the Australian food supply chain. J. Bus. Ethics 150, 199e210.
Dusoruth, V., Peterson, H.H., Schmitt, J., 2018. Estimating a local food waste baseline. J. Food Prod. Market. 24, 654e680.
Endalew, B., Muche, M. and Tadesse, S. (2015), "Assessment of food security situation in Ethiopia: a review", Asian Journal of Agricultural Research, Vol. 9 No. 2, pp. 55-68.
Fabi, C., Cachia, F., Conforti, P., English, A., Rosero Moncayo, J., (2021). Improving data on food losses and waste:from theory to practice. Food Pol. 98, 101934 https://doi. org/10.1016/j.foodpol.2020.101934.
Fabi, C., English, A., (2019). Methodological Proposal for Monitoring SDG Target 12.3. Sub-indicator 12.3.1.the Food Loss Index Design, Data Collection Methods and Challenges. FAO, Rome. FAO, 2022a. Food Loss and Waste Database. URL. https://www.fao.org/platform -food-loss-waste/flw-data/en/ (accessed 6.14.22).
FAO, 2022b. How to Use the FLW Database. URL. https://www.fao.org/platform-foodloss-waste/flw-data/user-guide/en/ (accessed 6.14.22). FAO, 2021a. How to Use the FLW Database. URL. https://web.archive.org/web/2021 (accessed 5.11.23). 0811090429/https://www.fao.org/platform-food-loss-waste/flw-data/user-g uide/en/
Fami HS, Aramyan LH, Sijtsema SJ, Alambaigi A (2019) Determinants of household food waste behavior in Tehran city: A structural model. Resources, Conservation and Recycling 143, 154-166. https://doi.org/10.1016/j.resconrec.2018.12.033.
FAO, 2021. Voluntary Code of Conduct for Food Loss and Waste Reduction. FAO, 2020. Online food loss And waste database. URL. https://www.fao.org/platform -food-loss-waste/flw-data/en/.
FAO, 2020. Online Food Loss and Waste database. Dataset of food loss and waste estimates from grey

literature, national and sectoral reports. (http://www.fao.org/foodloss-and-food-waste/flw- data/en/), access on February 2023.
FAO, 2019. The State of Food and Agriculture 2019. Moving Forward on Food Loss and Waste Reduction. FAO, Rome.
Food and Agriculture Organization (FAO). The State of Food Security and Nutrition in the World. Repurposing Food and Agriculture Policies to Make Healthy Diets More Affordable; Food and Agriculture Organization (FAO): Rome, Italy, 2022.
Foster, J., Greer, J. and Thorbecke, E. (1984), "A class of decomposable poverty measure", Econometrical, Vol. 52 No. 3, pp. 761-766.
Galli, F.; Cavicchi, A.; Brunori, G. Food waste reduction, and food poverty alleviation: A system dynamics conceptual model. Agric. Hum. Values 2019, 36, 289–300.
Ghosh, R., Eriksson, M., 2019. Food waste due to retail power in supply chains: evidence from Sweden. Glob. Food Sec. 20, 1e8.
Gillman, A., Campbell, D.C., Spang, E.S., 2019. Does on-farm food loss prevent waste? Insights from California produces growers. Resour. Conserv. Recycl. 150, 104408.
Gokarn, S and Choudhary, A. (2021): Modeling the key factors influencing the reduction of food loss and waste in fresh produce supply chains: Journal of Environmental Management 294 https://doi.org/10.1016/j.jenvman.2021.113063
Gogo, E.O., Opiyo, A., Ulrichs, C., Huyskens-Keil, S., 2018. Loss of African indigenous leafy vegetables along the supply chain. Int. J. Veg. Sci. 24, 361e382.
Goni, M. (2005), "Analysis of household food security in the lake chad area of borno state, Nigeria", MSc dissertation, Department of Agricultural Economics and Extension Services, University of Maiduguri, Borno State, 67p.
Goossens, Y., Berrens, P., Custers, K., Van Hemelryck, S., Kellens, K., Geeraerd, A., 2019. Correction to: how origin, packaging and seasonality determine the environmental impact of apples, magnified by food waste and losses. Int. J. Life Cycle Assess. 24, 688e693.
Greer, J. and Thorbecke, E. (1986), "A methodology of measuring food poverty, applied to Kenya", Journal of Development Economics, Vol. 24 No. 1, pp. 59-74.
Gundersen, C. and Oliveira, V. (2001), "The food stamp program and food insufficiency", Journal of Agricultural Economics, Vol. 83 No. 4, pp. 875-887.
Hartikainen, H., Mogensen, L., Svanes, E., Franke, U., 2018. Food waste quantification in primary production e the Nordic countries as a case study. Waste Manag. 71, 502e511.
Harvey, J., Smith, A., Goulding, J., Branco Illodo, I., 2019. Food sharing, redistribution, and waste reduction via mobile applications: a social network analysis. Ind. Market. Manag. 1e12.
Huang, C.H.; Liu, S.M.; Hsu, N.Y. Understanding Global Food Surplus and Food Waste to Tackle Economic and Environmental Sustainability. Sustainability 2020, 12, 2892.
Khalid S, Naseer A, Shahid M, Shah GM, Ullah MI, Waqar A, Abbas T, Imran M, Rehman F (2019) Assessment of nutritional loss with food waste and factors governing this waste at household level in Pakistan. Journal of cleaner production 206, 1015-1024. https://doi.org/10.1016/j.jclepro.2018.09.138.
Labadarios, D., Davids, Y. and Mciza, Z. (2009), "The assessment of food insecurity in South Africa", unpublished paper, Centre for Poverty, Employment and Growth, Human Sciences Research Council, Pretoria.
May, N., Guenther, E., 2020. Shared benefit by Material Flow Cost Accounting in the food supply chain the case of berry pomace as upcycled by-product of a black currant juice production. J. Clean. Prod. 245, 118946. McKenzie, T.J.,
McDonald, J.F. and Moffit, R.A. (1980), "The uses of Tobit analysis", *Review of Economics and Statistics*, Vol. 62 No. 2, pp. 318-321.
Mills, J. A., & Zandvakili, A. (1997). Statistical inference via bootstrapping for measures of inequality. Journal of Applied Econometrics, 12(2), 133–150. https://doi.org/10.1002/(SICI)1099-1255(199703)12:23.0.CO;2-H
Nassimbeni, G. (2001), "Technology, innovation capacity, and the exports attitude of smallmanufacturing firms: a logit/tobit model", *Research Policy*, Vol. 30 No. 1, pp. 245-262.
National Bureau of Statistics (NBS) (2022). Annual Statistics and Statistical Bulletin for State ministries of rural development for Nigeria 2022 and quarter (Q) 3–4 of 2022 (pp. 35–75). Abuja, Nigeria:
Nicholes, M.J., Quested, T.E., Reynolds, C., Gillick, S., Parry, A.D., 2019. Surely you don't eat parsnip skins? Categorising the edibility of food waste. Resour. Conserv. Recycl. 147, 179–188 . https://doi.org/10.1016/j.resconrec.2019.03.004.

Nord, M., Jemison, K. and Bickel, G. (1999), "Prevalence of food insecurity and hunger by state, 1996-1998", Food Assistance & Nutrition Research Report No. 2, USDA, Washington, DC.
Olayemi, J.K., (1980). Food crop production by small farmers in Nigeria: eds by Olayide, S.O., J.A. Eweka and V.E. Bello-Osagie, 1980 Nigerian small farmers: Problems and prospects in integrated rural. Ibadan, Nigeria: University of Ibadan
Oyebanjo, O., Ambali, O.I. and Akerele, E.O. (2013), "Determinants of food security status and incidence of food insecurity among rural farming households in ijebu division of ogun state, Nigeria", Journal of Agriculture and Environmental Sciences, Vol. 13 No. 3, pp. 92-103
Paudel, L. 2004. "Analysis of the relationship between poverty and income inequality in Alabama, U.S.A. The use of two-stage least squares method. Unpublished Master of Science Thesis, Department of Agricultural Business. Graduate School, Alabama University, U.S.A. xiv + 169 pp.
Principato L (2018) Food waste at consumer level: A comprehensive literature review. Springer International Publishing. doi: 10.1007/978-3-319-78887-6
Qi, D., Lai, W., Roe, B.E., 2021. Food waste declined more in rural Chinese households with livestock. Food Pol. 98, 101893 https://doi.org/10.1016/j. foodpol.2020.101893.
Santeramo, F.G. (2021): Exploring the link among food loss, waste and food security: what the research should focus on? Agriculture & Food Security (2021) 10:26 https://doi.org/10.1186/s40066-021-00302-z
Scubert, R. (1994), "Poverty in developing countries: its definitions, extent and implications", Economics, 49 (5), 17-40.
Serem, A.K. (2007), "Household food security in Vihiga district, Kenya: determinants of dietary diversity", Proceedings of the 8th African Crop Science Society Conference, El-Minia University, October 27-31, pp. 1383-1390.
Simms, C., Trott, P., Van den Hende, E., Hultink, E.J., (2020). Barriers to the adoption of waste-reducing eco-innovations in the packaged food sector: a study in the UK and The Netherlands. J. Clean. Prod. 244, 118792. Song, J., 1960.
Skawi ´nska, E.; Zalewski, R.I. (2020). Combining the Water–Energy–Food and Food Waste–Food Loss–Food Security Nexuses to Reduce Resource Waste. Energies 2022, 15, 5866.
United Nations Environment Programme (UNEP). Food Waste Index Report 2021; United Nations Environment Programme (UNEP): Nairobi, Kenya, 2021
UNEP, 2021. Food Waste Index Report 2021 (Nigeria).
United Nations Environment Programme (UNEP). Food Waste Index Report 2021; United Nations Environment Programme (UNEP): Nairobi, Kenya, 2021.
United Nations Environment Programme, (2021). Global Chemicals and Waste Indicator Review Document (Nairobi). USDA ERS, 2020. Loss-Adjusted Food Availability Documentation. URL. https://perma. cc/2LT2-QT7S (Accessed 5.29.23).
Vishwakarma, R.K., Jha, S.N., Dixit, A.K., Rai, A., Ahmad, T. (2020). Estimation of harvest and post-harvest losses of cereals and effect of mechanization in different agroclimatic zones of India. Indian J. Agric. Econ. 75, 317–336. https://doi.org/ 10.51168/sjhrafrica.v2i9.
van Geffen L, van Herpen E. van Trijp H (2020) Household Food waste—How to avoid it? An integrative review. In: Narvanen E., Mesiranta N., Mattila M., Heikkinen A. (eds) Food Waste Management (pp. 27-55). Palgrave Macmillan, Cham.
Wang, Y.; Yuan, Z.; Tang, Y. Enhancing food security and environmental sustainability: A critical review of food loss and waste management. Resource. Environ. Sustain. 2021, 4, 100023.
Wohner, B., Gabriel, V.H., Krenn, B., Krauter, V., Tacker, M., 2020. Environmental and economic assessment of food-packaging systems with a focus on food waste. Case study on tomato ketchup. Sci. Total Environ. 738, 139846.
Williams H, Lindstrom A, Trischler J, Wikstrom F, Rowe Z (2020) Avoiding food becoming waste in households–The role of packaging in consumers' practices across different food categories. Journal of Cleaner Production p.121775
Zasada, I., Schmutz, U., Wascher, D., Kneafsey, M., Corsi, S., Mazzocchi, C., Monaco, F., Boyce, P., Doernberg, A., Sali, G., Piorr, A., (2019). Food beyond the city analyzing foodsheds and self-sufficiency for different food system scenarios in European metropolitan regions. City, Cult. Soc. 16, 25e35.

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Role Of Gender in Postharvest Handling of Vegetables in Kwara State, Nigeria

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Abstract
This study evaluated gender roles in postharvest handling of vegetables using Parabolic Shaped Solar Dryer (PSSD) by processors in Alapa community, Kwara State. Data were obtained through Focus Group Discussions and questionnaires. Thirty-nine (39) vegetable processors were sampled purposively. Data components were analysed using both descriptive and inferential statistics. Analysis revealed the mean age of respondents to be 36 years, average monthly income as ₦31,989.06, and household size as 5. Okra was the most processed vegetable by the female (88%) and males (84%). Pepper comes second with 77.2% female and 48.5% male processors. PSSD is utilized more by females (60.7%) once a month (43.6%) because it's secured (97.4%). T-test results revealed that the female gender participates significantly ($p \leq 0.05$) using PSSD. Chi-square analysis showed significant associations ($p \leq 0.05$) between the level of utilisation of PSSD and their age ($\chi^2 = 19.23$); level of education ($\chi^2 = 12.52$), years of experience ($\chi^2 = 13.36$), household size ($\chi^2 = 4.90$) and monthly income ($\chi^2 = 19.72$). The study concluded that PSSD is utilised more by the female gender for drying vegetables. It is therefore a concerted effort to disseminate this technology to more communities within and outside Kwara State to attain food safety.
Keywords: *female, male, vegetable-processors, parabolic-solar-shaped-dryer, utilisation*

Introduction

Gender differences and gender roles in society have been one of the most debated topics in public discourse. Scholars' explanations as to how and why genders difference exists have been traced to biological, cultural, structural, and evolutionary reasons (Theja-Bhaargavi, 2022). In many parts of the world, women are traditionally the home keepers, they earn more respect in society when they support and take care of their children. Men are respected by their families and society when they can provide the necessities of life for their dependents. The existence of gender roles cannot be denied despite recent efforts directed toward addressing them (Robinson, 2019). Gender, therefore, is a term often associated with the roles and responsibilities of males and females in society, as a social classification of sex. It is the sociocultural differences between males and females as against the biological differences (Sinkaiye, 2005 cited by Benson, *et al*., 2018). Knowledge of gender roles is an important part of postharvest management of crops because it allows interventions to be tailored to specific groups of farmers, processors, and other stakeholders from production to consumption value chains.

Agricultural commodities such as vegetables are perishable when compared with other crops. The production, processing, and marketing offer potential opportunities in the form of high profits that can be attractive more precisely to youth and women because only a small amount of land is required for production within a short period (Schreinemachersa, 2018). In Africa, and especially Nigeria, the most dominant vegetables are tomatoes, pumpkins, bitter leaf, cucumbers, okra, onions, garlic, amaranth,

jute mallow, African nightshade, and chilies (peppers). These vegetables are consumed on a large scale although with much variation in shapes, sizes, colors, and tastes. According to World Vegetable Center, (2017), marketing of these vegetables accounts for significant revenue streams while consumptions offer superior nutritional properties. For example, the consumption of 100 g of leaves of amaranth, jute mallow, African nightshade, or vegetable cowpea by pregnant women can provide over 100% of the vitamin A needed. To continue enjoying the benefits of the nutrients in vegetables; it's imperative to seek how to increase the shelf life through an innovative drying method using a solar system.

Solar drying technologies are forms of confined solar drying which could be in the form of a tent, parabolic shaped, box, and other hybrid forms or shapes. The Nigerian Stored Products Research Institute (NSPRI) parabolic-shaped solar dryer (PSSD) can be used for the drying of a wide range of agricultural commodities under hygienic conditions. A brief description shows the following construction features: A transparent UV screen covering material that provides an enclosure and also transmits heat from the sun into the drying chamber. A black floor that stores heat from the sun is insulated to prevent heat loss to the ground due to conduction. The parabolic-shaped solar dryer is a stationary structure with two inlet vents and installed solar-powered blowers. The top is fitted with two pneumatic aspirators for the extraction of moisture from the drying chamber. The drying chamber has two drying racks with four layers each made of mild steel angle iron, and trays of 0.55 m x 0.55 m made of 25 x 25 mm square pipe and galvanized wire mesh. An access door is also provided at one end of the structure. The size ranged from small dimensions of 6.5x4.2x2.4m with an effective drying area of 17.85m2 to big dimensions measuring 10x6x4m with an effective drying area of 45.60m2 which can be further scaled up to meet client's desire. The operational cost of PSSD is near zero (Akomolafe *et al*, 2021).



Plate 1: NSPRI Parabolic Shaped Solar Dryer Exterior



Plate 2: NSPRI Parabolic Shaped Solar Dryer Interior

Objectives of the study

The broad objective of the study is to examine gender roles in the utilization of Parabolic Shaped Solar Dryer (PSSD) in post-harvest losses management of vegetables in Kwara State, Nigeria. Specifically, the study seeks to analyze the gender roles in the post-harvest handling of vegetables and also, to evaluate the level of utilization of PSSD by the vegetable processors.

Research Hypothesis

Ho_1: There are no significant associations between the socio-economic characteristics of the vegetable processors and their level of utilization of PSSD.

Methodology

The study was carried out in Kwara State in May 2022. The State belongs to the North Central geo-political zone of the country and shares a border with Niger, Kogi, Oyo, Ekiti, and Osun States besides her international border with the Benin Republic. Yoruba, Fulani, Bariba, and Nupe are the major ethnic groups in the State. According to the 2006 population census, the population of Kwara state was 2.37 million (NPC, 2006). Agriculture is the predominant occupation in the rural areas of the State. Common food crops produced are maize, rice, sorghum, millet, cowpea, yam, cassava, guinea corn, and vegetables which are grown mainly for domestic consumption. The research instrument was designed to capture the socio-economic characteristics of the respondents; the roles the gender could play utilizing PSSD; the level and frequency of utilization of PSSD; as well as reasons for the choice of PSSD and not open air were listed. Four (4) focus group discussion (FGD) sessions which comprised three (3) groups of ten (10) members each and one (1) group of nine (9) members was conducted alongside the administration of questionnaires on respondents. A total of thirty-nine (39) vegetable processors which constitute all individuals utilizing PSSD at the location were sampled purposively. The FGD sessions elicited more information with the aid of prompts as a tool for qualitative inquiry. Data components were analyzed using both descriptive and inferential statistics. Descriptive statistics such as frequency, percentages, and means were used to describe the personal characteristics of vegetable processors. Inferential statistics such as Chi-square was deployed to analyze associations between variables, and T-test revealed the significance of gender participation using SPSS 21.0.

Results and Discussion

Results in Table 1 revealed a pooled mean age of vegetable processors to be 36 years, this implies that processors are at their youthful and active age which could provide them with adequate energy to utilize PSSD to its' full capacity; Ajayi et al., (2021) posited that age is a key factor that could influence utilization of technology. A good percentage (66.7%) of the processors had one form of education or another which provides them an opportunity to embrace innovations in the postharvest management of vegetables. The average family size of the vegetable processors was five (5), which suggests that the majority of households of vegetable processors are within the government-recommended size of four children by both parents to make. This corroborates the finding of Benson et al., (2022) that respondents utilizing postharvest information had family sizes of four to six. The average monthly income for vegetable processors was N31, 989.06 ($43US). It could be inferred that processor earns $1.4/day from their enterprises; as such they live below the recommended poverty line of $2.15 a day (Jolliffe et al., 2022).

Table 1: Socio-economics characteristics of vegetable processors

	Male		Female		Pooled	
Socio-demographic variables	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Age						
Below 20	-	-	2	7.1	1	2.6
20-30	4	36.4	5	17.9	9	23.1
31-40	6	54.5	11	39.3	17	43.6
41-50	1	9.1	9	32.1	10	25.6
Above 50	-	-	1	3.6	1	2.6
Age mean values	***34***		***37***		***36***	
Educational status						

No education	1	9.1	7	25.0	7	18.0
Non-formal only	1	9.1	4	14.3	5	12.8
Primary	5	45.4	14	50.0	19	48.7
Secondary	4	36.4	3	10.7	7	18.0
Years of processing experience (YPE)						
Below 5years	2	18.2	3	10.7	5	12.8
5 – 10 years	8	72.7	13	46.4	21	53.9
10 – 15 years	-	-	7	25.0	7	18.0
15 – 20 years	1	9.1	2	7.1	3	7.7
Above 20 years	-	-	3	10.7	3	7.7
YPE mean values	***7***		***9***		***8***	
Household size (HHS)						
Less than 5	3	27.3	11	39.3	13	33.3
5 – 10	6	54.5	14	50.0	20	51.3
More than 10	2	18.2	3	10.7	5	12.8
HHS mean values	***5***		***5***		***5***	
Average Monthly Income (AMI)						
Less than N20,000	2	18.2	9	32.1	11	28.2
N20,000 – N50,000	4	36.4	12	42.9	16	41.0
N50,000 – 100,000	3	27.3	6	21.4	9	23.1
Above N100,000	2	18.2	1	3.6	3	7.7
AMI mean values	***37,613.42***		***29,771.59***		***31.989.06***	
Type of society belong						
Cooperative	3	27.3	5	17.9	8	20.5
Farmer's group	7	63.6	12	42.9	19	48.7
Processor's group	11	100.0	28	100.0	38	97.4
Others	4	36.4	19	67.9	23	59.0

Source: Field survey, 2022

Table 2 shows both genders participate in vegetable postharvest processing activities. It further reveals that the female gender participates more actively in PSSD drying activities such as harvesting (11.27*), loading into PSSD (11.23*), offloading from PSSD (11.62*), packing (9.64*), and marketing (8.06*) which featured prominently on the list and showed significant differences ($P<0.05$). Studies (Sarfo et al., 2023; Benson et al., 2018) have advanced reasons women folks engaged in postharvest processing activities more than their male counterparts. These reasons are but not limited to tradition; personal and means of sustenance; the fact that processing is homely and women consider as their natural responsibility; and the reason that vegetable processing doesn't require so much energy compared with production activities believed to be men's domain. Furthermore, low levels of mechanization in vegetable processing and the need for careful handling of produce often create a specific demand for female labor (Schreinemachers *et al*., 2018).

Table 2: Roles played by gender in the utilisation of parabolic shaped solar dryer for mitigating post-harvest loss in vegetables

Activities	**Male (n = 11) Mean±SD**	**Female (n = 28) Mean±SD**	**t-test male-female**
Harvesting	0.64±0.43	0.84±0.39	11.27*
Sorting	0.23±0.37	0.46±0.48	5.07*
Packing	0.24±0.31	0.81±0.37	9.64*
Transporting	0.69±0.47	0.73±0.45	8.04*
Washing	0.05±0.21	0.21±0.43	2.54*
Cutting	0.06±0.30	0.76±0.41	7.21*
Loading in PSSD	0.75±0.52	0.85±0.37	11.23*

Drying monitoring	0.47±0.50	0.61±0.49	6.81*
Offloading from PSSD	0.73±0.45	0.87±0.41	11.62*
Packaging	0.07±0.25	0.30±0.46	3.25*
Marketing	0.05±0.19	0.75±0.43	8.06*

* Signifies a significant value at P<0.05

Overall, seventy-nine percent (79%) of the processors are females while 21% are males (Fig 1). As depicted in Fig. 2, okra was the most processed vegetable by the females (88%) and males (84%). Pepper comes second after okra as the most processed vegetable with 77.2% female and 48.5% male processors. Figure 2 also reveals that the proportions of men that engaged in bitter leaf, pumpkin, and tomato processing were near zero; whereas, 7.1, 3.6 and 2.6% of women processed these vegetables respectively. This further lends credence to the finding of Sarto *et al*., (2023) which exerts that processing is a traditional practice amongst rural women.

According to Table 3, more than sixty percent of female processors use parabolic-shaped solar dryer moderately, in contrast, the male folks utilized PSSD poorly (82%).

Majorly, both gender employed PSSD for vegetable drying once a month because it's secured, it's hygienic, it has removed the stress of packing and repacking vegetables, and access to commodities by pests is largely restricted.

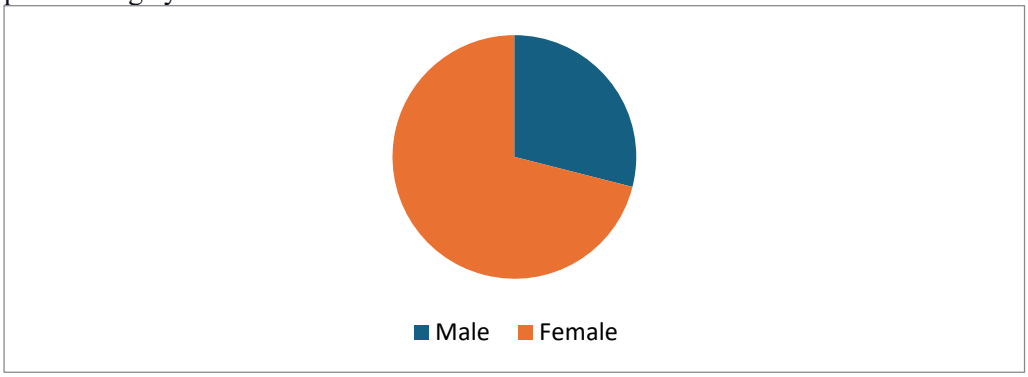


Figure 1: Gender involvement in vegetable processing Male 21%, female 79%

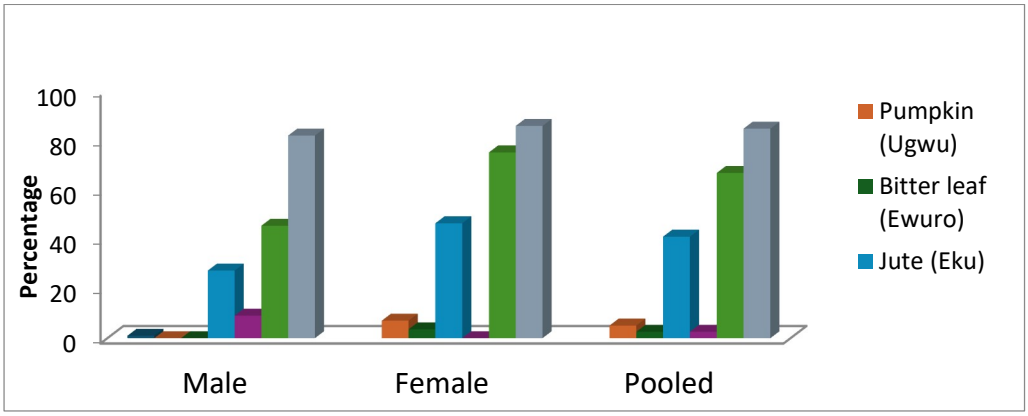


Figure 2: Type of vegetable processed

Table 3: Utilization of parabolic shaped solar dryer by the vegetable processors

Utilization	**Male**		**Female**		**Pooled**	
Level of usage	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
High	-	-	3	10.7	3	7.7
Average	2	18.2	17	60.7	19	48.7
Low	9	81.82	8	28.6	16	41.0
Frequency of use						
At least once a week	-	-	1	3.6	1	2.6
Ones in 2 weeks	-	-	2	7.1	2	5.1

Once a month	6	54.5	17	60.7	23	58.9
Rarely use	2	18.2	3	10.7	5	12.8
Never use	3	27.3	5	17.9	8	20.5
Reason for using PSSD instead of open air						
Hygiene	9	7.1	2	81.8	11	28.2
Very fast	6	32.4	9	54.5	15	38.5
Avoid wastage / loss	2	18.2	11	39.3	13	33.3
Reduce stress	8	72.7	23	82.1	31	79.5
Security of commodities	11	96.4	27	100.0	38	97.4
Pest and animal free	8	57.1	16	72.7	24	61.5

Source: Field survey, 2022

Association between the socio-economic characteristics of vegetable processors and their level of utilization of PSSD

Table 4 shows that age ($\chi2$=19.23; df=4) of the respondents had a positive significant ($p\leq0.00$) association with the level of utilization of PSSD. This result indicates that the age of vegetable processors is a factor that could influence the utilization of PSSD. A previous study by Ajayi et al., (2021) established that the age of a farmer is a factor in the adoption and utilization of improved postharvest innovations.

In the same manner, education attainment ($\chi2$ = 12.52; df=3) of the processors also had a positive significant ($p\leq0.00$) association with the utilization of the dryer. It is expected literate processors utilized more improved technologies than the non-literates will. This finding conforms with Sennuga et al., (2020) who revealed positive and significant associations between respondents' utilization of improved technology and their characteristics.

Processors' years of experience in vegetable processing helped in the utilization of PSSD ($p\leq0.00$; $\chi2$ = 13.36; df=4), probably; they have learned the art of vegetable handling and processing through open air/sun drying method, which could have assisted them in the usage of PSSD without constraint(s). This finding is in tandem with Petros (2010), whose study established a significant positive association between these variables.

According to Table 4, utilization of PSSD affected the monthly income of the processors significantly ($p\leq0.00$; $\chi2$ = 19.72; df=3). Since processors now have the opportunity to dry vegetables in neat and hygienic forms, products could be more appealing to vegetable consumers and attracts premium prices in the market and increase the monthly income of the processors significantly.

Table 4: Chi-square test of relationships between the socio-economic characteristics of vegetable processors and their level of utilization of PSSD.

Socio-Economic Variables	Chi^2 (χ^2)	Df	P> |z|	Decision
Age	19.23	4	0.000	Reject H_0
Education	12.52	3	0.000	Reject H_0
Year of experience	13.36	4	0.000	Reject H_0
Household size	4.90	2	0.003	Reject H_0
Monthly income	19.72	3	0.000	Reject H_0

Source: Field survey, 2022

Conclusion and Recommendations

Both genders employed PSSD to dry non-leafy than leafy vegetables once a month mainly because it's secured and hygienic. Also, it removed the stress of packing and repacking vegetables; and access to commodities by pests is restricted. The female gender participates more actively in PSSD drying activities such as harvesting, loading, offloading, packing, and marketing because these activities are traditional practices amongst rural women. The study established that PSSD was utilized moderately by women processors but poorly by men to dry vegetables. In addition, the personal characteristics of the processors as age, educational attainment, and others, could significantly influence the utilization of PSSD in the study location. In light of these conclusions, there should be a deliberate and concerted effort from policymakers to disseminate this useful drying technology to more communities and

relevant stakeholders within and outside Kwara State. More importantly, processors should be encouraged to dry vegetables more than once a month; this could increase their monthly income and raise them above the poverty line.

References

Ajayi, A. O., Benson, O. B., Johnson, O. M., Agboola, A. A. (2021) Willingness To Use Ice-Fish Box by Fresh Fish Value-Chain Actors in Lagos State, Nigeria. *Proceedings of the Annual Conference of the Agricultural Extension Society of Nigeria,* Number: Twenty-Sixth Annual Conference. Theme: Redefining Agricultural Extension Practice to Cope with Emergencies, page 77-83, http://aesonnigeria.org/ConfProc.

Akomolafe, O. P., Ajiboye, O., Oyewole, S. N., Ogunsua, J. M., Zubair, O. M., Idris Y. D., Olayemi, F. F. and Nababa A. K. (2021) Comparative evaluation of NSPRI solar dryers using fermented cassava (lafun) and cassava chips. *Nigerian Journal of Post-Harvest Research* 3(1) 12-25.

Benson, O. B., Olatilewa, O. M., Anifowoshe, A. O. and Sanusi, R. O. (2022). Exploring the effectiveness of selected postharvest training information on Improved Maize Crib utilization by maize farmers in Southwest, Nigeria. *European Journal of Training and Development Studies,* 9 (1) 20-31. https://doi.org/10.37745/ejtds.2014

Benson, O., Ambee, I., Akinnigbagbe, O., Omotuyi, B. and Solagbade, A (2018). Gender roles in fisheries post-harvesting activities in catch-locations within Coastal Areas of Lagos State Nigeria. *Journal of Agricultural Extension and Rural Development*, 10 (12), 245-250, https://doi.org/10.5897/JAERD2018.0980

Jolliffe, D. M., Mahler, D. G. Lakner, C., Atamanov, A., Tetteh, B., Samuel, K. (2022). Assessing the Impact of the 2017 PPPs on the International Poverty Line and Global Poverty (English). *Policy Research working paper,no. WPS 9941*, Paper is funded by the Knowledge for Change Program (KCP) Washington, D.C.: World Bank Group.
http://documents.worldbank.org/curated/en/353811645450974574/Assessing-the-Impact-of-the-2017-PPPs-on-the-International-Poverty-Line-and-Global-Poverty (Accessed 08/6/2023)

National Population Commission (NPC), (2006): National Population Commission, 2006

Petros T. (2010): Adoption of Conservation Tillage Technologies in Metema Woreda, North Gondar Zone, Ethiopia. An M.Sc thesis Submitted to School of Graduate Studies of Haramaya University.

Robinson V. (2019). Gender Inequalities: "Past" Issues and Future Possibilities. Humanities. Sociology. Available at https://www.bbvaopenmind.com/en/multimedia/audios/gender-inequalities-past-issues-and-future-possibilities/ (Accessed 25/3/2023)

Sarfo, J., · Pawelzik, E., Keding, G. B. (2023) Fruit and vegetable processing and consumption: Knowledge, attitude, and practices among rural women in East Africa, *Food Security 15(5)*
https://doi.org/10.1007/s12571-022-01343-3

Sennuga, S.O., Fadiji, T.O., and Thaddeus, H. (2020): Factors Influencing Adoption of Improved Agricultural Technologies (IATs) among Smallholder Farmers in Kaduna State, Nigeria. *International Journal of Agricultural Education and Extension*, 6(2): 382-391.

Schreinemachersa, P., Simmons, E. B., Wopereis, M. C.S. (2018) Tapping the economic and nutritional power of vegetables. *Global Food Security* 16 (2018) 36–45. http://dx.doi.org/10.1016/j.gfs.2017.09.005

Theja Bhaargavi, A. K. (2022) Gender Role Beliefs and Willingness to Change among Middle Adults. *International Journal of Indian Psychology, 10(2),* 1548- 1566. https://doi.org/10.25215/1002.155

World Vegetable Center, (2017). Healthier lives, more resilient livelihoods: World Vegetable Center Strategy 2017–2025 17–823 World Vegetable Center; Shanhua, Taiwan.

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The Effect of Preservation Strategies on Market Performance of Fish Sellers in Makurdi Local Government Area of Benue State, Nigeria

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Abstract

This study analyzed The Effect of Preservation Strategies on the Market Performance of Fish Sellers in Makurdi Local Government Area of Benue State, Nigeria. Multi-stage sampling method (purposive sampling technique and simple random sampling technique) was used to select its sample size of 120 fish marketers in the population area. A structured questionnaire was used to collect data. The test-retest method was used for validation and reliability. Data collected were analyzed using descriptive and inferential statistics. The result from the analysis showed that the majority (53.3%) of the respondent used the smoking method of preservation. Also, the market size was positive with an R2 of 0.239 and significant at 1% level of probability to market performance. This gave a positive mean profit of N218316.24 from gross margin analysis, indicating that fish marketing is profitable. The study also showed that inadequate capital, spoilage, and unwillingness of customers to buy were known to be the significant constraints of fish marketing in Makurdi LGA. The study concludes that preservation strategies positively affect the market performance of fish sellers.

INTRODUCTION

Fish is economically, socially and culturally important as a global dietary aspect of sustainable food security (Odebiyi et *al.,* 2013). Fisheries and related activities (processing and marketing) represent the main source of income for coastal fishing communities (United Nations, 2014). An important discourse among scholars is the marketing of fish and fish products due to its provision of more than 40% of animal protein consumed by average Nigerian, its contribution to the economy in terms of Gross National Product and its generation of income along its production, processing, preservation and marketing chains (Agbebi, 2010).

Fish products are highly traded and global fish trade has been increasing very rapidly in recent decades with an estimated 45% of the world catch now traded internationally (The Fish Project, 2015). Nigerians are high consumers of fish. Current demand for fish is estimated at 1.55 million tones. The key driving forces behind increased fish consumption are rapid population growth, rising incomes, urbanization, a growing appreciation of healthy and nutritious fish-based food, and innovations in processing and packaging technologies and distribution channels (Anderson, *et al*, 2017).

Intra-regional fish trade in Africa is constrained by inadequate market information, trade infrastructure, deficient policy and institutional frameworks which have prevented Africa from optimizing the social and economic benefits available from fish trade (Lokuruka, 2016). The malfunctioning of the marketing chain of major food leads to high rate of spoilage, constant food shortage, rising farm products prices and huge importation costs (Ayinde *et al.,* as cited in Ekine and Binaebi, 2018).

Normally the fish farms or other fish capturing sites are located far off from the market place and there is chance of fish decomposition and the uncertainties of their sale in market. When the fishes are caught in numbers, greater than the amount of consumption, their preservation becomes a necessity for their future use. Preservation and processing therefore become a very important part of commercial fisheries. Fish spoils easily after capture due to the high tropical temperature which accelerates the activities of bacteria, enzymes and chemical oxidation of fat in the fish. Due to poor handling, about 30 – 50% of fish harvested are wasted in Nigeria. These losses could be minimized by the application of proper handling, processing and preservation techniques (Bate and Bendall, as cited in Ugochukwu, 2017).

LITERATURE REVIEW

The processing and preservation of fish were of utmost importance since fish is highly susceptible to deterioration immediately after harvest and to prevent economic losses (Okonta and Ekelemu, in George et al., 2013). The long distance of distribution necessitates some processing and storage since preservation through refrigeration is not readily available. Ayuba and Omeji (2006) reported that insect infestation is the cause of most prominent losses in quality and quantity of stored, dried fish in Nigeria. If fish is not sold fresh, preservation methods should be applied to extend its shelf-life. These include freezing, smoking, drying and heat treatment (Sterilization, pasteurization, etc).

Efficient preparation of fish is important when top quality, maximum yield and highest possible profits are to be achieved. The processed fishery products were still stored using traditional processing and storage technologies, respectively.

Tawari and Abowei (2011) explored the traditional fish handling and preservation in Nigeria. The study revealed that the time elapsing between lifting of the nets and delivery to the shore can vary with the distance that has to be covered. The study further reveals that fish preservation techniques utilized in Nigeria include; Fish handling, filleting and fish preservation; chilling, super chilling, freezing, drying, smoking, salting and fermentation are reviewed in the article to provide information for improvement of culture fisheries management and practices in Nigeria. Inspite of these preservation practices, Adeyemi, et al., (2018) found out that Lack of adequate fish handling, processing techniques and storage facilities contribute significantly to the low supply of fish to poor rural dwellers that form three quarters of the population in developing countries.

Onyango, Sifuna, Otuya, Owigar, Kowenje, Lung'ayia and Oduor (2017) **e**valuated Fish Processing and Preservation Systems along the Shores of Lake Victoria towards Enhancement of Sun Drying Technology. The study aimed at identifying and documenting existing fish processing and preservation technologies practiced along Lake Victoria, Kenya and their adaptability in order to improve food security. Data documented in this study was gathered through open questionnaires, focus group discussions and stakeholders meetings. Demographically it reported that women accounted for over 85% of the fisher folk of which over 70% had basic level of education. The study revealed that technologically, sun-drying of fish is the most preferred fish preservation strategy at the landing sites.

Akinola et al. (2006) reported different types of preservation methods; drying, smoking, freezing, chilling and brining. But the most prominent fish preservation in Niger Delta is smoke drying. This could be adduced to the fact that most of the fish communities have no access to electricity to freeze their products. Electricity itself is fast becoming a less reliable source of energy for fish processing and preservation.

The fish marketing node in the value chain comprises those who sell fish at both retailing and wholesaling modes to the final consumers (Omonona and Ajani, 2014). Assessment of fish marketing channels is important in evaluating fish marketing system because they indicate how the various market participants are organized to accomplish the movement of a fish and fish products from the producer to the final consumers.

Agom *et al.* (2012) in their study carried out to evaluate wholesale frozen fish market in Calabar, Cross River state, Nigeria used herfindahl index to measure the concentration of the market. The result showed that wholesale frozen fish market structure is perfectly competitive with Herfindahl index of 0.211. Higher Gini coefficient means higher level of concentration and consequently, high inefficiency in the market structure (Adeleke and Afolabi, 2012).

Adeleke and Afolabi (2012) further indicated Gini coefficient value of 0.5292 for fresh fish market in Ondo State, Nigeria, which shows high level of concentration and consequently high inefficiency in the Ondo State fish market structure. In the analysis of the market structure of dried fish in Maiduguri metropolis, Borno state, Nigeria, Ismail *et al.* (2014) reported Gini coefficient of 0.5478 and 0.5252 for wholesalers and retailers, respectively.

There exist a plethora of literature on the preservation strategies and market performance of fish sellers across the globe. For instance Tawari and Abowei (2011) explores the traditional fish handling and preservation in Nigeria; Madugu, and Edward (2011) investigated the causal relationship between quantity of fish sold and marketing costs in Adamawa State; Onyango.*et al.* (2017) looked at fish processing and preservation technologies practiced along Lake Victoria: Kenya; and Maina (2011) researched on the analysis of market performance: a case of '*Omena*' fish in selected outlets in Kenya. Ismail *et al.* (2014) examined the market structure of dried fish in Borno State. However, none of these studies looked at the effect of preservation strategies on market performance of fish in Benue State of Nigeria. Thus, this study aimed at bridging this knowledge gap by investigating the effect of preservation strategies on market performance of fish sellers in Benue State of Nigeria.

METHODOLOGY

This study made use of primary data which was collected from 120 fish marketers in the study area with the help of well-structured questionnaire. Multistage sampling was used to select the sample size. Makurdi local government was selected using purposive sampling and four (4) markets in the local governments were randomly selected which includes Wadata Market, Fiidi Market, Modern Market and Wurukum market. The data was analyzed using both descriptive and inferential statistics. Test of hypotheses was done using t-test and the output from the gross margin analysis.

Table 1: Summary of the sampling procedure and sample size

S/No.	Markets	Sample Frame	Sample Size @10
1.	Fiidi	380	38
2.	Wurukum	350	35
3.	Wadata	220	22
4.	Modern	250	25
Total			**120**

Source: Author's Computation.

Measurement of Variables

- **Age:** was measured in years as the chronological age of the farmer
- **Sex:** was measured as dummy (male = 1 and female = 0)
- Marital Status: was measured as dummy(single =0, married =1, divorced =2, widowed or widower =3)
- **Household size:** was measured as the number of persons in the household
- **Educational level:** was measured as the number of years spent in formal school

- **Main Occupation:** Producer =1, Processor = 2 and Marketer =3 (Nominal level)
- **Preservation Strategies:** was measured as dummy with value of 1 for each strategy indicated and zero otherwise;
- **Challenges of Marketing of Fish:** was measured as dummy with value of 1 for each indicated and zero otherwise;
- **Years of experience: was** measured as the number of he/she has in fish production, preservation and marketing
- **Market size: was** measured as the number of fishes normally produced or purchased for re-sale.

Model Specification
Multiple Regression Analysis

This was used to examine the effect of preservation strategies on market performance of fish sellers. The model is specified as follows:

The implicit form of the model is specified as:
$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_{9,} X_{10 +} U_i)$ .....(4)
Y = Dependent variable
$X_{1\text{-}10}$= Explanatory variables
U_i = Error term
The explicit form of the model is stated hereunder
Linear function:
$Y_i = \beta_0 + b_1X_{1i} + b_2X_{2i} + b_3X_{3i} + b_4X_{4i} + b_5X_{5i} + b_6X_{6i} + b_7X_{7i} + b_8X_{8i} + b_9X_{9i} + b_{10}X_{10i} + U_i$
Semi-Log function:
$Y_i = \ln a + b_1 \ln X_{1i} + b_2 \ln X_{2i} + b_3 \ln X_{3i} + b_4 \ln X_{4i} + b_5 \ln X_{5i} + b_6 \ln X_{6i} + b_7 \ln X_{7i} + b_8 \ln X_{8i} + b_9 \ln X_{9i} + b_{10} + \ln U_i$
Double log function:
$\ln Y_i = \ln a + b_1 \ln X_{1i} + b_2 \ln X_{2i} + b_3 \ln X_{3i} + b_4 \ln X_{4i} + b_5 \ln X_{5i} + b_6 \ln X_{6i} + b_7 \ln X_{7i} + b_8 \ln X_{8i} + b_9 \ln X_{9i} + b_{10} + \ln U_i$
Where;
Y_i= **[Net] returns of selling fish (Naira) or Return on Investment (ROI) = Net profit/Total investment x 100**
β_o-β_5= Unexplained variables
X_{1i}= Smoking (Yes =1, otherwise =0)
X_{2i} = Canning (Yes =1, otherwise = 0)
X_{3i} = Salting(Yes =1, otherwise = 0)
X_{4i} = Freezing (Yes =1, otherwise = 0)
X_{5i} = Chilling(Yes =1, otherwise = 0)
X_{6i} = Drying (Yes =1, otherwise = 0)
X_{7i} = Type of fish sold (=1, otherwise = 0)
X_{8i} = Years of experience (years)
X_{9i} = Market size (number of fishes bought at a time for resale)
X_{10i}= Total Investment (Naira)
Value of coefficient of determination (R^2), the number of significant variables in conformity to apriori expectation.
Gross Margin Analysis
This was used to estimate market income (revenue), expenses (cost)and return on investment. Gross margin model is specified as follows:
GM = GR-TVC.....(5)
Where;
GM = Gross Margin
TVC = Total Variable cost
Return on Investment (ROI) was used to analyze the market performance of fish sellers.
ROI = Net profit/Total investment x 100

RESULT AND DISCUSSION

Preservative Strategies Adopted in the Study Area

The preservative strategies adopted by fish marketers in the study area. According the result gathered from the study, most (53.3%) of the respondents adopt or used smoking as a preservative strategy, (22.5%) use drying method, (20.0%) use freezing method, (11.7%) use salting method, (5.0%) used caning method while few (3.3%) adopt chilling as a preservative strategy respectively. Most of the respondents used smoking because of the availability of fire wood in the study area. This work is in disagreement with the literature of Onyango, et al (2017) and UNESCO (2011) study review that technologically drying of fish is the most preferred fish preservation strategy.

Table 2: Preservative Strategies Adopted in the Study Area

Variables	Frequency	Percentage (%)	Rank
Salting	14	11.7	4th
Canning	6	5.0	5th
Smoking	64	53.3	1st
Freezing	24	20.0	3rd
Drying	27	22.5	2nd
Chilling	4	3.3	6th

Source: *Field Survey, 2023*

Effect of Preservation Strategies on market performance of fish sellers

The result in table 3 below shows the estimate of the multiple regression analysis of the effects of preservation strategies on Market performance of fish sellers in Makurdi area.

The exponential (with superscript [b]) was selected as the lead equation because it had high R^2 and confirmation of significant coefficient to expectation.

The R^2 of 0.302 implied that 30.2% of variation in the market performance is explained by the changes in the independent variables. Furthermore, F^- statistic (5.278) was significant at 1% level of probability. Therefore, the Null Hypothesis which states that "there is no significant effect of preservation strategies on market performance of fish sellers in the study area" is rejected. It implies that the preservation strategies significantly affect the market performance of the fish marketers. Because once fish is not properly preserved or handled it leads to spoilage.

The result reviewed that, market size (0.239) was positive and significant at 1% level of probability to market performance. This implies that a unite increase in market size increases the market performance (revenue) by 0.239 holding other variables constant. This result agreed with the findings of Eyo et al., (2004) which stated that increases in market size increases number of fish available for sale which connotes increase in income.

Table 3: Effect of Preservation Strategies

Valuables	Linear	Double log[b]	Exponential[b]
Type of fish	40.041 (0.604)	0.327 (0.223)	0.126 (0.412)
Market size	-0.007 (0.201)	-0.002 (0.981)	0.239 (0.000)**
Salting	132.045 (0.517)	-1.154 (0.298)	0.017 (0.967)
Caning	285.225 (0.297)	2.310 (0.231)	0.774 (0.156)
Smoking	157.235 (0.323)	0.018 (0.984)	0.180 (0.569)
Freezing	292.104 (0.060)*	0.632 (0.483)	0.192 (0.531)
Drying	451.369 (0.0122)**	-0.976 (0.688)	0.642 (0.071)*
Chilling	857.374 (0.005)*	-0.976 (0.133)	1.480 (0.015)**
Total investment	0.000 (0.021)**	2.577 (0.000)**	1.443 (0.000)***

Constraint	90.593 (0.679)	12.355 (0.000)***	4.953 (0.000)***
F	2.375	4.559	5.278
p>f	0.17	0.000	0000
R-square	0.163	0.213	0.302
Adjusted R-square	0.094	0.094	0.244

*** ** and * significance at 1%, 5% and 10% level respectively. Values in parenthesis represent P-values.

Source: (field survey, 2023)

Cost/Return of fish marketing

The result shows that the TVC of fish marketing is ₦179662.09, which comprises of the cost of buying fish ₦176983.33 (99%), transportation cost and salaries to workers.

Total revenue from sales of fish is ₦397978.33. The gross margin of fish marketing (revenue-TVC) is ₦218316.24. This implies that fish marketing is profitable. This is in line with Abah *et al*. (2013) findings which revealed that profits made by wholesalers and retailers were positive.

Table 4: Cost and Returns in fish marketing

Variables	N	Mean	%
Cost of buying fish	120	176983.33	98.5
Transportation cost	120	770.42	0004
Salaries to workers	120	1908.33	0.01
Total variable cost	120	179662.09	10000
Revenue from fish sales	120	397978.33	
Gross margin (Revenue-TVC)	120	218316.24	

Source: (field survey, 2023)

Constraints on fish marketing

Table 5 below shows the constraints faced by respondents in the study area. It can be seen that the major challenges faced by fish marketers in the study area are inadequate capital, spoilage and unwillingness of customers to buy. This can be seen as 60.8% of the total respondent do not have enough capital to fund the fishing business, 40.8% experience spoilage and 39.2% had customers that were unwilling to buy. This is in line with the findings of Phukan, Mall, & Mishra (2015) which revealed that there was no support from the local government in fishing business and low selling price at the farm and also Jasbin and Radhika (2016) study which found out that the important problems of fish marketing of fishermen are storage and transportation.

Table 5: Constraints Facing Fish Marketers in Study Area

Constraint	**Frequency**	**Percentage (%)**	**Rank**
Inadequate capital	73	60.8	1st
Unavailability of sales help	26	21.7	6th
High cost of fresh fish	32	26.7	4th
Spoilage	49	40.8	2nd
Inadequate of supply of fresh fish	20	16.7	8th
Unwillingness of customers to buy	47	39.2	3rd
High cost of transportation	29	24.2	5th
Distance from the market	21	17.5	7th

Source: field survey, 2023

CONCLUSION AND RECOMMENDATIONS

Conclusion

The researcher analysed effects of preservation strategies on the market performance of fish sellers in Makurdi local government area of Benue state. The study concludes that gross margin analysis showed a positive mean profit of ₦218316.24 which indicate that fish marketing is a profitable venture in the study area, inadequate capital, Spoilage and unwillingness of customers to buy were known to be the major constraints of fish marketing in Makurdi LGA. Result of F^{-} statistic (5.278) was significant at 1% level of probability. The findings of the study also revealed that the mostly adapted preservative strategy by fish sellers in the study area is smoking (53.3%).

Recommendations

Based on the findings of this study, it is therefore recommended that:

i. Government should provide loans and grants accessible to fish marketers.
ii. Government should provide storage facilities to help prolong the shelf life of fish in the study area.
iii. The market Union and Government should regulate fish prices in the study area to enhance uniformity in prices of fish.

Contribution to Knowledge

The study established that fish marketing in the study area is profitable.

Suggestions for Further Study

Due to lack of time, the study was carried out in Makurdi local government only therefore it is suggested that the research should be extended to other local government areas of the state.

REFERENCES

Abah D., D. Zaknayiba and E. Simon (2013). Economic Analysis of fish marketing in Lafia Local Government Area of Nasarawa State, Nigeria. Production Agriculture and Technology Journal 9 (2): 54-62 ISSN: 0794-5213

Adeleke, M. L., Afolabi, J.A., (2012). Appraisal of Fresh Fish Marketing in Ondo State, Nigeria: IIFET Tanzanian Proceedings

Adeyemi M. A., Segun O. O. & Barakat O. S. (2018) Dermestes Maculatus Degeer Infestation impact on market loss of dried fish in Kwara State, Nigeria, Aquaculture and Fisheries; 3(4):170-173

Agbebi, F.O. (2010a). Fish Marketing and Food Security in Nigeria. *International Institute ofFisheries Economics and Trade 2010 Montpellier Proceedings* 1-10.

Agom, D.I and Etuk E.A (2012). Analysis of Wholesale Frozen Fish Markets in Calabar,Cross River State, Nigeria. Trends in Agricultural Economics 5 (2): 61 – 69.

Akinola, O.A., A.A. Akinyemi and B.O. Bolaji, (2006). Evaluation of traditional and solar drying systems towards enhancing fish storage and preservation in Nigeria (Abeokuta LocalGovernment as a case study). J. Fish. Int., 1(2-4): 44-49.

Anderson, M.L. and Ravesi, E.M (2017). Reactions of free fatty acids with protein in cod muscle frozen and stored at -26°C after aging in ice. Journal of Fish Res, 26: 2727-2736.

Ayuba, V.O. &Omeji, N.O. (2006). Effect of insect infestation on shelf life of smoked dried fish. Proceedings of the 21st Annual Conference of the Fisheries Society of Nigeria, November 13-17, 2006, Calabar, Nigeria, pp: 357-359.

Bate, E.C & Bendall, J.R. (2010). Changes in fish muscle after death. *British Medical Bulletin,* (12): 2305.

Ekine D. I. & Binaebi E. Structure and Performance of Fresh Fish Marketing in Yenagoa Local Government Area of Bayelsa State, *Nigeria IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*: 11(6) 63-68

Eyo et al., (2004). Department of Food science and Technology Michael Okpara University of Agriculture, Umudike.

Ismail A L, Tijani B A, Abdullah A M and Mohammed B, 2014. Analysis of Marketing Channel and Market Structure of Dried Fish in Maiduguri Metropolis of Borno State, Nigeria. European Journal of Business and Management, 6(7): 147-155.

Jasbin, B. P. & Radhika, R. (2016). Problems of Fish Marketing – With Special Reference toKanyakumari.*Journal of Chemical and Pharmaceutical Sciences January-March* 9(1).

Lokuruka, M.N.I. 2016. Food quality perspectives in African fish products: practices, challenges and prospects. *International Journal of Fisheries and Aquaculture Sciences* 6.1: 15-32

Madugu, A.J. & Edward, A. (2011). Marketing and Distribution Channel of Processed Fish in Adamawa State, Nigeria. *Global Journal of Management and Business Research* 11(4).

Maina, B. J. (2011). Analysis of Market Performance: A Case of '*Omena*' Fish in selected Outlets in Kenya. A Thesis Submitted to the Graduate School in Partial Fulfillment for theRequirements of the Master of Science Degree in Agricultural and AppliedEconomics of Egerton University.

Odebiyi, O.C., George, F.O.A., Odulate, D.O., Agbonlahor, M.U. and Olaoye, O.J. (2013). Value Chain Analysis for Coastal Fisheries Development in Nigeria. *Global Journal ofScience Frontier Research Agriculture and Veterinary* 13.11: 7-15

Okonta, A. A. &Ekelemu, J.K (2005). A prelimnary study of micro-organisms associated with fish spoilage in Asaba, Southern Nigeria. Proceedings of the 20th Annual Conference of the Fisheries Society of Nigeria, November 14-18, 2005, Port Harcourt, pp: 557-560.

Omonona B T and E K Ajani (2014). Value chain analysis of fish production in Nigeria: A case study of Lagos state. A project report submitted to the National Program for Food Security (NPFS), Federal Ministry of Agriculture and Rural Development, Abuja.

Onyango, D. M., Nyirima, J., Sote, T. B., Sifuna, A. W., Namuyenga, N., Otuya, P., Owigar, R., Kowenje, C., Oduor, A., and Lung'ayia, H., "Evaluation of the effectiveness of traditional Rastreneobola argentea sundrying process practiced along the shores of Lake Victoria, Kenya". Food and Public Health. 2015, 5: pp. 61-69 DOI: 10.5923/j.fph.20150503.01.

Phukan, C., Mall, M., Mishra, P. K., (2015). Study on challenges faced by progressive fish farmers in the Cachar district of Assam, International Journal of Engineering Technology, Management and Applied Sciences 2015, Volume 3 Issue 3, ISSN 2349-4476

Tawari C. C. &Abowei F. N. (2011) Traditional Fish Handling and Preservation *in Nigeria Asian Journal of Agricultural Sciences* 3(6): 427-436, 2011 ISSN: 2041-3890

The Fish Project. (2015). Artisanal fisheries. *In: FAO family planning knowledge platform.* Retrieved from *http://thefishproject.weebly.com/artisanal-fisheries.html* The Fish Site, 2015. Fish Trade in Africa: An Update. *The Fish Site Article*, *5m Publishing, Benchmark House, England*

UNESCO. Concept of Digital Preservation. (2011). Retrieved from www.unesco.org.

United Nations, (2014). The fisheries sector in the Gambia: trade, value addition and social inclusiveness, with a focus on women. *United Nations Conference on Trade anddevelopment Enhanced Integrated Framework, United Nations PublicationUNCTAD/DITC/2013/4.* 1-45.

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Analysis of Rice Value Chain Among Agro Processing, Productivity Enhancement and Livelihood Improvement Support (APPEALS) Beneficiaries in Kogi State, Nigeria

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ABSTRACT

This study analyzed the rice value chain among APPEALS beneficiaries in Kogi State, Nigeria. A sample size of 225 respondents from the six (6) rice clusters was randomly selected from the list of beneficiaries. Descriptive statistics and double hurdle regression model were used in analyzing the primary data obtained through questionnaire administration. The major actors in the rice value chain are farmers, processors, and marketers. Results of the survey showed that 64.1% of the farmers were male, with an average age of 31 years. Also, 52.2% had tertiary education, and 65.0% had between 3 and 5 household members. Results of the double hurdle analysis showed that household size, education, and information on value addition significantly influenced farmers and processors' decision to add value, while marketers' decision was influenced by age and household size. The level of value added was significantly determined by household size and information on value addition. The study recommends the need to improve actors' access to technology to enhance productivity, as this will reduce production costs. Areas of investment opportunities in the value chain should be advertised by APPEALS to encourage farmers and investors to focus more on such areas.

Keywords: APPEALS, beneficiaries, value addition decision, intensity of addition, double-hurdle

INTRODUCTION

Rice is indispensable in the strategy for food security in Sub-Saharan Africa (SSA), because it provides 27% of the energy and 20% of protein needs in developing countries, including African countries (Tollens, 2007). In Nigeria, per capita consumption of rice in the 1980's is put at 18kg and reached 22kg between 1995 and 2000 (Ogundele & Okoruwa, 2006). In 2005, average per capita consumption was between 24-28kg and represents 9% of total caloric intake per annum (Ochigbo, 2011). Nigeria's rice consumption has increased significantly over the last decade (6.5 % per annum) and is now estimated at 6 million metric tonnes annually and the total retail market value for rice in Nigeria was estimated at $3.6bn (Samarendu, 2013).

The Agro Processing, Productivity Enhancement and Livelihood Improvement Support – APPEALS Project is a six-year project developed by the Federal Ministry of Agriculture and Rural Development (FMARD) in collaboration with the World Bank and other stakeholders. The project which built on the legacy of the Agricultural Transformation Agenda (ATA) and plans to support policy thrusts on Food Security, local production, job creation and economic diversification. With focus on the following crops cassava, rice, and cashew in six (6) beneficiary States of Kogi, Cross River, Kaduna, Kano, and Lagos. Value addition at various stages of the rice value chain would bring improvements in the rice sector (APPEALS 2021).

The value chain describes the "full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and

final disposal after use" (Kaplinsky & Morris, 2002). Some reasons for promoting value added production may consist in higher profits, more stable market conditions, job creation, diversification of products and markets, and down-stream economic benefits through industry support sectors (Naji, 2011).

At the production stage, farmers adopt different production systems for various reasons, and it is geared towards income maximization. Income maximization entails comparison of costs and returns from different enterprises and stages of the value chain. The successful implementation of the value chain approach critically depends on the ability of the stakeholders (actors, supporters and promoters) to acquire, absorb, disseminate and apply new technological, organizational and institutional innovations in a continuous manner. It is against these backdrops that this research seeks to analyse value addition decision in the rice value chain in Kogi State, Nigeria.

METHODOLOGY

This study was carried out in Kogi State, Nigeria. Kogi State was created on August 27, 1991 with Lokoja as its capital. It has a total land area of 29,833 square kilometers and is located between $6^0$42'E $7^0$30'N. The State shares borders with Niger, Nassarawa and FCT Abuja to the North, with Benue to the East and Enugu, Edo, Ondo, Ekiti and Kwara States to the South and West respectively (Adams, 2018). The current population figure for Kogi State is about 5.2 million people as projected from 2006 population census by the Nigeria Population Commission (NPC, 2020).

The study adopted quantitative research in order to achieve the objectives of the study. The quantitative research approach was used because it is more fixed and deductive with variables clearly defined in advance of data collection. Data for the study were obtained from Agro-processing Productivity Enhancement and Livelihood Improvement Support, (APPEALS) six rice clusters across the state namely; ASCO Camp located in Ajaokuta Local Government Area with total beneficiaries of one hundred and eleven members (111) members, Ozi located Koton-karfi in Kogi LGA with total beneficiaries of eighty members (80) members, Girinya in Kogi LGA with total beneficiaries of sixty three (63) members, Chakaruku in Kogi LGA with total beneficiaries of sixty (60) members, Ejiba which covers Yagba east, Yagba west and Mopa-Amuro LGA with total beneficiaries of seventy two (72) members, Ogbogbo in Igala-Mela Odolu LGA with total beneficiaries of twenty five (25) members. The target populations are four hundred and eleven (411) actors in APPEALS Rice value chain in Kogi State.

A multi stage sampling technique was employed to select total respondents not less than 201 from all the rice clusters as determined using Krejcie and Morgan table randomly selected farmers are 116, processor are 65 while marketers are 44 giving the total number of beneficiaries is now two hundred and twenty five (225), the 225 beneficiaries were used as respondents for the research work. Data were obtained from the beneficiaries and analyzed with the use of descriptive statistics, and Double hurdle model. The double-hurdle model, originally formulated by Cragg (1971), assumes that households make two decisions with regard to purchasing an item, each of which is determined by a different set of explanatory variables. Double hurdle analyses explains that a condition need to be satisfied (first hurdle) before the second hurdle can be determined, in this case; socio-demographic characteristics must influence value addition decision in rice production before the level of value addition can be determine. If the socio-demographic characteristics did not influence value addition decision in rice production then, the level of value added cannot be determined.

$V = \sum_{j=1}^{n} b_j x_{ij}$ ……eq. 1

The regression was implicitly specified as:-

$$Pi = \beta qi + \mu i$$

$$P_i^* = \beta_i \alpha + \mu_i \; Potential\ to\ add\ value$$

The first hurdle is represented by;

$$P_i = 1 \; if \; P_1^* > 0,$$

$$P_i = 0 \; if \; P_1^* \leq 0$$

The first hurdle is thus assumed to be defined by the latent variable P_i^*, The second hurdle closely resembles the Probit model (eq. 1):

The second hurdle is represented by;

$$Pi = \partial i P_i^*$$

The dependent variable is intensity of value added while the independent variables are socio-economic factors. As the model name suggests, subjects must cross two hurdles to contribute.

The first hurdle needs to be crossed to be a potential contributor. Given that the subject is a potential contributor, his or her current circumstances and treatment in the experiment dictate whether he or she contributes this is the second hurdle.

Where

Pi - 1 for Xi, Z;I - 1, 2…,n

qi = is a vector of explanatory variables and is the vector of the parameters.

μi = random error.

The dependent variable Pi is a dichotomous variable which is one when the actor add value and zero if otherwise.

The explanatory variables was; X_1, = Sex (male = 1, female = 0), X_2, = Age (in years), X_3 = Farming experience (in years), X_4 = household size (in number of person), X_5 = Level of education (in years), X_6 = awareness of value addition (dummy Yes = 1, No = 0).

RESULTS AND DISCUSSIONS

The socio-demographic characteristics of the rice farmers, processors and marketer are represented in Table 1. The socio - demographic characteristic variables considered in this study include gender, age, number of years in farming business, house-hold size, level of educations, value addition awareness. The dominance of male in the value chain may be attributed to the nature of activities expected in rice farming in which energy and power is required. The mean age of rice farmers, processors and marketers was 33, 33 and 34 years respectively. This imply that there are economically active people involved in rice production in Kogi APPEALS. This is attributed to the fact that APPEALS focus on youth's farmers to empower as a beneficiary. This finding is in line with that of Nwalieji and Uzuegbunam (2012), which reported that majority of rice farmers are still within their middle, active and productive ages and hence can engage efficiently in rice production. The result revealed that the average household size of the actors was 4, 4 and 6 person in the household of farmer, processor and marketers respectively, this implies that majority of the actors had average household size this may be attributed to the age levels of the respondents which is more dominated by youths. Education plays a significant role in skill acquisition and technology transfer. It enhances technology adoption and the ability of farmers to plan and take risks. Farmers with higher levels of education are likely to be more efficient in the use of inputs than their counterparts with little or no education. The result also revealed that the average farming experience was 6 years for respondents (actors), while processor had a mean year of experience to be 5 years while that of marketers had 6 years as well. Actor's experience which is an important factor to determine both productivity and the production level is high hence a significant output is expected. Most of the respondents have knowledge about value chain which can boost the rice productivity in Kogi State.

Factors that influence farmers' decision to add value and level of value added

Estimates of the double hurdle analysis of factors that influences farmer's decision to add value to rice production shows that out of the six explanatory variables included in the model, three significantly influenced the likelihood of rice farmers' value addition decision. These are household size, level of education, and information on value addition and these variables also influenced the intensity of value added.

The coefficient of level of education and awareness was significant at 5%. By implication, an increase in the years of formal education and information on value will increase the likelihood of farmer's adding value to rice production. It is apparent that some technology requires some years of schooling than others. Education enhances individual farmer's ability to access and process agricultural information, and the application of information in improving on farm activities. This finding is supported by the study of Huffman (2001) who posited that education expands individual scope of inference and paradigm, whereas training re-enforces individual's experience and up-grade the skills

for effective implementation of any novel technology. The coefficient of household size was positive and statistically significant at 1%. This implies that having a large household size will enhance the probability of adding value to rice production. This is in line with the *a'priori* expectation that a large household size increases their ability to adopt different value addition techniques. This agrees with the findings of Afolami, Obayelu, Agbonlahor and Lawal-Adebowale (2012) who noted in their study that family labour was the most important source of farm labour in rice cultivation and about 60% of the members of the farm families participated in the family rice farm.

Factors that influence processors' decision to add value and level of value added

Six variables were considered to influence farmers' decision to add values which includes gender, age, business experience, household size, level of education, and awareness of value addition. The results showed that the coefficient of gender, business experience and educational level was negative and statistically significant at $P < 0.01$ (1%) and $P < 0.05$ (5%) level in determining value addition decision and the intensity of value added. These implies that for every years spent in processing, the rate of value addition decreases significantly, this can be attributed to the high rate of high dependents on manpower and crude implement used in processing rice within the state. The coefficient of age was positive and significant at 10% in determining the decision to add value but does not significantly influence the intensity to add value.

The coefficient of household size and awareness of value addition was positive and significant at 10% in determining the decision to add value and the intensity of value addition. By implication, an increase in the household size and information on value will increase the likelihood of processor adding value to rice production. Crude method of production requires high number of manpower than technical methods, process agricultural information, and the application of information in improving on farm activities also increases the level of value addition in production process. This agrees with the findings of Afolami, *et. al*. (2012) noted in their study that age, family labour and level of information was the most important source of rice farming.

Source: Field Survey, 2021

Table 1: Socio-Economic Characteristics of Respondents

Socioeconomic Characteristics	Farmers, n = 114 Freq.	%	Mean	Processors, n = 65 Freq.	%	Mean	Marketers, n = 44 Freq	%	Mean
A. Sex									
Female	13	11.4		42	64.6	Female	26	59.1	Female
Male	101	88.6	Male	23	35.4		18	40.9	
B. Age (years)									
18 – 25	6	5.3		0	0.0		3	6.8	
26 – 30	10	8.8		15	23.1		9	20.5	
31 – 35	40	35.1	33yrs.	37	56.9	33yrs.	23	52.3	34yrs
36 – 40	38	33.3		10	15.4		7	15.9	
Above 40	20	17.5		3	4.6		2	4.5	
C. Household Size (number)						4 members			6 members
Less than 3	17	14.9		4	6.2		1	2.3	
3 – 5	54	47.4	4 members	61	93.8		18	40.9	
6 – 8	34	29.8		0	0		20	45.5	
9 – 11	4	3.5		0	0		4	9.1	
11 and above	5	4.4		0	0		1	2.3	
D. Educational Level			Secondary			Secondary			Secondary
No formal education	7	6.1	Education	2	3.1	Education	0	0.0	Education
Primary education	15	13.2		4	6.2		7	15.9	
Secondary education	53	46.5		29	44.6		21	47.7	
Tertiary education	36	31.6		28	43.1		16	36.4	
Others	3	2.6		2	3.1		0	0	
E. Business Experience(yrs.)	2	1.8	6 yrs.	3	4.6	5yrs.	0	0.0	6yrs.
1 – 2 years	25	21.9		15	23.1		14	31.8	
3 – 4 years	36	31.6		30	46.2		13	29.5	
5 – 6 years	18	15.8		10	15.4		11	25.0	
7 - 8years	33	28.9		7	10.8		6	13.6	
Above 8 years									
F. Awareness of Value chain									
Yes	96	84.2	Yes	55	84.6	Yes	36	81.8	Yes
No	18	15.8		10	15.4		8	18.2	

Table 2: Double hurdle analysis for Farmers

Variables	First Stage Marginal effect	Second Stage Level of Value Added
Gender/Sex	-0.2329^{NS} (0.1952)	0.172969^{NS} (0.4369)

Age	-0.01209^{NS} (0.0148)	-0.0491486^{NS} (0.03795)
Farming experience	0.004456^{NS} (0.03271)	-0.0421851^{NS} (0.08336)
Hhdsize	0.12056*** (0.04679)	0.3704511*** (0.10071)
Educational level	-0.04054** (0.01952)	-0.1687865*** (0.05482)
Information on value addition	-0.28680** (0.13477)	-1.367792*** (0.46726)
LR chi^2 (6)	**= 80.35**	
Prob > chi^2	**= 0.0000**	
Pseudo R^2	**= 0.2951**	

Source: Computed from Field Survey, 2022 NOTE: values in parentheses are standard errors ***, ** and * = coef. Significant @ 1%, 5% and 10% level of probability, respectively. NS = Not Significant.

Table 3: Double hurdle analysis for Processor

Variables	**First Stage** **Marginal effect**	**Second Stage** **Level of Value Added**
Gender	-0.344591*** (0.1213)	-1.242768** (0.5669)
Age	0.0674196*** (0.0276)	0.1489091^{NS} (0.1200)
Business experience	-0.116497*** (0.0438)	-0.3291161* (0.1884)
Hhdsize	0.1981528*** (0.0654)	0.9310281*** (0.33791)
Educational level	-0.1073832*** (0.0252)	-0.1736372^{NS} (0.1233)
Information on value addition	0.5154227*** (0.194)	2.686683*** (0.8333)
LR chi^2 (6)	**= 71.94**	
Prob > chi^2	**= 0.0000**	
Pseudo R^2	**= 0.4703**	

Source: Computed from Field Survey, 2022 NOTE: values in parentheses are standard errors ***, ** and * = coef. Significant @ 1%, 5% and 10% level of probability, respectively. NS = Not Significant.

Factors that influence marketers' decision to add value and level of value added

The results showed coefficient of age, and household size was positive and significant at 1% and 5% respectively in determining the decision to add value but does not significantly influence the intensity of value addition. By implication, an increase in the household size and age will increase the likelihood of marketer adding value to rice production.

Table 4: Double hurdle analysis for Marketer

Variables	First Stage Marginal effect	Second Stage Level of Value Added
Gender	-0.6221219^{NS} (14.7715)	-10.87976^{NS} (308.435)
Age	0.0715125*** (0.0250)	0.1775558^{NS} (0.1761)
Business experience	-0.0852907^{NS} (0.0728)	-0.903515NS (0.7543)
Hhdsize	0.138627** (0.06359)	0.872075NS (0.6342)
Educational level	-0.0317693^{NS} (0.04065)	-0.1566546^{NS} (0.3323)
Information on value addition	0.03758^{NS} (13.339)	2.573012NS (580.962)
LR chi^2 (6)	**= 49.57**	
Prob > chi^2	**= 0.0000**	
Pseudo R^2	**= 0.4477**	

Source: Computed from Field Survey, 2021 NOTE: values in parentheses are standard errors ***, ** and * = coef. Significant @ 1%, 5% and 10% level of probability, respectively. NS = Not Significant.

CONCLUSION AND RECOMMENDATIONS

It can be concluded from findings of this study that factors such as household size, level of education, and information on value addition significantly influence the likelihood and intensity of value addition in the rice value chain. To promote value addition in the rice sector, policymakers should prioritize educational programmes, training initiatives, and information dissemination to enhance the knowledge and skills of farmers, processors, and marketers. Additionally, fostering collaborations, providing access to resources and support, and creating a supportive policy environment are crucial in encouraging widespread adoption of value addition practices and realizing the economic potential of the rice value chain.

To enhance the effectiveness and impact of the APPEALS project and for the state government to create an enabling environment for value addition, which will result in increased agricultural productivity and income generation across the rice value chain, the following policy recommendations are made:

1. APPEALS project should consider comprehensive training programmes focused on value addition techniques, market access, and business development for farmers, processors, and marketers participating in the APPEALS project.
2. The project should invest in appropriate infrastructure and technology, such as processing facilities, storage facilities, and equipment, to support value addition activities.
3. State government and relevant stakeholders should facilitate access to financial resources by providing targeted loans, grants, or financial support programs to enable farmers, processors, and marketers in the APPEALS project to invest in value addition initiatives. There should also be established market linkages and partnerships with retailers, wholesalers, and potential buyers to create sustainable market channels for value-added products produced under the APPEALS project.

REFERENCES

Adams, O. K. (2018). Challenges of Rice Production in Nigeria: A Case Study of Kogi State. *Food Science and Quality Management,* 74, 14-17.

Afolami, C. A., Obayelu, A. E., Agbonlahor, M. U., and Lawal-Adebowale, O. A. (2012). Socioeconomic analysis of rice farmers and effects of group formation on rice production in Ekiti and Ogun States of South-West Nigeria. *Journal of Agricultural Science*, *4*(4), 233.

Agro Processing, Productivity Enhancement and Livelihood Improvement Support – APPEALS. (2021). *Agro Processing, Productivity Enhancement and Livelihood Improvement Support Kogi report.* Kogi State: https://kogiappeals.org.ng/about.php.

Cragg, J. (1971). Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica, 39*, 829-844.

Huffman, W. E. (2001). Human capital: Education and agriculture. *Handbook of Agricultural Economics*, *1*, 333–381.

Kaplinsky, R., & Morris, M. (2002). *A handbook for value chain research. Prepared for the IDRC.* Sussex: Institute of Development Studies.

Naji, M. (2011). *Enhancing small-scale fisheries value chains in the Mediterranean and Black Sea.* General Fisheries Commission for the Mediterranean.

National Population Commission (NPC), N. P. (2020). 2020 Population Distribution by Age and Sex; 2006 Census Priority Tables (Volume 4). Retrieved August 11, 2022, from http://www.population.gov.ng/index.php/publications/141-population-distribution

Nwalieji, H. U., & Uzuegbunam, C. O. (2012, December). Effect of climate change on rice production in Anambra State, Nigeria. *Journal of Agricultural Extension, 16*(2), 81-91.

Ochigbo, A. A. (2011). Enabling policies and sector strategies and plan for rice: The Nigerian experience. *Proceedings of the First International Conference on "Rice for Food, Market and Development" held on 3rd -5th, March 2011 at Raw Materials Research and Development Council (RMRDC).* Maitama, Abuja: Raw Materials Research and Development Council (RMRDC).

Ogundele, O. O., & Okoruwa, V. O. (2006). Technical efficiency differentials in rice production technologies in Nigeria. *African Economic Research Consortium*, 52. Nairobi. http://www.aercrafrica.org/documents/RP154.pdf

Samarendu, M. (2013). Trends in global rice consumption. Rice Today. *International Rice, 12*(1), 33-41.

Tollens. (2007). Markets and institutions for promoting rice for food security and poverty reduction in Sub-Saharan Africa. *African Crop Science Journal, 15*(4), 237-242.

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Constraints and Prospects of Plantain Marketing in Owo Local Government Area, Ondo State

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ABSTRACT
The study was designed to examine the constraints and prospects of plantain marketing in Owo Local Government Area of Ondo state. The factors considered include: socio-economic characteristics of plantain marketers, marketing structures and channels, costs and returns, constraints and prospects of plantain marketing. Multi-stage sampling technique was used to select seventy five (75) plantain marketers. Primary data were collected using a well-structured questionnaire. The data were analysed using descriptive statistics and budgetary analysis. The results showed that 70.7% of the respondents were female and married. They were between 31and 40years (37.3%) and had at least secondary education (52.0%). Thirty seven percent (37.3%) of the respondents sold their plantain to retailers, 30.7% of them sold to final consumers, 28.0% sold to wholesalers and the remaining 4.0% sold theirs to processors. The results further revealed that plantain market in the study area is a perfect competitive market. The results showed that plantain marketing is a profitable business with a Gross Margin of ₦7,625,744.00, Net Margin of ₦7,526,678, Rate of Return (ROR) of 1.44 and marketing margin of 25%. Hence, plantain marketing has a good prospect. The study recommends that government should provide good road networks and processing facilities for the marketers.

1. INTRODUCTION

1.1 Background Information

In Nigeria and other developing countries alike, plantain is considered as staple food crop for many. Available trade records and associated indices showed that Nigeria is one of the largest producers of plantain in the world (FAO, 2013; Chiemela *et al*., 2021). Nigeria is ranked first in Africa and fifth in the world producing 2,722,000 metric tons in 2011(FAO, 2012; Chiemela *et al.,* 2021). Nigeria produced 3,088,938 tons of plantains in 2016, ranking fourth in Africa after Uganda, Rwanda, and Ghana. Plantain is a seasonal, annual crop with relative short shelf life, and its production in Nigeria is concentrated in humid lowland to upland tropical areas (FAO, 2016). Due to the rich availability of fertile forests and laterite soils favourable for plantain growth, plantain production is concentrated in the southern region of Nigeria: Anambra, Benue, Cross River, Akwa-Ibom, Imo, Kwara, Enugu, Plateau, Kogi, Rivers, Edo, Delta, Lagos, Ondo, Ogun, Osun, and Oyo (Ekunwe & Helen, 2010).

Nutritionally, ripe plantain is a good source of energy while unripe plantain serves as a source of iron (Achike *et al*., 2011). More so, it is a rich source of vitamins A, B complexes and C, and also includes minerals and dietary fibre essential for healthy growth (Honfo *et al*., 2007). It equally serves as a source

of employment and cash income to rural dwellers in countries like Nigeria. The crop has become a crucial revenue earner because of its export potentials (Olumba & Onunka, 2020). Plantains serve as raw material for several indigenous delicacies and snacks (Newilah *et al*., 2005). Depending on the mode of consumption, plantain can be roasted, boiled, or fried. Studies have shown that fibres acquired from the pseudo stem may be used in the paper and pulp industry as biodegradable and in other sectors such as the textile industry (Rana & Fangueiro, 2016).

Idachaba, (2000) disputed that it is inadequate for policy makers to concentrate on solving problems in production alone without reference to the difficulties faced during the stage of marketing. This implies that product marketing requires sufficient attention owing to the role it plays in the empowerment of marketers and facilitating supply to meet market demand. Plantains are perishable, and where advanced technology is lacking, they must be consumed in about three weeks after harvest. If their perishability must be reduced, then they must be spontaneously distributed and marketed (Fonsah & Chidebelu, 2011). More so, Eronmwon *et al*., (2014) asserted that increase in the output of plantain needs adequate marketing because the product has a significantly low shelf life. In Nigeria, output of plantain is believed to have doubled, even though production system is largely driven by small scale farmers (Akinyemi *et al*, 2010). So, in a situation where the production and consumption of plantain is on the rise and the link between the producers and the consumers make up the market as reported by (EPAR, 2013; Oladapo *et al*., 2007; Olumba and Onunka, 2020), it thus becomes imperative to examine marketing of this commodity as the link between the producer and consumer will always be the marketers.

1.2 Problem Statement

Despite large production of plantain in the study area (Owo, Ondo State) its marketing and distribution system to other parts of the country and is not well and effectively developed compared to other food and cash crops. This study will add to the already existing literature on marketing of plantain which may aid further researchers in other tropical rain forest regions where the production of plantain is massive.

Due to the nutritional importance of plantain, venturing into its enterprise holds promising potentials. However, the relatively little attention given to plantain is focused on its production technology while only a few is done on its marketing. It is obvious that increased production without corresponding increase in marketing may amount to wastage of resources leaving people on the same platform of malnutrition. According to Ariyo *et al*, (2013) profit in plantain marketing involves the role of middlemen in passing plantain from the farms to the markets or from a particular market to another and selling them at a greater price at the detriment of the farmers who produced the crop. One of the factors that have militated against efficient marketing of plantain according to Aina & Ajijola, (2010) has been thought towards ignorance on the part of marketers. This has led to low profitability. There is also high post-harvest losses which are the major problems limiting the availability of plantain in the country and in the study area (Bayeri and Nwachukwu, 2003; Yebirzaf and Esubalew, 2021). Also, unavailability or ignorance of when to provide storage facility or subsidy for storage facilities according to Josiah, (2014) has discouraged many marketers and farmers who would want to keep part of their produce till off season so that profit could be enhanced.

However, majority of the agricultural studies in Nigeria highlighted other factors that have limited maximum profit in marketing of plantain. Akinyemi *et al*., (2010)pointed out that majority of plantain marketers still operate on a small scale which makes unit cost of plantain costly, high cost of transportation, seasonal price fluctuation, poor access road which has caused perishable goods such as plantain to spend so much time on transit. Amidst all these challenges, there is need to examine the marketing of plantain in Owo Local Government Area so as to help the farmers to avail themselves of the opportunity to acquire knowledge to improve their plantain markets so as to receive good price for the product and thus enjoy more profit in the business.

1.3 Research Questions

i. What are the socio economic characteristics of plantain marketers in the study area?
ii. What are the marketing channels and structures of plantain in the study area?
iii. What are the costs and returns of plantain marketing in the study area?
iv. What are the prospects of plantain in the study area?
v. What are the constraints of plantain marketers in the study area?

1.4 Objectives of the study

The broad objective of the study is to analyze the marketing system of plantain in Owo local government area of Ondo State.
The specific objectives are to;
i. identify the socio economic characteristics of plantain marketers in the study area;
ii. describe the market structure and marketing channels of plantain in the study area;
iii. evaluate costs and returns of plantain marketing and its profitability in the study area;
iv. examine the prospects of plantain marketing in the study area; and
v. determine the constraints of plantain marketers in the study area.

1.5 Justification of the Study

Plantain is an important crop in Nigeria and plays a significant role in the country's economy. Understanding the dynamics of plantain marketing can provide insights into the factors that affect the supply and demand of plantains and how it affects the economy. The study of plantain marketing in Nigeria can provide insights into the market structure, market trends, and market access for plantains. This information can help farmers and traders to make informed decisions about pricing, production, and marketing strategies.

Plantain marketing creates employment opportunities for many people, including farmers, traders, and transporters. Studying the marketing of plantains can help to identify the challenges faced by people in the plantain value chain and how these challenges can be addressed to improve the livelihoods of those involved. Studying plantain marketing can help to identify ways to improve the competitiveness of Nigerian plantains in both local and international markets and can also help to ensure that there is a stable supply of plantains in the market, which is essential for food security in the country. It will also be helpful to potential investors interested in plantain business in Owo, Ondo State.

2. METHODOLOGY

2.1 Study Area

The study area is Owo Local Government Area (LGA) Ondo State, Nigeria. It has its administrative headquarters in the town of Owo. Owo Local Government Area is domiciled in Ondo state, South-west geopolitical zone of Nigeria. The LGA is made up of seven towns/ villages which include Iyere, Idasen, Uso, Upenmen, Isuada, Ipele, and Owo town. Its geographical coordinates are 7° 11' 0" North, 5° 35' 0" East. It is bounded by the states of Kwara and Kogi on the north, Edo on the east, Delta on the southeast, and Osun and Ogun on the west and by the Bight of Benin of the Atlantic Ocean on the south. The current estimated population of Owo LGA is put at 222,262 inhabitants with the area primarily populated by members of the Yoruba ethnic group (Oyeniyi, 2022). The Yoruba language is commonly spoken in the LGA while the religions of Christianity and Islam are practiced in the area.

Owo, Ondo State has a tropical climate, with temperatures ranging from 25°C to 32°C, and an annual rainfall of about 1200 mm (Ogunbameru, 2012). It has fertile soils suitable for plantain cultivation. The land is well-drained, and the soil is rich in nutrients, which favours the growth of healthy plantains (Akinwale *et al*., 2013). Owo has a lot of arable land suitable for plantain farming. This makes it easier for farmers to acquire land and start their plantain farms. Owo LGA, Ondo state is a major collecting point for cocoa. It also serves as a market center for yams, cassava (manioc), corn (maize), rice, palm

oil and kernels, pumpkins. The LGA is also known for food processing, lumbering, and farming with crops such as cocoa, pepper, cotton, maize and cassava grown in the area.

2.2 Data Collection

The data for this study was collected from primary sources using well-structured questionnaires.

2.3 Sampling Techniques

Multi-stage sampling procedure was used to select the plantain marketers in Owo Local Government Area of Ondo State. The first stage involved purposive selection of five communities/towns in the LGA where plantain is produced and marketed in large quantities. The second stage involved purposive selection of five markets from the five communities. The third stage involved random selection of fifteen plantain marketers from each market. A sample size of seventy five was used for this study.

2.4 Data Analysis

Objectives (i), (ii), (iv) and (v) was realized using descriptive statistics while objective (iii) was analyzed using budgetary analysis.

2.4.1: Budgetary Analysis

2.4.2: Gross Margin Analysis

The gross margin analysis used for the study is given as:

GM = TR – TVC

Where:

GM = Gross Margin (₦)

TR = Total Revenue (₦)

TVC = Total Variable Cost (₦)

The higher the GM, the more likely a farm was considered to be profitable and the smaller the GM, the less the profit possibility.

2.4.2: Net Margin

Net Margin = TR - TC

Where,

TR= Total Revenue

TC = Total Cost

2.4.3: Marketing Margin

Marketing Margin = SP- CP×100%

Where,

SP = Selling Price

CP = Cost Price

2.4.4: Rate of Return

Rate of Return = TR ÷ TC

Where,

TR = Total Revenue

TC = Total Cost

2.4.5: Marketing Efficiency (ME)

ME = ROR* 100%

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of the Plantain Marketers

Table 1 describes the socio-economic characteristics of the respondents in terms of age, sex, marital status, marketing experience, education, household size, occupation etc.

Table 1: Distribution of plantain marketers according to their gender and age

Variables	Frequency	Percentages (%)
Gender		
Male	22	29.3
Female	53	70.7
Total	**75**	**100**
Age		
20 years and below	2	2.7
21-30 years	12	16.0
31-40 years	28	37.3
41-50 years	23	30.6
51-60 years	8	10.7
60 years and above	2	2.7
Total	**75**	**100.0**

Source: Field survey, 2023.

Majority (72.0%) of the respondents were plantain sellers only while the remaining respondents (28.0%) were plantain farmers and sellers. This result is very motivating as there is no need to venture into farming before becoming a plantain marketer. Also, majority (70.7%) of the plantain marketers

were female while the remaining (29.3%) were male. This signifies that female dominates plantain marketing. This corresponded with the result reported by Chiemela C. *et al*., (2021).

Majority (37.3%) of the respondents were between the ages of 31-40 years, 30.6% have their ages ranged between 41-50 years, 16.0% have their ages ranged between 21-30 years, 10.7% have their ages ranged between 51-60 years, 2.7% were between 20 years and below and 2.7% were between 60 and above. This result indicates that most of the plantain marketers in the study area were agile, middle aged individuals. As such, they should be provided with adequate and relevant market information to increase their efficiencies.

Table 2: Distribution of plantain marketers according to their marital status and level of education

Variables	Frequency	Percentage
Marital status		
Single	6	8.0
Married	53	70.7
Divorced	10	13.3
Widowed	3	4.0
Separated	3	4.0
Total	**75**	**100**
Level of education attained		
No formal education	10	13.3
Primary	12	16.0
Secondary	39	52.0
Tertiary	14	18.7
Total	**75**	**100.0**

Source: Field survey, 2023

The result of marital status of the respondents in Table 2 showed that majority (70.7%) were married, 13.3% were divorced, 8.0% were single, 4.0% were widowed and 4.0% were separated. This result implies that majority of the plantain sellers were married people. The mean is 2.44. Most (52.0%) of the respondents had secondary education, 18.7% had tertiary education, 16.0% had primary education, while 13.3% had no formal education. This indicates that the respondents have different level of education most especially formal education, so they could read and write.

Table 3: Distribution of plantain marketers according to the size of their household and marketing experience

Variables	Frequency	Percentage
Household size		
1-5	33	44.0
6-10	37	49.3
11-15	3	4.0
16 and above	2	2.7
Total	**75**	**100**
Years of marketing experience		
1-10	53	70.7
11-20	15	20.0
21-30	4	5.3
31-40	3	4.0
Total	**75**	**100.0**

Source: Field Survey, 2023.

Still on socio-economic characteristics of the plantain marketers, Table 3, the result showed that 49.3% of the respondents had household size of between 6-10 individuals, 44.0% of the respondents had household size of between 1-5 individuals, 4.0% of the respondents had household size of between 11-15 individuals, while the remaining 2.7% had the household size of 16 and above individuals. This fall in line with finding of Nelson *et al.,* (2016) that 54% of plantain markerters had household size between 6-10 persons. The plantain marketers in the study area had an average household size of 10 individuals comprising of an average 1 husband, 1 wife, 6 children and at least 2 dependent relatives. This implication of this is that majority of the households in the study area had a large family size and the marketers may need to work and earn more income in order to maintain and feed the large family. The more the individuals in the household, the less the work for the marketer/farmer as the individuals will be a source of manpower for marketing operations like loading and offloading of plantains. Majority of the people in the study area (60%) have no other occupation than plantain marketing, some were engaged in farming (20%) while few were engaged in trading (9.4%).

On marketing experience, the result showed that 70.7% of the respondents had marketing experience of between 1-10 years, 20.0% had marketing experience of 11-20 years, 5.3% of the respondents had 21-30years of marketing experience while 4.0% of the marketers had 31-40 years of marketing experience. This implies that majority of the marketers were well-experienced and they are expected to make higher profits with their wealth of experience in the plantain business.

3.2 Market Structures and Marketing Channels for Plantain

Table 4: Distribution of plantain marketers according to their type and source of plantain

Variables	Frequency	Percentage
Type of marketer		
Wholesaler	48	64.0
Retailer	27	36.0
Total	**75**	**100.0**
Sources of plantain		
Producer/farmers	47	62.7
Wholesalers	11	14.7
Self	17	22.7
Total	**75**	**100.0**

Source: Field Survey, 2023.

Table 4 also showed that 64.0% of the marketers were wholesalers while the remaining 36% were retailers. Majority (86.7%) of the marketers sold their plantains in the markets, 9.3% sold theirs at farm gate, 2.7% sold theirs in the shop while the remaining 1.3% sold in the streets. This shows that plantains are readily available for the consumers.

The Table further showed that 62.7% of the marketers got the plantain they sell from producers, 22.7% got it from their own farms while the remaining 14.7% got it from wholesalers. This shows that large percentage of those who sell plantains are plantain marketers are not farmers.

Table 5: Distribution of plantain marketers according to their customers and frequency of sales

Variables	Frequency	Percentage
Who they sell to		
Wholesalers	21	28.0
Retailers	23	30.7
Final consumers	28	37.3
Processors	3	4.0
Total	**75**	**100.0**
Total	**75**	**100.0**
Frequency of sale		
Everyday	18	24.0
Once in four days	51	68.0
Once in a month	3	4.0
Once in a week	3	4.0
Total	**75**	**100.0**

Source: Field survey, 2023.

From the table 5, 46.7% of the marketers purchased their plantain at a distance less than 50kilometres, 25.3% purchased their plantain at a distance between 50-99kilometres, 20.0% purchased their plantain at a distance between 150kilometres and above while the remaining (8.0%) purchased at a distance between 100-149kilometres. This indicates that plantain is readily available within the study area.

About thirty seven percent (37.3%) of the respondents sold their plantain to final consumers, 30.7% of them sold to retailers, 28.0% sold their plantains to wholesalers and the remaining 4.0% sold theirs to processors. The table also showed that majority (68.0%) sold their plantain once in four days, 24.0% sold their plantain everyday while 4.0% sold their plantain once in a week and once in a month. This result shows that most of the plantain marketers sold their plantains on market days, which is once in four days because of large turnout of buyers on such days compared to any other days.

Table 6: Distribution of plantain marketers according to units of measurement and barriers in marketing

Variables	Frequency	Percentage
Units of measurements		
Bunches	43	57.3
Heaps	20	26.7
Kilograms	1	1.3
Fingers	5	6.7
Dozens	6	8.0
Total	**75**	**100.0**
Barriers in entering market		
Yes	19	25.3
No	56	74.7
Total	**75**	**100.0**
Barrier type		
Association	15	20.0
None	57	76.0
Transportation	3	4.0
Total	**75**	**100.0**
Does barriers affect plantain marketing		
Yes	7	9.3
No	68	90.7
Total	**75**	**100.0**

Source: Field survey, 2023

The most commonly used unit of measurement was bunches according to 57.3% of the plantain marketers, 26.7% measured using heaps, 8.0% measured in dozens, 6.7% used size of fingers while 1.3% used kilogrammes. The use of different units of measurement gives room for buyers to purchase the quantity they desire at better pricing and helps in profit maximization

From the results in Table 6, 74.7% of the respondents made it known that there was no barrier in entering the market while 25.3% said that there were barriers. The barriers were membership of the association and transportation and these were insignificant as 90.7% of the respondents reported the barriers don't affect marketing of plantain in the study area

Table 7: Distribution of plantain marketers according to types of market operated, source of market information and availability of information

Variables	Frequency	Percentage
Types of market operated		
Many buyers and many sellers	71	94.7
One seller, many buyers	3	4.0
Few buyers and few sellers	1	1.3

Total	**75**	**100.0**
Source of information		
Radio/TV	2	2.7
Newspaper/Other publications	1	1.3
Market place	59	78.7
Cooperative/Trade association	9	12.0
Extension agents	2	2.7
Handsets	2	2.7
Total	**75**	**100.0**
Availability of information		
Not available	3	4.0
Not always available	35	46.7
Readily available	37	49.3
Total	**75**	**100.0**

Source: Field survey, 2023.

The plantain market is a perfectly competitive market as discovered from the respondents, 94.7% of the respondents said that there were many sellers and many buyers in the market.

Access to adequate to market information is one of the backbone of marketing, 78.7% of the plantain marketers got market information from market place, 12.0% got theirs from cooperatives/trade association, 2.7% obtained market information from radio/TV, extension agents and handsets each while the remaining 1.3% got theirs from newspaper and other publications. This shows that market information is available and obtainable to most of the plantain marketers.

Table 8: Distribution of plantain marketers according to criteria for buying and selling price

Variables	Frequency	Percentage
Criteria for buying		
Size of fingers	6	8.0
Size of bunch	69	92.0
Total	**75**	**100.0**
Determination of selling price		
Fix price arbitrarily	3	4.0
Fix price based on purchase price and other expenses incurred	44	58.7
Fix price on market conditions of demand and supply	12	16.0
Fix price through bargaining with market channels(retailer, wholesaler, consumer)	16	21.3
Total	**75**	**100.0**

Source: Field survey, 2023.

One of the criteria used by buyers and sellers for quality assessment of plantain, most of them (92.0%) agreed that size of bunches is the major criteria used while the remaining 8.0% said that the size of fingers are used.

About fifty eight percent (58.7%) of the plantain marketers fixed their selling price based on the cost of the goods (plantain) and expenses incurred, 21.3% fixed price through bargaining with retailers, wholesalers or consumers, 16.0% fixed price based on market conditions of demand and supply while 4.0% of the respondents fixed selling price arbitrarily.

3.3 Gross Margin Analysis

Analysis of costs and return data supplied by the respondents revealed the following:

Average Selling Price is ₦2000 per bunch of plantain while the Average Cost of plantain is ₦1500 per bunch of plantain.

Total Revenue per annum = Selling Price × Quantity Sold =₦2,500 × 739,116 = ₦1,847,790,000

Total revenue for a marketer per year = ₦1,847,790,000 ÷ 75

= ₦24,637,200

Total Variable Cost (TVC) per annum = cost of transportation + cost of loading/offloading +toll fee + purchase price+ cost of processing

= ₦147,294,000 + ₦16,027,200 + ₦2,940,000 + ₦1,108,674,000 + 924,000

= ₦1,275,859,200

Total Variable Cost for a marketer per annum = ₦1,275,859,200 ÷ 75

= ₦17,011,456

Total Fixed Cost (TFC) per annum = cost of storage + cost of market stand + loan interest + market levy

= ₦2,172,000 + ₦2,125,200 + ₦2,158,320 + ₦974,400

= ₦7,429,920

Total Fixed Cost for a marketer per annum = ₦7,429,920 ÷ 75

= ₦99,065

Total Cost (TC) = TVC + TFC

= ₦1,275,859,200 + ₦7,429,920

= ₦1,283,289,120

Total Cost for a marketer per annum = Total Cost ÷ 75

=₦ 1,283,289,120 ÷75

= ₦17,110,522

Gross Margin = Total Revenue (TR) ─ Total Variable Cost (TVC)

Gross Margin = ₦24,637,200.00 ─ ₦ 17,011,456.00
Gross Margin = ₦7,625,744.00

Net Margin = Total Revenue - Total Cost

= ₦24,637,200.00 - ₦17,110,522

= ₦7,526,678

Rate of Return = TR ÷ TC

= ₦24,637,200.00 ÷ ₦17,110,522

= 1.44

Marketing Efficiency (ME)

ME = ROR* 100%

= 1.44 * 100%

= 144%

Marketing Margin (MM)

MM = SP- CP /SP×100%

= ₦2000 − ₦1500/₦2000 × 100%

= ₦500/₦2000× 100%

= 25%

The results of analysis of plantain marketing shows that the total value of sales was ₦24,637,200.00 at the unit cost of ₦2,000 per bunch and the total cost was ₦17,110,522. The Gross Margin was ₦7,625,744.00, Net Margin was ₦7,526,678 while Rate of Return (ROR) was 1.44. The Rate of Return (ROR) of 1.44:1 which is above one (1) showed that for every one naira (₦1) spent on plantain marketing, the marketer stand to gain an additional ₦1.44k.

Marketing Efficiency (ME) is 144% which surpasses 100%, this showed that the return on investment in plantain marketing is greater than the resources put into marketing plantain, this shows plantain is a profitable business. Marketing margin of 25% implies that plantain marketing is a profitable business in the study area.

3.4 Prospects of Plantain Marketing

Table 4.9: Distribution of plantain marketers according to forms they processed plantain, processing facilities and health benefits of plantain

Variables	Frequency	Percentage
Form of processing plantain		
Flakes	4	5.3
Plantain flour	8	10.7
Plantain chips	9	12.0
None	54	72.0
Total	**75**	**100.0**

Availability of processing facilities		
Yes	5	6.7
No	70	93.3
Total	**75**	**100.0**
If yes, specify		
None	73	97.3
Facilities for Plantain chips	2	2.7
Total	**75**	**100.0**
Specify other benefits of plantain		
Treatment of Ulcer	10	13.3
Treatment of Diabetes	14	18.7
No idea	46	61.3
Treatment of Diabetes and Ulcer	1	1.3
Good health	3	4.0
Treatment of kwashiorkor	1	1.3
Total	**75**	**100.0**

Source: Field Survey, 2023.

The results obtained from analysis as shown in Table 4.9 revealed that majority (72.0%) of the respondents didn't process plantain, 12.0% processed to plantain chips, 10.7% processed plantain to flour while 5.3% processed plantain into flakes.

Furthermore, greater percentage (93.3%) of the respondents have no processing facilities in their area which makes processing of plantain difficult even though 94.7% of the respondents were of the opinion that processing of plantain extends its shelf life, while only few (5.3%) were not in aware of that. This indicates that processing of plantain to other forms is not common among the marketers. This can be as a result of the extra cost incurred in changing the form of a produce to add value and the time needed. Hence, there are indications that plantain production and marketing will flourish and become more profitable in the future because if there is improvement in its marketing through processing, its production will also expand.
Plantain has nutritional benefits such as provision of carbohydrates and iron; 61.3% of the plantain marketers had no idea of other benefits of plantain, 18.7% of the respondents indicated that plantain can also be effective in treatment of plantains are useful in the treatment of diabetes, 13.3% indicated plantain can be eaten by ulcer patients, 4.0% consumed plantain for general wellbeing (good health) while 1.3% accepted that it helps to prevent kwashiorkor. The implication of this result is that many individuals are yet to understand other importance of plantain apart from its nutritional values.

Table 4.10: Distribution of plantain marketers according to their interest in expanding their business and ways plantain marketing can be improved

Variables	Frequency	Percentage
Will you like to expand your plantain business?		
Yes	74	98.7
No	1	1.3
Total	**75**	**100.0**

In what ways can plantain marketing be improved?

Access to credit facilities	20	26.7
Easy access to transportation	18	24.0
Access to farmland	8	10.7
Adequate storage facilities	2	2.7
Provision of labour	2	2.7
E-marketing	2	2.7
Provision of shed	1	1.3
No idea	22	29.3
Total	**75**	**100.0**

Does processing make plantain marketing more profitable

Yes	74	98.7
No	1	1.3
Total	**75**	**100.0**

Source: Field survey, 2023.

Majority of the respondents (98.7%) affirmed that they will expand their plantain business if provided with adequate resources. They suggested that plantain marketing can be improved in various ways such as access to credit facilities (26.7%), improvement in transportation (24.0%), provision of more farmland for its cultivation. Thus, by providing adequate credit facilities, efficient transportation system and more farmland for cultivation of plantain, the future of plantain marketing in the study area will be brightened.

3.5 Challenges Associated with Plantain Marketing in the Study Area

The challenges majorly identified by the respondents include: insufficient fund (14.1%), low price of plantain during on-season (6.9%), bad road (19.5%), lack of processing facilities (7.2%), poor market structures (7.8%), inadequate storage facilities (11.1%), perishability of plantain (14.7%), high cost of shop/space (3.0%), high cost of labour (4.2%), theft (4.2%), herdsmen invasion (2.1%), illiteracy (1.8%), packaging cost (1.8%) and marketers health challenges (1.8%). The pressing problems facing plantain marketers in the study area is perishability of plantain, followed by insufficient fund and bad road.

Table 4.11: Challenges Associated with Plantain Marketing in the Study Area

Challenges	Frequency	Percentage
Insufficient fund	47	64.4%
Low price of plantain	23	31.5%
Bad road	65	89.0%
Lack of processing facilities	24	32.9%
Poor Market structures	26	35.6%
Inadequate storage facilities	37	50.7%

Perishability of plantain	49	67.1%	
Marketers health challenges	6	8.2%	
High cost of shop/spaces	10	13.7%	Multiple responses recorded Source: Field survey, 2023.
High cost of labour	14	19.2%	
Theft	14	19.2%	
Herdsmen invasion	7	9.6%	
Illiteracy	6	8.2%	
Packaging cost	6	8.2%	
Maximum responding unit	75	100.0%	

4. SUMMARY, CONCLUSION AND RECOMMENDATION

4.1 Summary

The study analysed marketing of plantain in Owo Local Government Area, Ondo State. It examined the following factors: socio-economic characteristics of the respondents, marketing structures and channels, costs and returns of plantain marketing, prospects of plantain marketing and constraints to marketing of plantain in the study area. Multi stage sampling technique was adopted for data collection. A total of seventy-five respondents were used for the study. The analytical methods used include descriptive statistics and Gross margin analysis.

The result obtained from the socio-economic analysis showed that 37.3% of the respondents were between the ages of 31-40 years while 30.6% have their age ranged between 41-50 years, 16.0% have their age ranged between 21-30 years, 10.7% have their age ranged between 51-60 years, 2.7% were between 20 years and below, also 2.7% were between 60 and above. This implies that the respondents were young, vibrant and efficient in undertaking activities involved in plantain marketing.

The study also showed that 49.3% of the respondents had household size between 6-10 individuals. The result further showed that 44.0% of the respondents had household size between 1-5 individuals, 4.0% of the respondents had household size of between 11-15 individuals, while the remaining 2.7% had the household size of 16 and above individuals. This implies that the large household size will save overhead cost in transporting, offloading and loading activities in the marketing process.

From the result obtained from market structure, 64.0% of the marketers were wholesalers while the remaining 36% were retailers. Majority (86.7%) of the marketers sold their plantains in the organized markets, 9.3% sold theirs at farm gate, 2.7% sold theirs in the shop while the remaining 1.3% sold in the streets. This shows that plantains are readily available for the consumers.

Result obtained from the Gross margin analysis showed that the total value of sales was ₦24,637,200.00 at the unit cost of ₦2,000 per bunch and the total cost was ₦17,110,522. The Gross Margin was ₦7,526,678.00, Net Margin was ₦7,526,678, the Rate of Return was 1.44:1, the Marketing Efficiency (ME) was 144% and the Marketing Margin was 25%. These results show that plantain marketing is a profitable business in the study area.

Greater percentage (93.3%) of the respondents have no processing facilities in their area which makes processing of plantain difficult even though 94.7% of the respondents were of the opinion that processing of plantain extends its shelf life, while only few (5.3%) were not aware of that. Also, plantains are useful in the treatment of diabetes, 13.3% indicated plantain can be eaten by ulcer patients, 4.0% consumed plantain for general wellbeing (good health) while 1.3% accepted that it helps to prevent kwashiorkor.

The challenges majorly identified by the respondents include: insufficient fund, low price of plantain during on-season, bad road, lack of processing facilities, inadequate storage facilities and perishability of plantain.

Conclusion

The study concluded that plantain marketing is a profitable enterprise and marketing activities are adequately and efficiently carried out in the study area. Factors determining revenue generated are size and quantity of plantain sold, storage cost, rent on shops/space, market levy, cost of transportation, cost of loading/offloading, toll fee. The socio-economic characteristics of the respondents showed that majority of the plantain marketers were females and married and have household size of 6-10. The market structure of plantain in the study area involved many sellers and buyers, comprising of large numbers of wholesalers, retailers and final consumers. Most marketers sell once in every four days in the market. The responses about prospects of plantain in the study area showed that large number of the respondents don't process plantain and information gathered from the marketers showed plantain is useful in treatment of diabetes and ulcer. Values obtained from the gross margin analysis, rate of return, marketing margin, net margin and marketing efficiency showed that plantain marketing is profitable and has good prospects. Challenges hindering plantain marketing in the study area include: insufficient fund, perishability of plantain, bad road, lack of processing facilities, inadequate storage facilities, low price of plantain during surplus season

Recommendations

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

1. Government should provide good road network in the study area to facilitate easy transporting of plantain to point of sale or usage.
2. Loans should be made available to plantain marketers by credit institutions to facilitate effective plantain marketing.
3. Programmes that will improve plantain marketing should be organized for the marketers by relevant government or non-government agencies. The programme should include: value addition, marketing strategies, proper recording and fund generation.
4. Plantain marketers should be encouraged to form cooperative societies so that they can pull resources together to overcome problems of insufficient fund and other marketing issues.
5. Processing of plantain should be encouraged to reduce spoilage during on-seasons as a result of perishability of plantain.

References

Achike, A. I., Okoroafor, U. U., & Mkpado, M. (2011). Community Empowerment via Economic and Technical Assistance with Hybrid Plantain/Banana Enterprise Expansion Programme in Rivers State, Nigeria.

Adekunle, W., & Omole, T. (2020). The Impact of Economic Recession on Consumer Behavior in Nigeria. *Journal of Economics and Behavioral Studies, 12(6),*, 1-12.

Aina, O., & Ajijola, S. (2010). Economic Analysis of Plantain Marketing in Odigbo Local Government Area of Ondo State Nigeria.

Akinwale, M. G., Ogunjobi, A. A., & Olowolafe, M. O. (2013). Assessment of Land Suitability for Plantain Production in Owo Local Government Area, Ondo State, Nigeria. *Agricultural Science Research Journal*, 3(11), 335-341.

Akinyemi, S., Aiyelaagbe, I., & Akyeampong, E. (2010). Plantain (Musa spp.) Cultivation in Nigeria: a Review of Its Production, Marketing and Research in the Last Two Decades. *Acta Horticulturae.* https://doi.org/https://doi.org/10.17660/ActaHortic.2010.879.19

Ariyo, O., Ariyo, M., & Okeola, O. (2013). Profitability Analysis of Plantain Marketing in Kaduna Metropolis. *Journal of Agricultural and Food Science*, Vol (19)-134.

Ayanwale, A. B., Fatunbi, A. O., & Mathew, O. (2016). *Innovation Opportunities in Plantain Production in Nigeria.* Forum for Agricultural Research in Africa (FARA). https://doi.org/ISBN 978-9988-8519-6-2

Bank, My Agriculture Information. (2017). *Cost Type and Concepts.* Retrieved from My Agriculture Information Bank: https://agriinfo.in/cost-type-and-concepts-225/

Base, M. K. (2021). *Gaps between Theory of the Firm and Managerial Economics.* Retrieved from https://www.mbaknol.com/managerial-economics/gaps-between-theory-of-the-firm-and-managerial-economics/

Bayeri, K., & Nwachukwu, I. (2005). Storage Methods Influenced Occurence and Severity of Crown Rot and Anthracnose Diseases on Plantain Fruits during Storage and Post-storage. *African Journal Online, (11)2*. https://doi.org/10.4314/gjpas.v11i2.16478

Byju. (2020). *Agricultural Marketing* . Retrieved from BYJU'S: https://byjus.com/commerce/agricultural-marketing/#:~:text=Agricultural%20marketing%20is%20a%20process,agricultural%20commodities%20across%20the%20country.

Cervoni, B. (2021). *Nutritional Value of Plantains*. Retrieved from verywellhealth: https://www.verywellhealth.com/diabetes-and-plantains-1087504#citation-1

CFI. (2023). *CFI is the leading global provider of training and productivity tools for finance and banking professionals. CFI delivers the skills, certifications, CPE credits, and resources to help anyone—from beginner to seasoned pro—drive their career in finance & b*. Retrieved from https://corporatefinanceinstitute.com/resources/economics/market-structure/

Chiemela, C. J., Nwangwu, K. N., Nzennwa, R. C., Chiemela, S., Ibe, J., & Asogwa, B. (2021). Profitability of On and Off-Season Plantain Marketing in Nsukka Local Government Area, Enugu State, Nigeria. *Journal of Agriculture and Food Sciences, 19*(1), 134-149.

Chris, B. M. (2020). *Theory of the Firm: What It Is and How It Works in Economics.* Cambridge University Press. https://doi.org/978-0521736602

Ekunwe, P., & Helen, I. A. (2019). Economics of Plantain Production in Edo State Nigeria. *Research Journal of Agriculture and Biological Sciences, 6*(6), 902-905.

Emmanuel, F. O. (2022). High Cost of Production, Insecurity Responsible for Hike in Food Prices. *Tribune*, pp. 5-8. Retrieved from https://tribuneonlineng.com/high-cost-of-production-insecurity-responsible-for-hike-in-food-prices-%E2%80%95-ogunnaike/

Eronmwon, I., Alufohai, G. O., & Ada-Okungbowa, C. I. (2014). Structure, Conduct & Performance of Plantain Marketing in EdoState, Nigeria. *J. Appl. Sci. Environ. Management,*, 18(3), 437- 440.

Ewete, F. K., Olowolafe, O. K., Adewale, B. D., Ogundipe, &., & O, O. (2018). The Underutilization of Plantain in Nigeria: An overview of its Causes, Effects and Remedies. *Journal of Horticulture and Forestry, 10(7), 137-143.*

FAO. (2012). *Commodity data, Country rankings,*. Retrieved from http://mongabay.com/commodities/data/category/1-Production/1-Crops/489- Plantains/51-Production+%28tonnes%29

FAO. (2013). *Plantain Value Chain Mapping in South Western*. Retrieved from http://www.fao.org/3/ca1732en/ca1732en.pdf

FAO. (2016). Strengthening Nigeria's Plantain Value Chain to Curtail Post-harvest Loss. *Food and Agricultural Organization.*

Fonsah, E., & Chidebelu, A. (2011). Economic of Banana Production and Marketing in the Tropics. *Economic of Banana Production and Marketing in the Tropics*, 1-242.

Hanks, G. (2021). *Corporate Marketing Systems.* Retrieved from https://smallbusiness.chron.com/examples-corporate-marketing-systems-69775.html

Honfo, F. G., Polycarpe, K., Coulibaly, O., & Tenkouano, A. (2007). Relative Contribution of Banana and Plantain Products to the Nutritional Requirements for Iron, Zinc and Vitamin A of Infants and Mothers in Cameroon. *http://dx.doi.org/10.1051/fruits:2007023, 62*. https://doi.org/10.1051/fruits:2007023

Idachaba, F. (2000). *Food policy in Nigeria.* Tropical Issues in Agricultural , Department of Agricultural Economics,University of Ibadan.

Ifeanyi-Obi, C. C., Amadi, C. O., Onwurah, I. N., & Nnadozie, O. C. (2018). Processing and Storage of Plantain Chips: A value Addition and Income Generating Venture for the Rural Areas. *Journal of Applied Sciences and Environmental Management, 22*, 5-6.

Imf. (2019). *Nigeria: Selected Issues.* International Monetary Fund Country Report No. 19/171,.

Jahanzeb, A., Naeem, M. A., Shahzad, F., & Shahbaz, M. (2021). Dynamic Linkages Between Stock Market Performance, Trading Volume, Market Capitalization, and Investor Sentiment: Evidence from Pakistan. *Journal of Quantitative Economics., 19(3)*, 719-737.

James, M. L., & Mark, D. H. (2010). Effects of Dietary Fiber and Its Components on Metabolic Health. *doi: 10.3390/nu2121266. Epub 2010 Dec 15. PMID: 22254008; PMCID: PMC3257631., 12:12*, (66-89.

Jones, A., & Smith, B. (2022). Determining Equilibrium Price. *Journal of Economics*, 25(3), 45-56.

Josiah, P. (2014). *Analysis of the Profitability of Plantain Farming in Orhionwo Local Government Area of Edo State Nigeria.* Academia.

Kabir, A. (2020). Retrieved from Premiumtimes: https://www.premiumtimesng.com/news/top-news/419370-ondo-election-20-things-to-know-about-south-west-state.html?tztc=1

Kennedy, M. (2022). Market Structure, Conduct and Performance. *Academia*.

Kotler, P., & Armstrong, G. (2021). *Principles of Marketing, 18th edition.* Pearson. https://doi.org/978-1292341132

Nelson, F., Oke., U., & Adindu, J. (2016). Analysis of Plantain Marketing in Ikwuano Local Governnment Area of Abia State, Nigeria. *Nigerian Journal of Agriculture, Food and Environmnent, 12*(1), 85-89.

Newilah, G., Tchango, T., Fokou, E., & Etoa, F. (2005). Processing and Food Use of Bananas and Plantains. *https://doi.org/10.1051/fruits:2005031*, (60)245-253.

Ogunbameru, B. O. (2012). Evaluation of Factors Affecting Plantain Production Among Smallholder Farmers in Ondo State, Nigeria. *Journal of Agricultural Extension and Rural Development, 4(11)*, 294-299.

Ojo, S. O. (2011). The Application of Marketing Mix Elements in the Agricultural Marketing System. *International Journal of Business and Management, 2*(1), 1-7.

Oladapo, M., Mommoh, S., Yussuf, S., & Awoyinka, Y. (2007). Marketing Margin and Spatial Pricing Efficiency of Pineapple in Nigeria. *Asian J. Mktg., 1(1)*, 14–22.

Olumba, C., & Onunka, C. (2020). Banana and Plantain in West Africa. *African Journal on Food, Agriculture, Nutrition and Development Vol 20 No 2*.

Oyeniyi, T. (2022). History of Owo, Ondo State. (Naijabiography, Interviewer) Naijabiography.

Pankaj, M. (2019). Marketing Ethics: Enhancing Firm Valuation and Building Competitive Advantages. *Journal of Indian Management*.

Patel, N. (2016). *Marketing Strategy*. Retrieved from How to Build a Hybrid Content Marketing Strategy.: https://neilpatel.com/blog/hybrid-content-marketing-strategy/

Paul, K., Robin, W., & Kathryn, G. (2021). *Microeconomics.* Berkeley: Macmillian Learning.

Philip, K. (2016). *Marketing Management 15th edition.* India: Pearson.

Pomeroy, R., & Trinidad, A. (1995). *Industrial Organization and Market Analysis: Fish Marketing in GJ Scott,ed. Prices,Products and People: Analysing Agricultural Markets in Developing Countries.* . Boulde: Lynne Rienner Publishers lnc.

Rana, S., & Fangueiro, R. (2016). *Natural Fibres: Advances in Science and Technology Towards Industrial Application.* Researchgate. https://doi.org/10.1007/978-94-017-7515-1

Rebecca, R. (2021). *Key Performance Indicators to Help Improve Your Marketing.* Hubspot.

Research, E. E. (2013). Banana and Plantain Value Chain: West Africa. *EPAR Brief No. 239.*

Taylor, J. (2023). *Ethical Issues for Marketers.* TrinityP3.

Tnau. (2021). *TNAU*. Retrieved from https://agritech.tnau.ac.in/agricultural_marketing/agrimark_Marketing%20channels.html#:~:text=Channels%20of%20Fruits%3A,%2Dharvest%20contractor%E2%80%93retailer%E2%80%93consumer

Tracey-White, J. (2017). *Wholesale Markets,Planning and Design Manual.* Rome,Italy: ISBN 92-5-1031 07-X.

Vanguardngr. (2021). *Ondo Govt Restates Commitment to Tackle Unemoloyment,Youths Restiveness Through Agriculture*. Retrieved from https://www.vanguardngr.com/2021/06

Vedantu. (2023). *Our vision at Vedantu is to reimagine and evolve the way teaching and learning have been happening for decades. By combining quality teachers, engaging content and superior technology we are able to create a superior learning experience for students and a.* Retrieved from Vendatu: https://www.vedantu.com/commerce/intro-to-determination-of-prices

Wallstreetmojo. (2023). *the number one source for finance, accounting, and investment-related information. We are dedicated to giving our readers the very best of educational resources and online courses on Investment Banking, Financial Modeling, Private Equity, Venture Capital,*. Retrieved from wallstreetmojo: https://www.wallstreetmojo.com/profit-maximization/

Woodruff, J. (2018). *Price Determination in Economics* . Retrieved from https://smallbusiness.chron.com/price-determination-economics-3884.html

WorldBank. (2019.). *Nigeria Economic Report: Promoting More Inclusive Growth.* World Bank.

Yebirzaf, Y., & Esubalew, T. (2021). An Investigation into Major Causes for Postharvest Losses of Horticultural Crops and Their Handling Practice in Debre Markos, North-Western Ethiopia. *Advances in Agriculture, 2021*. https://doi.org/https://doi.org/10.1155/2021/1985303

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Sustainable Agricultural Products Marketing for Food Security

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ABSTRACT
Sustainable agricultural products marketing play a crucial role in ensuring food security. This study was designed to examine how sustainable agricultural marketing can affect food security. The study examined the factors that could influence food security through agricultural produce marketing and also examined the factors that could militate against food security in the study area. Data were collected from the sampled respondents through the use of interview schedule. The data were analysed using descriptive and inferential statistics. The results of the analysis revealed that the respondents attained food security through the sales of agricultural produce. The factors that influenced the respondents' food security were age (b=-0.089), level of education (b= 0.325), gender inequality (b=0.861), household size (b=0.189), and market information (b=0.253). The constraints identified to be mitigating against food security among the food crops producer/marketers were climate change and environmental shocks (M= 3.46), low market price (M= 3.43), lack of credit facilities (M= 3.35), lack of agricultural inputs and technology (M= 3.31), poor yield (M= 2.97), and poor road network (M= 3.83). The study therefore recommends provision of agricultural inputs and modern technology, price stability, and access to favourable credit facilities among others for sustainable agricultural produce marketing for food security.
KEYWORDS: Sustainable Agriculture, Agricultural Produce Marketing, Food Security

INTRODUCTION
There is a transformation taking place on farms across the globe for decades, we have produced the bu lk of our food through subsistence agriculture, a system dominated by small scale farmers growing the same crops and producing the same animals year after year. This continuous system leads to degrading of the resources it depends on, and the sales of the products are determined by market forces which lea ve little or no sustainability for the actors.

But a growing number of innovative farmers and scientists were taking a different path moving toward s a farming system that is sustainably, environmentally, economically and socially competitive. This s ystem has room for farms of all sizes producing a diverse raw materials adapted to local conditions an d regional markets. It uses state-of-the-art to maximize productivity and profit while minimizing envir onmental damage. Sustainability also means the system is more resilient to draughts, flood and other c limate change problems that farmers are already experiencing.

Sustainable agricultural products marketing plays a crucial role in ensuring food security by promoting environmentally friendly practices that aimed to minimize negative environment and encourage efficie nt distribution of food products that ensure availability of food all year around. Sustainable agricultura l products marketing engage sustainable farming methods and connecting farmers with consumers wh o value eco-friendly choices (Bryan, *et. al*, 2010). Sustainable agricultural products marketing is a holi stic approach that puts equal emphasis on environmental, social equity, and economic concerns in the

development of marketing strategies in achieving food security (Adanacıoğlu, 2015). The long-term st rategies to increase food security are somehow difficult and cannot be determined at once due to the fa ct that successful sustainable agricultural products marketing initiatives require proper planning which cannot be automatically achieved within a short period of time in ensuring food security of any Nation . Therefore government should come up with good policies and programmes that are compatible with t he goals of sustainable agricultural products marketing in Nigeria.
Food security refers to the state in which all people have physical, social, and economic access to suffi cient, safe, and nutritious food that meets their dietary needs and preferences for an active and healthy life. It encompasses not only the availability of food but also the ability of individuals and communitie s to access and afford it. Achieving food security requires a combination of factors through a coordina ted efforts of well organise sustainable agricultural products marketing practices that guarantees effici ent distribution systems for everyone to have access to reliable food supply (Below, *et. al*, 2010)

Food security is the condition where individuals and communities have consistent access to enough sa fe, nutritious food to maintain a healthy and active life. It involves availability, accessibility, utilizatio n, and stability of food sources. *For in more cases in Nigeria, even when the foods are available and d esirable they are not always affordable, accessible, and convenient but, sustainable agricultural produ cts marketing is a good initiative in addressing these challenges because it encourages collaboration t hat initiate ecosystem of connecting farmers, aggregators, processors of food-Small Medium Enterpris es (food-SMEs) and other service providers who are involved in food value chain system in order to g uarantee food security* (AGRA News Center, 2019). Collaborative initiatives between farmers, retailer s, and consumers can further educate people about the positive impacts of sustainable practices on foo d security and the environment. By emphasizing the value of sustainable products in terms of nutrition , quality, and environmental benefits, the marketing efforts contribute to building a more resilient and secure food system for present and future generations. This awareness would lead to increased demand for products that are produced using sustainable agricultural farming methods, connects farmers with markets that value sustainability, helps create a more stable income for them, and then encourage wide r adoption of these practices, which would in turn contribute to the overall resilience of the food syste m. It's a symbiotic relationship where sustainable practices ensure long-term food production and strat egic marketing. To ensure sustainable agricultural producers/markers achieve food security there shou ld be collaborative initiatives between farmers, products markers and consumers
In Nigeria there are abundance of research and publications on sustainable agricultural practices and p roducts marketing but there is scarcity of empirical and conceptual literature in the area of sustainable agricultural products marketing for food security. Most of the researchers who have undertaken studie s on sustainable agricultural practices failed to give satisfactory evidence on how sustainable agricultu ral food products marketing would enhance food security. This forms the research gap. To achieve the objectives of the study and fill identified knowledge gaps, this paper would address the following rese arch questions. What are the benefits of sustainable agricultural products marketing? What are the fact ors influencing agricultural produce marketing and food security? What are the challenges to sustainab le agricultural products marketing and food security?

The benefits of Sustainable Agricultural Products marketing for Food Security, cannot be overemphas ized, as it plays important roles in food supply chains and consumer preference, pricing, affordability, and access to nutritious foods by households in Nigeria, because of it efforts in making agricultural pr oducts available, accessible, stable and affordable all year round through value addition. However, wh en value is added to agricultural products, it changes its forms and thereby increases its price and invar iably threatens food security. In most cases, government intervention is a prerequisite in addressing un affordable scenario imposed by value addition.

METHODOLOGY
The study was carried out in Edo State. Household heads producing and marketing agricultural food p roducts were sampled for the study. Interview schedule was use to elicit information from the respond ents. Data collected were analysed using descriptive and inferential statistics, comprising of mean and logistics regression analysis respectively. The Statistical Package for Social Science (SPSS) was used f

or the analysis. For the measurement of food security viz-a-viz agricultural product sale, a scale was d eveloped guided by the FANTA/CORNELL, validated instrument (Coates, Swindale and Bilinsky, 20 07).

Measurement Scales for Sustainable Agricultural Products Marketing for Food security.
Having examined the roles and challenges of sustainable agricultural products marketing in achieving food security, the study developed scales to measure sustainable agricultural products marketing for fo od security. The paper suggested that sustainable agricultural products marketing depend on food secu rity domains, which are availability, affordability and accessibility. To measure each of the domains, m easurement scales were developed to capture the state of food supply through agricultural products ma rketing. To measure the dependent variable of sustainable agricultural products Marketing, the study d eveloped questions on a three points Likert scales using strongly agreed "3", agreed "2" and disagreed "1", the independent variables listed in table 1, 2 and 3 in the appendix can now be measured. The mea n benchmark of 3+2+1/3 =2.00 was achieved. Any of the variables with a score below the mean bench mark, indicates that sustainable agricultural products marketing do not enhance food security. Also an y of the variable having a score within the mean benchmark, indicates agricultural products marketing moderately enhance food security. While variables that score above the mean benchmark, indicates tha t sustainable agricultural products marketing enhance food security. The independent variable was cate gorical or continuous, while the dependent variable was divided into four categories, “highly food sec ure”, moderately food secure” and severely food insecure”
The implicit model is given as:
Logit $[P(Y \leq j)] = \Sigma^{\beta}, X_i$
Where j=1……and i =1……..,m
Here j is the level of an ordered category with j levels and i correspond to independent variables

RESULTS AND DISCUSSION
Factors that Enhance Food Security
In other to examine the factors that could enhance food security in the area of study, a null hypothesis stated as there is no significant relationship between the socioeconomic characteristics of the responde nts and the prevalence of food security was tested using logistic regression model. Giving the results o f the analysis, it was revealed that the following independent variables, viz; age, level of education, ge nder inequality, family size and market information significantly affected food security.

- Age: The age of the farmer/marketers is a proxy for sustainable agricultural farming and marketin g on the assumption that the household’s knowledge of agricultural products marketing for food s ecurity issues will increase as the household head grows older and more experienced. The result o f the regression analysis in table 1, revealed an odd ratio value 0f 0.914, which implies that as age increases, the odds of experiencing food insecurity decrease slightly. Empirical studies have also c onfirmed this result. As the age of the household head increases, the household acquires more sust ainable agricultural products marketing experience, becomes more risk averse, strategies’ and div ersifies its production and develop more marketing channels (Bogale & Shimelis, 2009; Mitiku e*t al.,* 2012). Households headed by older people are thus more likely to be food secure than those w ith younger heads. In contrast, Gebre (2012) shows that as the age of the household head increase s, households become less productive and rely more on gifts and remittances. Hence households w ith older heads are more likely to be food insecure than those with younger heads.

- Level of education: the coefficient (b= 0.325) shows a positive relationship of level of education w ith food security, revealing that the higher the level of education of the producer/marketer, the hig her the level of food security. The odd value of 0.869 revealed that there is a strong positive relati onship between education and food security. The level of education influences individual access t o and use of information, acquisition of knowledge and skills, enhanced innovativeness and adopt ion of mitigating strategies to climate change. This has the capacity to build sustainable food prod uction, access to markets and marketing activities, create greater food availability, generates inco me which enhances the affordability of a variety of nutritious food. Thereby reducing the risk of f ood insecurity. Makombe **et al** (2010)

- Gender Inequality: Gender inequality with an odd ratio of 0.822 suggests that there is an associati on between gender inequality and reduced food security. The males being the reference group are less likely to have adequate food security compared to females. Gender influences sustainable agr icultural products marketing for food security orientation. Horrell & Krishnan (2007), argued that male-gender is better positioned to source on-farm resources than their female counterparts, and a s such, had positive influence on sustainable agricultural products marketing for food security. In t his study the female-gender were more frequently involved in post-harvest processing and value a ddition activities, their participation influenced the quality and marketability of agricultural produ cts, thereby leading to food security.
- Household size: An odd ratio of 0.346 in relation to household size and food security suggests th at there is a negative association between household size and food security in the area of study. In other words as household size increases, the odds of experiencing food insecurity decease. House hold size represents the consumption-level needs of a household and shows the burden it faces to f eed its members. Larger households obviously have a higher burden to feed in other to meet their nutritional needs which can strain the household budget. This can lead to food insecurity. Smaller families may find it easier to ensure food security since they have fewer mouths to feed and can al locate resources more efficiently. (Bogale & Shimelis, 2009; Gebre, 2012; Mitiku *et al*., 2012).
- Market Information: Access to market information is the main factor inducing market participatio n (Alene *et al*., 2008). In this study, the coefficient of b= 0.253 indicates a positive relationship wi th food security, indicating that the more information the respondents get the more likelihood they will be food secured. The odd ratio of 1.014 is also indicative of the fact that availability of marke t information enhances food security. Households with access to market information know what is demanded by the market, when to sell, whom to sell to, and what price to accept. Households with greater market information are more likely to get higher cash incomes and diversify in the event o f uncertainties. Infact, households with access to market information are more likely to adopt sust ainable agricultural products marketing strategies to be food secure than their counterparts.

Table 1:Variable Estimates for socioeconomic factors affectinf Food Security.

Parameters	Coefficient	Std. Error	Prob. Level	Odd Ratio
Age	-0.089	0.051	.000	0.914
Level of Education	0.325	0.192	.009	0.869
Gender Inequality	0.861	0,451	.001	0.821
Household Size	0.189	0.091	.002	0.346
Market Information	0.253	0.124	.001	1.014

Dependent Variable: Food Security

FACTORS MILITATING AGAINST HOUSEHOLD FOOD SECURITY

The factors militating against respondents' food security in the area of study is presented in table 2, be low. The constraints with the mean values above 2.50 were regarded as serious. Among these were Cli mate Change and Environmental Shocks(M=3.46), Low market price (M=3.43), lack of credit facilitie s(M=3.35), lack of agricultural inputs and technology (M=3.31), poor yield(M=2.97), and poor road n etwork(M=2.83). it can therefore be concluded that the respondents under study were faced with some constraints that prevented them from achieving food security.

TABLE 2: FACTORS MILITATING AGAINST HOUSEHOLD FOOD SECURITY.

CONSTRAINTS	**MEAN**
Climate Change and Environmental Shocks	3.46*
Low market price	3.43*
lack of credit facilities	3.35*
lack of agricultural inputs and technology	3.31*
poor yield	2.97*
poor road network,	2.83*
inadequate training	2.34
Disruptions in the Food Chain	2.19
lack of agricultural inputs and technology	2.04

≤ 2.50* Serious Constraints

Suggested ways for sustainability of agricultural products marketing for food security

Through the following ways, agricultural products marketing can be improved upon;

a. Provisions of basic infrastructure such good road network system to ease the movement of goods and reduce food prices;
b. Price control mechanism: This will motive every farmer to maximize profits. But if prices of agric ultural products are too low due to market forces it reduces the expectations of the farmer. In orde r to protect the interest of farmers and help increase productivity, government has greater role to p lay in regulating prices of agricultural products, this would help to boast competitiveness in the m arkets.
c. Government can also play a role by buying off excess products from the farmer, which would nor mally cause glut and then reduce prices drastically, causing the farmers to sell at a reduce price an d sometimes at a loss. This measure will ensure food security (Erie, 2015).
d. Increase food supply through provisions of subsidies on farm inputs and value-added tools and eq uipment;
e. Provision of technical assistant to the farmers to increase food production;
f. Review of market policy that would encourage accessibility, affordability, availability of agricultu ral products at any time and any place in Nigeria (Bayrac, abd Yenilmez 2005)
g. Increase access to market: this can be achieved by establishing farmers market, a modern market system that allow farmers gather at an interval to sell their freshly and healthy cultivated farm pro duces direct to individual consumers, retailers, wholesalers, tourists, travelers, supermarkets, groc ery firms, canneries at farm gate price. This will eliminate the activities of the middlemen, grow t he income of the farmers and enhance affordability, accessibility, availability of agricultural prod ucts to the final consumers (Katherina *et al*, 2016)
h. Provision of storage and preservation facilities to help tackle post harvest losses

All these would promote and support sustainable agricultural products marketing for food security in N igeria.

CONCLUSION

Increasing the competitiveness of agricultural products can involve improving crop yields, optimizing production processes, adopting innovative technology, enhancing product quality, exploring new mark ets and effective marketing systems and implementing sustainable practices to achieve the goal.

RECOMMENDATION

Based on the findings from the study, the following recommendations were made

1. provision of agricultural inputs and modern technology,
2. price stability to ensure that glut due to seasonality does not discourage marketer from engagi ng is their activities and
3. access to favourable credit facilities among others for sustainable agricultural produce marketi ng for food security

References

Adanacıoğlu, H. (2015). Sustainable Agricultural Marketing Initiatives. Turkish Journal of Agriculture-Food Science and Technology, 3(7), 595–603. https://doi.org/10.24925/turjaf.v3i7.595-603.446

AGRA News Center, (2019). The hidden middle: Bringing SMEs into the light Available at: https://agra.org/news/the- hidden-middle-bringing-africas-smes-into-the-light/

Alene, AD, Manyong, VM, Omanya, G, Mignouna, HD, Bokanga, M & Odhiambo, G, (2008). Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. Food Policy 33(4), 318–28.

Bashimov G. & Çiçek, R. 2017. Orta Asya Ülkelerinin Tarım Ürünlerinde Karşılaştırmalı Üstünlüğün Belirlenmesi (Determination of Revealed Comparative Advantage of Central Asia's Countries in Agricultural Products). Journal of Economic Innovation, 4 (3), pp. 10-21.

Bayraç H.N. & Yenilmez F. (2005). Türk Tarımının AB Ortak Tarım Politikasına Uyum Çalışmaları ve Olası Ekonomik Etkileri (Adaptation of Turkish Agriculture to Common Agricultural Policy and Possible Economic Effects). Journal of Social Sciences, Eskişehir Osmangazi University, 6(1), pp. 23-42.

Below, T, Artner, A, Siebert, R & Sieber, S, (2010). Micro-level practices to adapt to climate change for African small-scale farmers: A review of selected literature. Discussion Paper 953, International Food Policy Research Institute (IFPRI), Washington, DC.

Bogale, A & Shimelis, A, (2009). Household-level determinants of food insecurity in rural areas of Dire and Dawa, Eastern Ethiopia. African Journal of Food, Agriculture, Nutrition and Development 9(9), 1914–26.

Bryan, E. , Ringler, C. , Okoba, B. , Roncoli, C. , Silvestri, S. , & Herrero, M. (2013). Adapting agriculture to climate change in Kenya: Household strategies and determinants. Journal of Environmental Management, 114, 26–35. 10.1016/j.jenvman.2012.10.036

Coates, J. Swindale, A & Bilinsky, P, (2005). Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide, Version 2. Food and Nutrition Technical Assistance Project. Academy for Educational Development, Washington, D.C.

Erie, G. O, (2015). Fundamentals of Agricultural Marketing. Rudel Publishers, Benin City

FAO (2016). How do markets encourage the adoption of sustainable agriculture? The role of institutional innovations in developing countries.

Gebre, GG, (2012). Determinants of food security among households in Addis Ababa, Ethiopia. Interdisciplinary Description of Complex Systems 10(2), 151–73.

Horrell, S & Krishnan, P, (2007). Poverty and productivity in female-headed households in Zimbabwe. Journal of Development Studies 43(8), 1351–80.

Katharina, W. Mark. T.V.W, Steffen.F, Linda. S, Philip. K.T, Jannike.W, and Mario H. (2018). Agricultural diversification as an important strategy for achieving food security in Africa. Global Change Biology. 24(8): 3390–3400. doi: 10.1111/gcb.14158.

Makombe, T, Lewin, P & Fisher, M, (2010). The determinants of food insecurity in Rural Malawi: Implications for agricultural policy. Malawi Strategy Support Program (MaSSP) Policy Note 4, International Food Policy Research Institute (IFPRI), Washington, DC.

Mitiku, A, Fufa, B & Tadese, B, (2012). Empirical analysis of the determinants of rural household food security in Southern Ethiopia: The case of Shashemene District. Basic Research Journal of Agricultural Science and Review 1(6), 132–8.

APPENDIX

Table1: Measurement Scale for Food Availability

Available variables	Strongly Agreed	Agreed	Disagreed
Food is not always available to me			
Most of the food that are available are seasonal			
The level of famine is very high			
Drought affects my food supply			
Pests and diseases affect my food supply			
Herdsmen and crop farmers crashes affect my food supply			
Crisis/war affect my food supply			
The farmers are subsistence and they do not adopt improved far ming methods to increase food supply			

Table 2. Measurement Scale for Food Affordability

Affordability variables	Strongly Agreed	Agreed	Disagreed

I spent too little on agricultural products			
Agricultural product is too expensive for me			
I do not have money to buy agricultural product of my choice			
My salary have not been paid or be delayed			
My income is very small			
Activities of the middlemen increase price of agricultural produ ct			
I do not buy direct from the farmers			
My household is very large			
Sometimes I go to beg hungry			
Sometimes I beg to feed myself and my household			
I do not have a job			

Table 3. Measurement Scale for Food Accessibility

Accessibility variables	Strongly Agreed	Agreed	Disagreed
I do not always have access to agricultural product			
Quality agricultural product is not sold in my area			
No market to buy agricultural product of my choice			
Bad road network affect agricultural product supply in my area			
I work some distance to buy my agricultural product			
Farming activities in my area is very low			
I eat less-preferred agricultural product			
I do not have access to different varieties of agricultural produc ts			

NIGERIAN ASSOCIATION OF AGRICULTURAL ECONOMISTS (NAAE)
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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Application of Neem Plant (*Azadirachta indica*) for Postharvest Treatment of Maize and Financial Assets of Farmers in Kwara State, Nigeria

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Abstract

This study assessed the influence of usage of neem plant-based treatment for reducing postharvest loss of maize grains on financial assets of farmers in Kwara State, Nigeria. Four hundred (400) maize farmers were randomly selected across the 16 local government areas of Kwara State. Primary data was collected with the use of structure questionnaire. Data collected was analysed with descriptive and regression statistical tools. Findings showed that average size of maize farm was 2.4heactares, average yearly maize harvest was 39.3bag50kg, and average yearly income from maize farming was ₦241,815.00. Majority (64.0%) of the maize farmers used neem leaf/seed to preserve maize produce and 63.5% further indicated that the use of neem leaf/seed was effective to reduce postharvest loss of maize for the period of 6 months and 3 weeks. Neem leaf/seed usage had moderate (52.3%) increase income and saving able to meet basic needs. Regression analysis indicated that neem leaf/seed usage significantly (β=0.730; $p<0.05$) influenced farmers' access to income and savings. This study concludes that the usage of neem leaf/seed is effective in reducing postharvest loss and has positive influence farmers' access to financial assets. The study recommends that upgrading neem-based treatment of maize by concern research institute in Nigeria.

Keywords: Maize, neem plant, effectiveness, income, savings, loan

INTRODUCTION

Insecticides of plant origin have played an important role in the traditional methods of protection against grain pests (Ehisianya et al., 2019; Jahromi et al., 2012). Insecticidal plants are also used by farmers to prevent infections in stored maize in the humid forest zone of Nigeria (Sugh et al., 2020). It has also been shown that the presence of *S. zeamais* in maize grains harvested led to a reduction in both weight and germination capacity of the grains (Ukeh *et al.,* 2008). Previously, the control of storage insects like *S. zeamais* has centered mainly on the use of chemical insecticides that are hampered by many attendant problems such as toxicity to humans that consume the product, development of insect resistant strains and the cost of procurement (Stancic *et al.,* 2011). The use of more natural and sustainable methods that can offer compatible control efficiency plus the benefit of reduced hazards to the environment is most favoured (Abdelgaleil, 2009).

Neem (*Azadirachta indica*) leaf and seed contain natural bioactive compound which are effective antimicrobial, antioxidant, biopesticide and insecticide. It is an effective deterrent against insect attacks in stored food grains. Need is a promising alternative to synthetic chemicals especially in food sector.



Figure 3: Neem Leaf, Seed, flour and extract

It has been shown that neem leaf and seed powder at 2% and 3% w/w provided effective postharvest control of *S. zeamais* infesting maize grains (Tilahun and Daniel, 2016). *Syzygium aromaticum* (clove) inflorescence and *Dennettia tripetala* (pepper fruit) seed either as powder or extract (1.5% w/w or 1.5 ml/20 g maize) have been found effective against damage by *S. zeamais* (Nwosu, 2014). Neem contains bitter principles called meliacins like azardiracin, nimbin, salannin, meliantriol etc., and acts as anti-feedants against several pests. The active ingredient azadirachtin, found in neem/Margosa leaves, acts as an insect repellent and insect feeding inhibitor and sterilant, antifungal and nontoxic qualities (Suresh et al. 2013).

Several studies have affirmed the effectiveness of neem in storing maize. Marilei *et al.* (2010) that 40 g of corn treated with 6g of the extracts from leave and seeds extracts from neem can be considered as a viable alternative for controlling *S. zeamais* in stored corn. A similar work by Shiberu and Negeri (2017) in Ambo University, Ethiopia suggested that Pyrethrum flower, neem leaf (*Azadirachta indica*) and seed powder can replace chemical insecticides against *S. zeamais* due to their higher high mortality, lower grain damage and lower maize weight losses recorded as compared to untreated and synthetic insecticides. In previous study, *P. glandulosus* powder and neem seed powder greatly inhibited progeny production of *S. zeamais* (Nukenine *et al.,* 2007). Manju et al. (2019) also evaluated the efficacy of twelve botanicals found that neem seed kernel powder were effective to control bruchid pest, C. maculatus in green gram seed storage.

In recent times, there is a steady increase in the use of plant products as a cheaper, renewable and ecologically safer means of controlling insect pest infestations of stored cereal and grains especially in the tropics where the resource poor farmers are found (Ileke and Oni, 2011). Such plant materials include powders from parts of the neem tree (*Azadirachta indica A. Juss*). Mixing dried neem leaves with grain in storage is a classic example of natural product use that has been practiced by farmers in many countries for many years. Neem is well known for its insecticidal properties and it is very effective against a wide range of insect pests (Radha, 2014). The most active insecticidal ingredients are present

mostly in the seeds, leaves and other parts of the neem (Sonalkar et al., 2014). Its various plant parts have been traditionally used to control domestic insects pests in stored grains, crop, in human and livestock medicine. These properties have been attributed to hundreds of chemicals present in the tree. Hence, the objective of this laboratory experiment was to determine the effect of ground neem leaf and seed against maize weevil and prolonged storage of neem leaf and seed powder on its insecticides activity.

Tilahun and Daniel (2016) examined the effect of Neem Leaf and Seed Powders Against Adult Maize Weevil (*Sitophilus zeamais* Motschulsky) Mortality. Authors found that the highest mean mortality percent were recorded at the 3% w/w concentration. The 1, 2 and 3% w/w concentration rates of neem seed powder killed about 63.30, 70.72 and 82% of adult weevils, respectively throughout the storage period. Whereas the leaf powder treatment killed 61.13, 68.76 and 77.75% adult weevils respectively. Authors concluded that the application 3% w/w of both neem seed and leaf powder are effective in the control of maize weevil and could be used as an alternative control option in integrated stored pest management strategies by small scale farmers. Ileke and Oni (2011) found mortality of adult Sitophilus zeamais that increase with concentration from 2.5-25% w/w. Moreover, Khaliq et al. (2014) found at concentration of 5% w/w maize weevil mortality of 35.81% from *Glycyrrhi zaglabra* and mortality rate of 35.55% due to 24 hr exposure to the same plant. Khaliq et al. (2014) found at concentration 5% w/w mortality rate of 55.01 and 63.56% from *Chicorium intybus* and *Terminalia chebula*, respectively and mortality rate of 46.11 and 48.88% due to exposure for 24 h for the same plants.

Based on the above background, this study was set-out to investigate the nexus between effectiveness of neem plant and farmers access to financial assets. The general objective of the study was to investigate the application of neem plant for postharvest treatment of maize and financial assets of farmers in Kwara State, Nigeria. The specific objectives were to: (i) describe the socio-economic characteristics of maize farmers, examine the usage of neem leaf/seed for postharvest treatment of maize, assess the effectiveness of neem leaf/seed for postharvest treatment of maize, and examine farmers access to financial assets for maize farming. The study null hypothesis as; effectiveness (duration) of neem leaf/seed do not influence farmers' access to financial assets.

METHODOLOGY

Study Area: This study was conducted in Kwara State. The state capital is Ilorin. The state has sixteen (16) Local Government Areas (LGAs) and occupies an area of 33,773.3 square Kilometres, with a population of 2,371,089 which is made up of 1,220,581 males and 1,150,508 females according to the 2006 census. The projected 10 years population with 3.0% annual population change was estimated at 3,192,893 in 2016 (NBS, 2016). Kwara State is located between latitudes 7º45'N and 9º30'N and longitudes 2º30'E and 6º25'E. The topography is mainly plain lands to slight gentle rolling. The annual rainfall ranges between 1000mm and 1500 mm. Average temperature ranges between 30 and 35ºC (KWADP, 1996). More than 90% of the rural populations who constitute about 80% of the total population are engaged in farming (Yusuf, 2000).

Population of the study: The target population for the study include all maize farmers in the sixteen local government areas (LGAs) of Kwara State. According to the Kwara State Agricultural Development Project (KWADP), the estimated registered maize farmers in Kwara State as at December, 2020 was 5300 farmers (KWADP, 2020).

Sampling procedure and sample size: Cluster, purposive and snowball sampling techniques were used to select the actual respondents for the study. Maize farmers were clustered into four agro-ecological zones that make up the agricultural zones in Kwara state. These zones are Kaima, Edu, Shao and Igbaja. Next was the purposive selection of one LGA each from the four agro-ecological zones based on the level of maize production. The selected LGAs were 4 namely: Kaima, Edu, Asa and Oyun LGAs in zone A, B, C and D respectively. Purposive sampling was further employed to select four (4) communities in each of the LGAs making sixteen (16) communities, based on the level of maize production from each LGA selected. Lastly snowball sampling technique was adopted to arrive at the

individual respondents within the communities where a respondent gave the researcher information on where to locate the next respondent hence they are within the same locality and know themselves. Twenty-five (25) respondents were selected from each selected communities making a total of 400 respondents for the study.

Data Collection: A semi-structured questionnaire was used as instrument to collect quantitative data through field survey.

Techniques of Data Analysis: Data collected was analysed with both descriptive and inferential statistics. This involved the use of frequency tables, percentages, mean, standard deviation and charts. Multiple Regression analysis was used to assess hypothesis. Analysis was done with the aid of Statistical Package for Social Sciences (SPSS).

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Respondents

As presented in Table 1, the results of the analysis showed that the average age of respondents was 47 years. This finding implies that respondents are still in their economic active age and are capable to contribute significantly to maize production. The results in Table 1 furthers indicated that majority were male (87.5%) while 12.5% were female, implying that maize farming in Kwara State is dominated by male folks. As regards education of the respondents, appreciable percentage (37.5%) had no formal education and 33.0% also had primary education. The implication is the larger percentage of the respondents' education had primary education as their highest level of education.

The average household size of the maize farmers was 8persons and 80.5% of the maize were members of farmers' group. Membership of farmers group is expected to influence their exposure to innovation on preventing maize postharvest losses. Similar factors that is likely to negatively influence indigenous knowledge practices to prevent maize postharvest losses was access to extension services on maize farming among 80% of the maize farmers. Table 1 also showed that the average years of experience in maize farming among respondents was 20.6years cultivating average of 2.4hectares. This implies that the farmers cultivate relative small size maize farm with appreciable years of experience in maize farming and have some experience of various practices to prevent postharvest losses of maize. The average harvest of maize was 39.3bags/50kg with annual income of ₦241,815.00.

Table 1: Socio-Economic Characteristics of Respondents (n=400)

Variables	N	%	Mean (Std Dev.) Range
Age (years)			47.4 (9.227) 23 – 80
Household Size (persons)			8 (3.116) 1 – 20
Size of Maize Farm (ha)			2.4 (2.191) 0.4 – 15.0
Maize Harvest in the year 2020 (bag50kg)			39.3 (52.79) 2 – 360
Annual Income from Maize Farming (₦)			241,815.00 (296,509.757) 10,000 – 1,900,000
Sex			
Male	350	87.5	
Female	50	12.5	
Educational Status			
No formal	150	37.5	
Primary	132	33.0	
Secondary	42	10.5	
Tertiary	76	19.0	
Membership of farmers' group			
Yes	322	80.5	
No	78	19.5	

Access to extension services of maize farming		
Yes	320	80.0
No	80	20.0

Application of neem plant to preserve maize grain

Regarding the application of neem seed and leaf, Table 3 showed that 64% of the maize farmers used neem seed and leaf to preserve maize produce. According to Prakash, Raghavendra, Gowthami and Shashank (2016), the use of neem seed and leaf are crucial traditional storage practices among majority of maize farmers in India. Agea, Lugangwa, Obua, and Kambugu (2008) similarly reported high level of usage of neem in preserving grains among majority of farmers in Uganda.

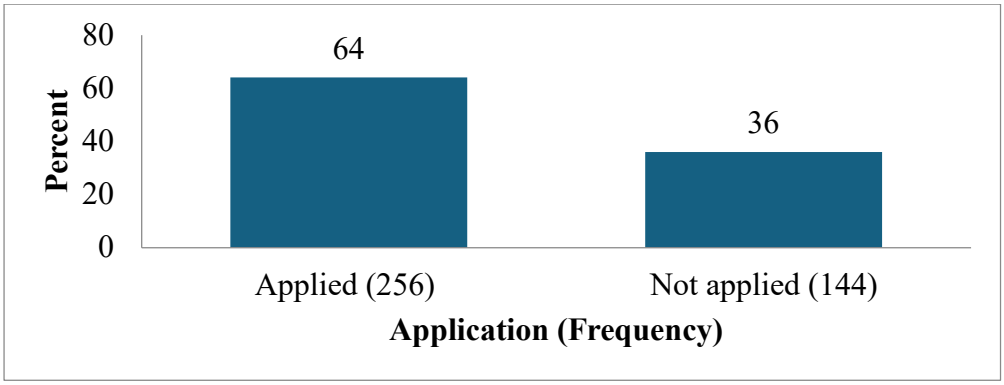


Figure 1: Application of neem leaf/seed to preserve main grains

Perceived effectiveness of neem plant in reducing postharvest loss of maize grains

Result illustrated in figure 2 show that majority (63.5%) further indicated that neem leaf/seed is effective in reducing postharvest loss of maize grains. This finding implies that the use of neem leaf or seed for preserving maize grain is effective.

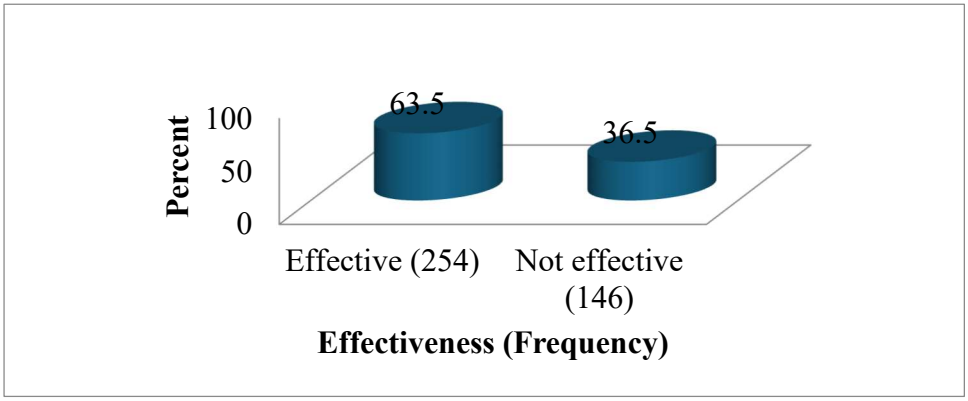


Figure 2: Perceived effectiveness of neem plant in reducing postharvest loss of maize grains

Finding in Table 2 indicated that neem seed and leaf can preserve maize for about 6 months and 3 weeks. Adesina et al. (2019) had stated that in order to satisfy the demand for a plentiful supply of cereals and legumes in Nigeria, grains must be stored for a year. The authors maintained that traditional storage system is considered to be effective or give satisfaction in which they continue improving so as to sustain grains from damage while retaining the quality for at least 1 year (12months).

Table 2: Months of durability of indigenous knowledge practices' applied to prevent post-harvest losses

Indigenous Knowledge Practices	Value
Mean duration (months)	6.32
Standard Deviation	9.72
Min. – Max.	0.3 – 72.0

Findings in Table 3 also show that 60.5% opined that the use of neem leaf/seed to preserve maize results to low loss, 17.0% indicated moderate loss while 3.0% indicated high loss. This shows that the application of traditional technology such as the use of neem function in reducing postharvest loss of maize grain among majority of farmers in Kwara State.

Table 3: Perceived level of maize post-harvest losses after the use of neem leaf/seed

Level of loss	Frequency	Percentage
High	12	3.0
Moderate	68	17.0
Low	242	60.5

Characteristics of neem plant as indigenous postharvest practice

Data provided in Table 4 indicated that majority of the respondents indicated that neem leaf and seed is available (66.0%), accessible (68.0%), less costly (68.5%), observable (62.0%), and complex to apply (18.0%). This shows that neem leaf/seed available, accessible, less costly, observable, and less complex to apply by maize farmers in Kwara State.

Table 4: Characteristics of neem plant as indigenous postharvest practice

Neem leaf and seed	Frequency	Percentage
Accessible	272	68.0
Available	264	66.0
Less costly	274	68.5
Observable	248	62.0
Complexity to apply	72	18.0

Farmers' Access to Financial Assets

The contribution of indigenous knowledge practice of neem in reducing postharvest losses of maize produce to farmers' access to financial assets such as income and savings that are able to meet basic needs (mean=1.98) and credit loan (mean=1.55) as presented in Table 5 were both considered high and were rated first and second respectively. As perceived by respondents, this finding implies that utilization and effectiveness of indigenous knowledge practice of neem in reducing postharvest losses of maize produce is capable of earning the income that can meet their basic needs of the farmers and the application could be used to secure credit loans for maize production. *This finding corroborates Nwowu (2008) who proved indigenous knowledge as* a viable option for resource-poor farmers in their pursuit of increased output and income.

Table 5: Access to Financial Assets

Financial Assets	**High**	**Moderate**	**Low**	**Never**	**Mean(SD)**	**Mean rating**
Income/saving able to meet basic needs	92(23.0)	209(52.3)	99(24.8)	0	1.98(0.69)	1
Access to credit loan	37(9.3)	164(41.0)	181(45.3)	18(4.5)	1.55(0.72)	2

Relationship between the duration of neem leaf/seed in reducing postharvest loss of maize and farmers' access to financial assets

The results of the multiple regression analysis of the relationship between the quantity of post-harvest loss of maize saved by indigenous preservative knowledge and farmers' access to financial assets is presented in Table 6. The table showed that duration of neems in reducing post-harvest loss of maize had positive significant relationship with farmers' access to income/saving able to meet basic needs (β-0.140; p-0.016). This finding implies that increase quantity of post-harvest loss of maize saved by indigenous preservative knowledge of neem leaf/seed, the more quantity of maize to sell which in-turn increase farmers' income and savings the farmers used to cater for their daily needs. With regards to farmers increase income and savings, the null hypothesis is rejected while the alternative is accepted.

Table 6: Multiple regression analysis of the relationship between the duration of neem leaf/seed in reducing postharvest loss of maize and farmers' access to financial assets

	Unstandardized Coefficients		**Standardized Coefficients**		
Model	B	Std. Error	Beta	**t**	**P-value**
(Constant)	2.318	1.223		1.896	0.059
Income/saving able to meet basic needs	0.730	0.302	0.347	2.418	0.016*
Access to credit loan	-0.309	0.291	-0.140	-1.062	0.289

*Significant at p≤0.05 level

Conclusion and Recommendations

This study concludes that the usage of neem leaf/seed is effective in reducing postharvest loss and has positive influence farmers' access to financial assets. The study recommends that upgrading neem-based treatment of maize by concern research institute in Nigeria. Percentage effectiveness of neem seed/leaf was very high. This study suggests that maize farmers should consider the use of neem seed/leaf when preserving maize to retain quality/viability, original colour, longer shelf life, and lesser percentage of insect/pest infestation.

References

Abdelgaleil, S. (2009). Fumigant and contact toxicity of monoterpenes to *Sitophilus oryzae* (L.) and *Tribolium castenum* Herbst and their inhibitory effects on acetylcholinesterace activity. *J. Chem. Ecol.*, 42:1-8.

Ehisianya, C.N., Ikpi, P.O., Okore, O.O. and Obeagu, I.A. (2019). Assessment Of Plant Powders As Protectants Of Stored Maize Grains Against Maize Weevil, Sitophilus Zeamais (Motsch). [Coleoptera: Curculionidae]. Nigerian Agricultural Journal Vol. 50, No. 1 | pg. 37-45.

Jahromi, M. G, Pourmirza, A. A and Safaralizadeh, M. H. (2012). Repellent effects of sirino (garlic emulsion) against *Lasioderma serricorne* (Coleoptera: Anobiidae) and *Tribolium castaneum* (Coleoptera: Tenebrionidae) by three laboratory methods. *Afr. J. Biotechnol.* 11(2): 280-288.

Khaliq, A., A. Nawaz, M.H. Ahmad and M. Sagheer, 2014. Assessment of insecticidal potential of medicinal plant extracts for control of maize weevil, *Sitophilus zeamais* motschulsky (Coleoptera: Curculionidae). Basic Res. J. Agric. Sci. Rev., 3: 100-104.

Tilahun F. E. and Daniel H. B., 2016. Effect of Neem Leaf and Seed Powders Against Adult Maize Weevil (*Sitophilus zeamais* Motschulsky) Mortality. *International Journal of Agricultural Research, 11: 90-94.* DOI: 10.3923/ijar.2016.90.94

Ileke, K.D. and M.O. Oni, 2011. Toxicity of some plant powders to maize weevil, *Sitophilus zeamais* (motschulsky) [Coleopteran: Curculiondae] on stored wheat grains (*Triticum aestivum*). Afr. J. Agric. Res., 6: 3043-3048.

Manju, K., Jayaraj, J., Shanthi, M., 2019. Efficacy of botanicals against pulse beetle callosobruchusmaculatus (F.) in green gram. Indian J. Entomol. 81 (1), 144–147.

Marilei, N. S., Alberto, C. V., Augusto, T. A. P. and Heron, O. S. L. (2010). Leaves, stems and seeds powder of neem (*Azadirachta indica* A. Juss.) used as repellent of *Sitophilus zeamais* (Coleoptera: Curculionidae) in stored corn. *Brazilian J. Food Res.,* 1(1): 21- 24.

Nwosu, L.C. (2014). Integrating Host Resistance and Plant Materials in the Management of Sitophilus zeamais Motschulsky Infestation in Stored Maize. PhD Thesis in the Department of Biology, Federal University of Technology Akure, Nigeria.

Shiberu, T. and Negeri, M. (2017). Determination of the appropriate doses of promising botanical powders against maize weevil, *Sitophilus zeamais* Mots (Coleoptera: Curculionidae) on maize grain. *J. Stored Prod. Postharvest Res.* 8(4): 49 – 53.

Stancic, M. R., Coprean, D., Sava, D. Dobrinas, S. Miron, L and Schiopu, S. (2011). Use of Garlic, *Absinthium* and *Celandine* extract as natural repellents. *Env. Engineer. Manage. J.,* 10(3):445-449.

Sugh, E.T., Ahule, B.G. and Nkwain, K.T. (2020). Indigenous Strategies Of Shelf Life Extension Of Maize Among Farmers In Nigeria. Journal of the College of Agricultural Economics, Extension & Science, 6 (2), 221 – 234.

Sonalkar, M.Y., S.A. Nitave and A.A. Kagalkar, (2014). Review on neem plant. World J. Pharm. Pharm. Sci., 3: 590-598.

Ukeh, D., Arong, G. and Ogban, E. (2008). Toxicity and oviposition deterrence of *Piper guineense* (Piperaceae) and *Monodora myristica* (Annonaceae) against *Sitophilus zeamais* (Motsch.) on stored maize. *J. Entomol.,* 5(4):295-299.

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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Multidimensional Poverty Status of Sweet Potato Processors in Kwara and Osun States, Nigeria

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Abstract

This study examined the multidimensional poverty status of sweet potato Processors in Kwara and Osun States. It also described the socio-economic characteristics of the respondents. Multistage sampling technique was used to select 124 sweet potato processors. An interview guide was used through structured questionnaire to obtain primary data which were analysed using descriptive, and multi-dimensional poverty index. The results revealed that majority of sweet potato processors in both states were male (68.7% and 91.7), educated (81% and 70%), married (50% and 68%) with the mean age of 42 and 41 years for Kwara and Osun States respectively. The sweet potato processors were considered poor, since, they have more than four indicators having deprivation values greater than the cut-off level of deprivation (36%), that is {Action taken when sick, with deprivation level of (76.6%, 53.3%,), Toilet facility (67.2%, 61.7%,), Training participation (51.7%, 43%), Land (64.1%,61.7%), Water source 40.6% and Daily food frequency at 40%. The study concludes that sweet potato processors were considered poor in the study areas. It is therefore recommended that Government and Non-Governmental agencies should subsidize processing inputs and engage the processors in training to boost the processing and commercialization level of this important crop.
Keywords: Processors, deprivation indicators, gender, multidimensional and poverty.

Introduction

Sweet potato (*Ipomeabatatas* (L.) Lam.) is a very important crop that is widely cultivated across the globe. According to FAO (2011), sweet potato is one of the seven crops in the world that produce over 105 hundred million metric tonnes of edible food products annually. China alone produced 80 to 85% of the total sweet potato production in the world while the remaining countries in Asia have the next highest production and then, followed by Africa and Latin America (Centro International de la Papa, 2009). It is among the world most important and under exploited food crops (Scott and Maldonado, 1999; Grant, 2003). With more than 133 million metric tonnes in annual production in the world, sweet potato currently ranks as the fifth most important food crop on a fresh-weight basis in developing countries after rice, wheat, maize, and cassava (Scott and Maldonado, 1999; Grant, 2003).

It is the most important tuber crops in terms of economic values, contribution to calories and protein. Apart from this, it is the important staple food for many developing nations. Nigeria is the number one producer of sweet potato in Africa with annual output of 3.46 million metric tons and globally the second largest producer after China. Apart from being a rich source of starch, sweet potatoes contain good quantity of secondary metabolites and small molecules which play an important role in a number of processes (Friedman, 1997). Many of the compounds present in sweet potato are important because of their beneficial effects on health, therefore, are highly desirable in the human diet and functions as a functional food (Katan and De Roos, 2004). The crop also plays an important role in ensuring food security and incomes for local communities.

Fresh sweet potatoes having relatively high moisture contents are very sensitive to microbial spoilage, even at refrigerated conditions. Hence, they must be consumed within a few weeks after harvest or be processed into various products. Utilization of sweet potatoes has been limited to their traditional uses (Sohail et al, 2013), though they have tremendous flexibility of utilization as food, feed and industrial products (Thottappilly and Loebenstein, 2009). They are mainly used as human food; tubers are mainly consumed boiled or fried (Ingabire and Vasanthakaalam, 2011).

Although, Sweet potatoes have been in food systems for hundreds of years, its cultivation is still wholly subsistence. Commercialization or value addition to the crop would go a long way in generating farmers more income, increase their standard of living and eventually reduce their poverty status. Tipraqsa and Schreinemachers (2009) defined agricultural commercialization as the process by which farm households increasingly integrate with both agricultural input and output markets. Commercialization of smallholder agriculture meaning a shift from subsistence to more market-oriented farming which can lead to productivity growth, income growth, employment growth, and poverty reduction (Bellemare and Novak, 2017). In order to maximize the potentials that sweet potato possess in ensuring food security and poverty alleviation of the processors, there is a need to commercialize and engage in value addition.

Objectives of the Study

The main objective of this study is to examine Multidimensional Poverty Status of Sweet Potato Processors in Kwara and Osun States, Nigeria. While the specific objectives are to:

i. Identify the socio-economic characteristics of the respondents in the study areas
ii. Examine the poverty status of the respondents in the study areas

RESEARCH METHODOLOGY

The study Areas

The study was conducted in Kwara and Osun States of Nigeria. The two states are the major producers of sweet potatoes in Nigeria and the processing of sweet potato relatively more prevalent there. Primary data was obtained through the administration of structured questionnaire Multistage sampling technique was used in the selection of the respondents. Two states were purposively selected, and four Local Government Areas (LGAs) with preponderance in producing sweet potatoes crop were also purposively selected from each of the two states, making a total of eight LGAs. Further, four sweet potatoes processing communities were randomly selected from each of the eight LGAs making a total of 32 communities. Then using the sample table by Crejcie and Morgan to select 66 respondents from Kwara state and Osun state based on their population size of (80 respectively), making a total number of 132 respondents for this study.

The sample size was calculated using the following formula:

$$s = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P).$$

where, s = required sample size.
X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).
N = the population size.
P = the population proportion (assumed to be .50 since this would provide the maximum sample size).
d = the degree of accuracy expressed as a proportion (.05).

RESULT AND DISCUSSION

Socio Economic Characteristics of Agricultural Sweet Potato Processors

Gender of the Respondents

The results in figure 1 showed that the gender distribution of the respondents indicated that majority of the Sweet Potato Processors were males 79.84%, while 20.16% were females. This indicates women in the study areas are not lazy but hardworking type that are ready to support their husband in caring for their family which makes them to be fully involves in processing and marketing of agricultural crops.

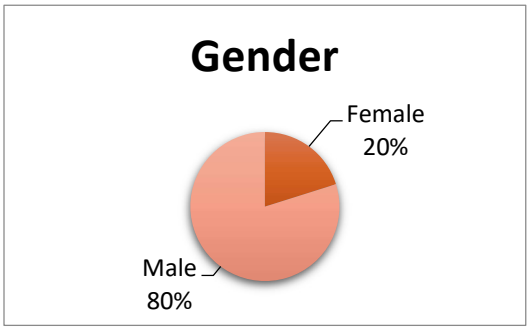


Fig. 1: **Distribution of Respondent by Gender**. Source: Field Survey, 2022

Education Level of the Respondents

It was reveals in figure 2 that the education status of the respondents was about 24% of the respondents were illiterate while other 76% were educated with at least primary school certificate, this is an indication that adoption and accepting new innovations on processing and commercialization practices will not be a difficult thing in the study areas.

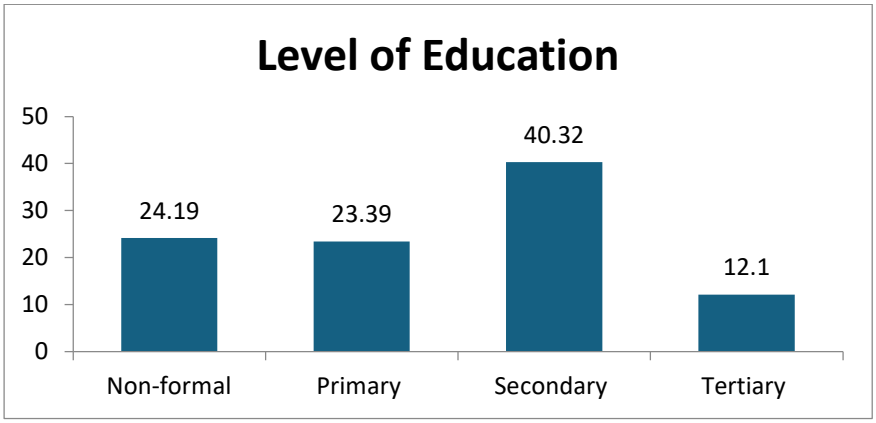


Fig. 2: **Distribution of Respondent by level of Education**. Source: Field Survey, 2022.

Marital Status of the Respondents

The distribution of marital status in figure 3 indicates that 58.87% of the Sweet Potato Processor were married, 18.55% of the respondents were single, 13.71% were Widow/Widower, and 8.87% of the respondents were Divorced/Separated. This implied that the married has a sense of belonging and responsibility. This contributes to the commercialization of sweet potato in the sense that if one is not available in participation other will be.

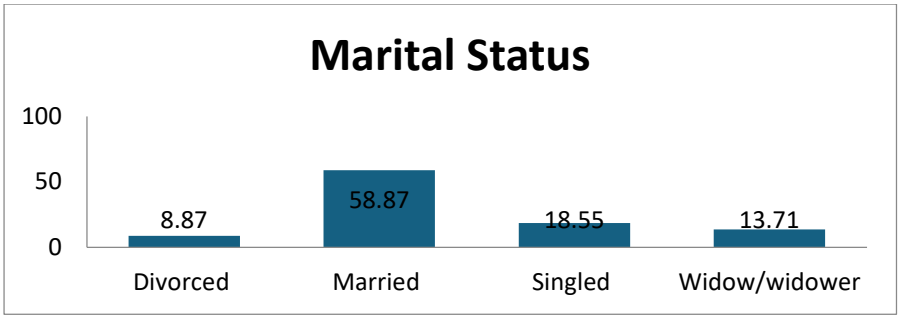


Fig. 3: **Distribution of Respondent by Marital Status**. Source: Field Survey, 2022

Household Head of the Respondents

The result shows in the figure 4 that about 52% of the sweet potato processors were male household head while 48% of the respondents were females. This slide variation indicates that most women bears family's responsibilities in catering for their family all alone.

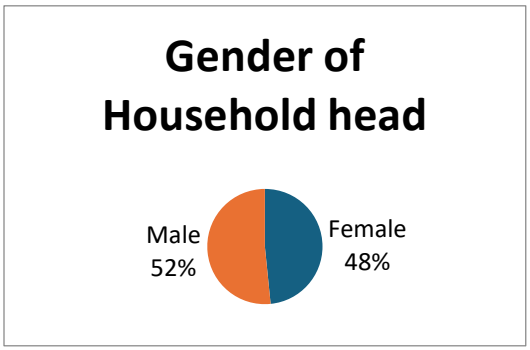


Fig. 4: Distribution of the Respondents by Household Heads. Source: Field Survey, 2022

Household Size of the Respondents

Figure 5 below revealed that household size having between 1 and 2 members have the highest representation of 64%, household having between 3 and 4 members had 29%, while the remaining 7% belong to a household size that greater than 4. The average household size of the respondents were appropriately 2 members per household during the study which indicates that the number of household size is moderate and cause reduction in cost of hired labour.

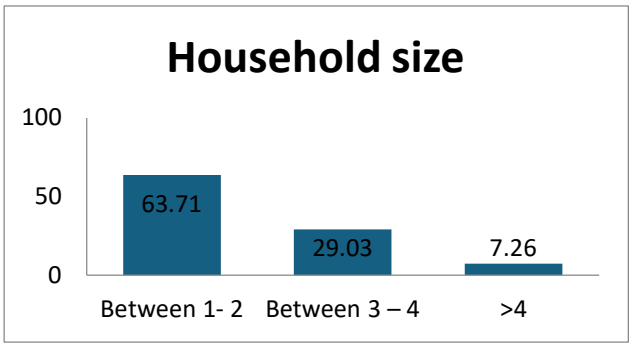


Fig. 5: Distribution of the Respondents by Household Size. Source: Field Survey, 2022

Mean ($\bar{x}$) = 2.3145, Standard deviation= 1.3873, minimum= 1.0, maximum = 6.0.

Age of the Respondents

The age distribution in figure 6 showed the mean age of the sweet potato Processors in the study was 42years which falls to the class range with the modal age of "between 36 – 45". This implies that the respondents were still under productive and active age to engage fully into processing of sweet potato for commercial purpose. This is in line with the findings of (Gebreslassie, *et al.,* 2015, and Oyebamiji, *et al* 2019) got an average age of 45%. This indicates that majority of the sweet potato processors are matured, strong and were productive and active to take part in the agricultural commercialization practices. About 25.81 percent of the sweet potato household heads were between ages 25 and 35 years, this indicates that the youth and young ones were showing interest in processing of agricultural produce.

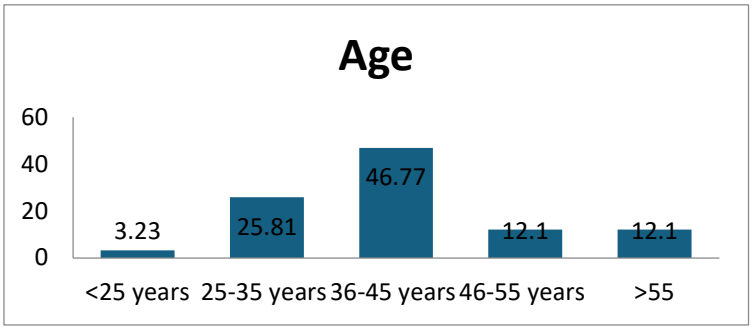


Fig. 6: Age Distribution of the Respondents. Source: Field Survey, 2022

Poverty Level of Sweet Potato Processors in the Study Areas

Table 1: below shows the result of MPI output with a summary of the deprivation indicators. The indicators are organized in deprivations domains, and for each of them MPI shows the data type and the share of deprived individuals from the total population. These binary indictors were constructed under four domains (education, health, living standard and agricultural commercialization) and the AF measure was estimated with a poverty cut-off of 0.36 (36%). For Kwara state Processors, Education domain deprivation was 18.7% level of education, and 40.6% level of Child school enrolment. Domain 2, which is Health contains Hospital at deprivation level of 21.8%, Action taken when seek with 76.6%, and Daily food frequency at 28.1%. Living standard which is domain 3 contains of Toilet facility with deprivation level of 67.2%, Water source 40.6%, Electricity 53.1%, and Land 64.1%.

Then the last domain which is Agricultural commercialization comprises of Training participation, and Absence of training which have deprivation level of 64.1% and 10.9% respectively. This implies that since the numbers of indicators that have deprivation value greater than the cut off level of 36% are more than four simultaneous deprivations, it therefore indicates that sweet potato processors were considered poor. So also, for the Osun state sweet potato processors of which their education domain deprivation was 30% level of education and 23.3% level of Child school enrolment. Domain 2, which is Health contains Hospital at deprivation level of 33.3%, Action taken when seek with 53.3%, and Daily food frequency at 40%.

Living standard which is domain 3 contains of Toilet facility with deprivation level of 61.7%, Water source 36.7%, Electricity 35%, and Land 61.7%. Then the last domain which is Agricultural commercialization comprises of Training participation, and Absence of training which have deprivation level of 51.7% and 21.7% respectively. This implies that since the numbers of indicators that have deprivation value greater than the cut off level of 36% are more than four simultaneous deprivations, it therefore indicates that sweet potato processors were considered poor.

The pooled shows the result of MPI output with a summary of the deprivation indicators. Education domain deprivation was: 26.4% level of education, and 35% level of Child school enrolment. Domain 2, which is Health contains Hospital at deprivation level of 34.5%, Action taken when seek with 58.8%, and Daily food frequency at 45.5%. Living standard which is domain 3 contains of Toilet facility with deprivation level of 59%, Water source 37.8%, Electricity 43%, and Land 82.4%. Then the last domain which is Agricultural commercialization, comprises of Training participation, and Absence

of training which have deprivation level of 43% and 32.2% respectively. This implies that since the numbers of indicators that have deprivation value greater than the cut off level of 36% are more than four simultaneous deprivations, it therefore indicates that sweet potato processors were considered poor.

Table 1: Percentage of Sweet Potato Processors whose indicator values are below the threshold.

Indicator	Data type	Kwara Deprivation (%)	Osun Deprivation (%)	Pooled Deprivation (%)
Domain 1: Education				
Level of education	Binary	18.75	30.00	26.437
Child school enrolment	Binary	40.63	23.33	34.811
Domain 2: Health				
Hospital access	Binary	21.87	33.33	34.483
Action taken when sick	Binary	76.56	53.33	58.483
Daily food frequency	Binary	28.13	40.00	45.484
Domain 3: Living standard				
Toilet facility	Binary	67.18	61.67	58.949
Water source	Binary	40.63	36.67	37.767
Electricity	Binary	53.13	35.00	43.021
Land asset	Binary	64.06	61.67	82.430
Domain 4: Agricultural commercialization				
Training participation	Binary	64.06.	51.67	43.021
Absence of training	Binary	10.94	21.67	32.184

Source: Field Survey 2022

Multidimensional Poverty Index Parameters of Sweet Potato Processors

Table 2 displays the AF (MPI) poverty measures with the related standard errors. The tables consist of three MPI parameters: M_0 (the MPI estimate); H (the incidence of the poor in the population); and A (the average intensity of simultaneous deprivations among the poor). Since the model made use of only binary indicators the MPI computes only M_0. The result for Kwara stat sweet potato processors shows that the MPI of the population (potato processors) accounted for 60.9%. This reflects both the share of the respondents in poverty and the degree to which they are deprived. H which is the poverty incidence, estimates the proportion of the population that are multi-dimensionally poor at 0.313. This implies that 31.3% of potato farmers and processors are multi-dimensionally poor. The final MPI parameter A, which is the average intensity of simultaneous deprivations among the poor accounted for 0.514. This gives an indication that the intensity of deprivations across the dimensions is 51.4%.

Also, for Osun sweet potato processors the result shows that the MPI of the population accounted for 55%. This reflects both the share of the respondents in poverty and the degree to which they are deprived. H which is the poverty incidence estimates the proportion of the population that are multi-dimensionally poor at 0.273. This implies that 61.4% of potato farmers and processors are multi-dimensionally poor. The final MPI parameter A, which is the average intensity of simultaneous deprivations among the poor accounted for 0.497. This gives an indication that the intensity of deprivations across the dimensions is 49.7%.

Moreover, the pooled result shows that the MPI of the population accounted for 61.4%. This reflects both the share of the respondents in poverty and the degree to which they are deprived. H which is the poverty incidence, estimates the proportion of the population that are multi-dimensionally poor at 0.523. This implies that 32.1% of potato farmers and processors are multi-dimensionally poor. The final MPI parameter **A**, which is the average intensity of simultaneous deprivations among the poor accounted for 0.523. This gives an indication that the intensity of deprivations across the dimensions is 52.3%.

Table 2: Poverty Measures with the related Standard Errors of Sweet Potato Processors

MPI	Kwara Coefficient	Kwara Standard Error	Osun Coefficient	Osun Standard Error	Pooled Coefficient	Pooled Standard Error
M_0	0.609	0.061	0.550	0.065	0.614	0.020
H	0.313	0.033	0.273	0.034	0.321	0.011
A	0.514	0.016	0.497	0.019	0.523	0.006
N	64		60		124	

Source: Field Survey 2022

Multidimensional Poverty Index Overall Decomposition of Sweet Potato Processors

Table 3 of the MPI output shows the percentage of contribution of each of the indicators to the overall index, that is, the overall decomposition of the domains and indicators. For Kwara state sweet potato processors, education domain, the deprivation in level of education accounted for 3.1% of the overall value of M_0, 16.2% accounted for Child school enrolment. In the Health domain: deprivation level for Hospital access was 5.4%, the action taking when seek accounted for 14.1%, and daily food frequency accounted for 5.4%. Under the standard of living of the respondents; owning toilet facility accounted for 9.7%, water source has a deprivation of 6.9% that of electricity was 7.5%, while land asset was 8.7%. Lastly, under Agricultural commercialization awareness; training participation accounted for 18.7%, and Absence of training accounted for the deprivation level of 4.4%.

Pro Osun state sweet potato processors, education domain, the deprivation in level of education accounted for 11.4% of the overall value of M_0, 10.7% accounted for Child school enrolment. In the Health domain: deprivation level for Hospital access was 7.1%, the action taking when seek accounted for 9.1%, and daily food frequency accounted for 8.6%. Under the standard of living of the respondents; owning toilet facility accounted for 7.6%, water source has a deprivation of 6.5% that of electricity was 3.8%, while land asset was 8.4%. Lastly, under Agricultural commercialization awareness; training participation accounted for 19.1%, and Absence of training accounted for the deprivation level of 7.6%.

The pooled result for education domain, the deprivation in level of education accounted for 6.9% of the overall value of M_0, 13.7% accounted for Child school enrolment. In the Health domain: deprivation level for Hospital access was 6.2%, the action taking when seek accounted for 11.9%, and daily food frequency accounted for 6.9%. Under the standard of living of the respondents; owning toilet facility accounted for 8.7% water source has a deprivation of 6.7% that of electricity was 5.8%, while land asset was 8.6%. Lastly, under Agricultural commercialization awareness; training participation accounted for 18.9%, and Absence of training accounted for the deprivation level of 5.8%.

Table 3: Contribution of each indicator to MPI of Sweet Potato Processors

Indicator	Kwara M_0 (%)	Osun M_0 (%)	Pooled M_0 (%)
Domain 1: Education			
Level of education	0.031	0.114	0.069
Child school enrolment	0.162	0.107	0.137
Domain 2: Health			
Hospital access	0.054	0.071	0.062
Action taken when sick	0.141	0.091	0.119
Daily food frequency	0.054	0.086	0.069
Domain 3: Living standard			
Toilet facility	0.097	0.076	0.087
Water source	0.069	0.065	0.067
Electricity	0.075	0.038	0.058
Land asset	0.087	0.84	0.086
Domain 4: Agricultural commercialization			
Training participation	0.187	0.191	0.189
Absence of training	0.044	0.076	0.058

Source: Field Survey 2022

Multidimensional Poverty Index Derivative per Domain of Sweet Potato Processors

Table 4 of MPI output provides the contribution of each of the deprivations per domains. For Kwara state sweet potato processors, domain 1 whose indicators are level of education and child/children school enrollment contributed 19.3% to the overall value of M_0, Domain 2 whose indicators are contributed 24.9% to the overall value of M_0, Domain 3 whose indicators are contributed 32.7% to the overall value of M_0. And Domain 4 whose indicators are training participation and absence of training contributed 23.1% to the overall value of M_0. This implies that the contribution of each of the deprivations per domain was not up to the cut off value of deprivation which means that at each domain, the sweet potato processors were not poor.

Then, for Osun state sweet potato processors, domain 1 whose indicators are level of education and child/children school enrollment contributed 22.1% to the overall value of M_0, Domain 2 whose indicators are contributed 24.9% to the overall value of M_0, Domain 3 whose indicators are contributed 26.3% to the overall value of M_0. And Domain 4 whose indicators are training participation and absence of training contributed 26.7% to the overall value of M_0. This implies that the contribution of each of the deprivations per domain was not up to the cut off value of deprivation which means that at each domain, the sweet potato processors were not poor. The pooled result shows domain 1 whose indicators are level of education and child/children school enrollment contributed 20.6% to the overall value of M_0, Domain 2 whose indicators are contributed 24.9% to the overall value of M_0, Domain 3whose indicators are contributed 29.8% to the overall value of M_0. And Domain 4 whose indicators are training participation and absence of training contributed 24.7% to the overall value of M_0. This implies that the contribution of each of the deprivations per domain was not up to the cut off value of deprivation which means that at each domain, the sweet potato processors were not

Table 4: Contribution of each domain to MPI of Sweet Potato Processors

Domain	Kwara M_0 (%)	Osun M_0 (%)	Pooled M (%)
Domain 1	0.193	0.221	0.206
Domain 2	0.249	0.249	0.249
Domain 3	0.327	0.263	0.298
Domain 4	0.231	0.267	0.247

Source: Field Survey 2022

Conclusion

Based on the findings from the data analysed, this study concluded that majority of the processors were male, married and educated The sweet potato processors were considered poor, since, they have more than four indicators having deprivation values greater than the cut-off level of deprivation (36%), that is {Action taken when sick, with deprivation level of (76.6%, 53.3%,), Toilet facility (67.2%, 61.7%,), Training participation (51.7%, 43%), Land (64.1%,61.7%), Water source 40.6% and Daily food frequency at 40%}. The mean agricultural commercialization level for the processors was 0.2. Also, spoilage, inadequate labour, bad road and inadequate sweet potato roots for processing were the major constraints affecting both Kwara and Osun States' sweet potato processors. The study concludes that sweet potato processors were considered poor in the study areas.

Recommendation

Agricultural commercialization as one of the pathways towards economic growth has potential to increase agricultural productivity, adding value to sweet potatoes for shelf-life extension. However, it is therefore recommended that:

- Government and Non-Governmental agencies should subsidize processing inputs and engage the processors in training to boost the processing and commercialization level of this important crop.

Reference

Centro Internacional de la Papa (2009). Sweet Potato. (retrieved 06.10.12 from http://www.cipotato.org/sweet potato/)

FAO (2011). Statistical database.*http://faostat.fao.org/site/567/DesktopDefault.aspx?Page ID=567#ancor (accessed October 7, 2012)*.

Fellows PJ (2000). Food Processing Technology - Principles and Practice *(2nd Edition) CRC Press, Boca Raton Boston New York Washington, DC Woodhead Publishing Limited, Cambridge England*.

Friedman M (1997). Chemistry, biochemistry, and dietary role of potato polyphenols. *A review. J. Agric. Food Chem. 45:1523–1540.*

Grant V (2003). Select markets for taro, sweet potato and yam. A report for the Rural Industries Research and Development Corporation (RIRDC). *Publication No 0 3 /052 RIRDC project No UCQ-13A. Online: http://www.rirdc.gov.au*.

Ingabire M. R. and Vasanthakaalam H. (2011). Comparison of the Nutrient Composition of four sweetpotatoes varieties cultivated in Rwanda. *American Journal of Food and Nutrition,* **1**(1): 34-38.

Olagunju FI, Fakayode S B, Babatunde RO, Ogunwole-Olapade F (2013) Gender analysis of sweet potato production in Osun State, Nigeria. AJAEES 2(1): 1-13.

Sohail M., Khan R.U., Afridi S.R., Imad M. and Mehrin B. (2013). Preparation and Quality Evaluation of Sweetpotato ready to drink Beverage. *ARPN Journal of Agricultural and Biological Science:* **8**(4)

Thottappilly G. and Loebenstein, G. (2009). *The Sweetpotato*, Sardaya College of Engineering and Technology,*Kodakara, Kerala, India Springer Science+Business Media B.V. DOI: 10.1007/978-1-40209475-0 1, C.*

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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Assessments of Maize Farmers Production and Climate Change Coping Strategies in Oyo State, Nigeria

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Abstract
The study investigates maize farmers' production in Oyo State Nigeria. The following objectives were examined: the socio-economic characteristics of the respondents, assess farmer's perceptions to climate change in the cultivation of maize, examine the adaptation strategies to climate change and analyse the factors affecting maize production. Seventy respondents were selected from three villages through a well-structured questionnaire. Data were analysed using descriptive statistics such as frequency, percentage, mean, like art and inferential statistics. Results showed that, female (64.3%) were predominant in the study 28.6% were within the ages of 31-40 years while25.7% were within the ages of 41-50 years, with mean age of 43years, mean household size of 6 persons, majority (70%) of the farmers had one form of formal education, 35.7% hired labour, 65.7% belong to farmers association, 57.1% do not use organic fertilizer. Regression result showed that educational level (β= -2.029, $p<0.05$), extension agent contact (β= 8.188, $p<0.01$), years of farming experience (β= 0.973, $p<0.01$), fertilizer application (β= -6.436, $p<0.05$) and climatic conditions (β= -0.258, $p<0.01$) were the significant variables determining farmers output in the study area. Lack of credit facilities (40.0%), lack of vital information (35.7%) were the major constraint to the adoption of climate change and coping strategies by farmer's, however, planting of different crop varieties and mixed farming among others were the major adaptive and coping strategies adopted by maize farmers in the study area.

Keywords**:** Assessments, Climate change, Adaptation, Management, Production, Maize, Oyo state

Introduction

Nigeria agricultural production is solely dependent on rainfall. The threatening effect of climate change is aggravating the problem of agricultural productivity. Awotide *et al.*, (2008) stated that to a great extent, climate and soil resources determine the output of maize and other crops. The variability in the climatic condition affects the production of maize directly and indirectly. Climate variability can be defined as the short term variations in mean state of the climate and variations in other statistics (such as the occurrence of extremes) on all temporal and spatial scales beyond that of individual weather events. Climate is the statistics of weather over long period of time it is measured by accessing the patterns of variations in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time. Climate differs from weather in that weather only describes the short term condition of these variables in a given region (Planton, 2013).

Climate change impacts on agricultural crop production changes from place to place and from crop to crop (Muller *et al.,* 2011). When temperature is high, it can reduce the production of crops in parts of

the world (Schlenker and lobell 2010; Gohari *et al*., 2013), although crop yield could multiply or increase with warm –wet climate change in some areas (Chevas *et al*., 2009). The effect of climate changes includes among other things, the rise in sea level, changes in the intensity, timing and spatial distribution of precipitation, changes in temperature and the frequency, intensity and deviation of extreme climate event, such as floods, drought and tropical storms (IPCC, 2007). The changes in precipitation and temperature have resulted in land and water managements that have subsequently affected the production of agriculture in all developing countries (Kandji *et al*., 2006).

The developed countries are primary causes of climate change. Therefore, it is the bitter irony of destiny that Africa contributes at least (92,000 + of Co_2 each year, less than 4% of the global production) of all continents to the climate change but will probably suffer most from its consequences. Economic refers to this as a typically case of negative external effects, and externalisation of cost (Medugu, 2008), climate change will probably increase the risk of food insecurity most especially in Oyo State, the study therefore examines the Maize Farmers Productivity and Climate Change Coping Strategies in Oyo State, Nigeria with the following

Objectives which are to: examine the farm specific and socio-economic characteristics of maize farmers; assess the perception of farmers on climate change in the cultivation of maize, examine the adaptation strategies to climate change and analyse the factors affecting maize production in the study.

Methodology

Study Area

The study was carried out in Ido local government area (LGA) one of the rural urban city in Ibadan, Oyo State Nigeria. It has an area of 986km^2 and a total population of 103,261 using a growth rate of 3.2% from 2006 census with a population density of 116 persons by square kilometre. Its headquarters is in the town of Ido situated along Ibadan-Eruwa road. The people are predominantly Yoruba and blessed with fertile land which is suitable for agriculture and so an agrarian community. The main occupation of the people is farming mainly food and cash crops such as cassava, maize, yam, vegetable, timber, cocoa, oil palm and kola nut mainly on small scales with significant proportion of the farmers engaging in secondary occupation such as hunting, trading, artisan, civil service, food processing among others.

Sampling techniques

Simple random technique was used to select three (3) villages in Ido Local Government Area, these are Akufo, Omi-Adio and Aba dada based on the availability of the farmers for the study, 25 questionnaires were administered in Akufo, 20 in Omi-Adio and 25 in Abaa dada, making a total of seventy questionnaires administered. The LGA was purposively selected because of its agrarian nature.

Data collection and analysis

The data collected were analysed using descriptive statistics such as tables, frequencies, percentage, means and inferential statistics was used to analyse the factors of maize production in the study.

Regression Model Specified:

$Y= (a+b_1X_1+ b_2X_2 + b_3X_3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots b_8X_8 + \mu)$

Where: Y= Maize Output; X_1= Educational level; X_2= Association; X_3= Labour source; X_4= Extension agent contact; X_5= Years of farming experience; X_6= Source of land; X_7= Fertilizer application; X_8= Credit source; a= Constant; b= Parameter estimated and μ= Error term.

Results and Discussions

Table 1: Socio-economic characteristics of maize farmers in the study area

Variables (N=70)	Frequency	Percentage (%)	Mean
Gender			
Male	25	35.7	
Female	45	64.3	
Age			
20-30	14	20.0	
31-40	20	28.6	
41-50	18	25.7	
51-60	11	15.7	
60 and above	7	10.0	43
Marital status			
Singles	12	17.1	
Married	40	57.1	
Divorced	9	12.9	
Widow(er)	9	12.9	
Level of education			
Non-educated	21	30.0	
Primary	16	22.9	
Secondary	23	32.9	
Tertiary	10	14.3	
Household size			
1-5	39	55.7	
6-10	30	42.9	
11 and above	1	1.4	5.53
Source of labour			
Family	22	31.4	
Hired	25	35.7	
Both	23	32.9	
Association membership			
Do not belong	24	34.3	
Belong	46	65.7	
Aware of climate change			
Not aware	20	28.6	
Aware	50	71.4	
Cropping system			
Mono cropping	20	28.6	
Mixed farming	29	41.4	
Intercropping	21	30.0	
Farm specific in maize production			
Variable	Frequency (70)	Percentage (%)	Mean
Extension agents contact			
Do not have access	44	62.9	
Have access	26	37.1	
Years of farming experience			
1-5	16	22.9	
6-10	26	37.1	
11-20	22	31.4	
21 and above	6	8.6	11

Source of land			
Inherited	24	34.3	
Bought	18	25.7	
Rented	17	24.3	
Gift	6	8.6	
Government	3	4.3	
Communal	2	2.9	
Fertilizer application			
Do not apply	8	11.4	
Applied	62	88.6	
Type of fertilizer			
Organic	22	31.4	
In organic	40	57.1	
Source of Irrigation			
Artificial irrigation	17	24.3	
Rainfall	53	75.7	
Farm size (hectares)			
Small scale (0.1-3.0)	65	92.9	
Large scale (4.0-10.0)	5	7.1	
Source of credit			
Commercial bank	9	12.9	
Agricultural bank	8	11.4	
Cooperative society	14	20.0	
Money lenders	19	27.1	
Friends and family	13	18.6	
Others	7	10.0	
Estimated cost (₦)			
1000-20000	16	22.9	
21000-40000	14	20.0	
41000-60000	13	18.5	
61000-80000	9	12.9	
81000-100000	7	10.0	
100000-200000	7	10.0	
200000 and above	4	5.7	73964
Quantity of maize (tons)			
1-2	6	8.6	
3-4	7	10.0	
5-6	44	62.8	
7 and above	13	18.6	

The result in table 1 shows the socio-economic characteristics of the maize farmers in the study area. The gender distribution of respondents shows that majority (64.3%) ware female while 35.4% are male. This indicating that female engages in maize production than male in the study. This is in line with findings of Kang, (2007) which stated that gender plays a vital role in farming practices, also conform with the work of Mgbada (2000), Rahman and Usman (2004), which noted that rural women contribute two-third of the labour force spent in agricultural production and marketing by producing up to 60-80% of food and other products in Nigeria and Africa at large. Thomas and Adebayo (2003), also claimed that majority of rural women took active part in agricultural production. The age distribution reveals that 54.3% ware within the ages of 31-50years, while 10% are within 60 years and above with mean age of 43 years. This showed that most of the respondents were young and energetic and could actively participate in maize farming. This is in line with the findings of Salawu (2001) and Oyewo *et al*., (2014) who noted that the most productive age in agriculture and forestry activities fall within the age group

of 31-50 years. 57.1% of the respondents were married, while 12.9% were divorced and widowers respectively. This shows that married people dominate maize production in the study area. This however corroborate with the findings of Jibowo (2000) who stated that high percentage of the rural population ware married, 32.9% of the farmers had secondary education, while 14.3% had tertiary education. This implies that higher proportion of the respondents had secondary education and majority had one form of formal education. This conforms to Shehu *et al*., (2017) and Oke *et al*., (2022). This could have a positive effect on their awareness of climate change; more than half (55.7%) of the farmers had 1 to 5 members household size, 35.7% used hired labour while 31.4% used family labour, 65.7% of the farmers belong to farmer association while 34.3% do not belong to any association. This implies that majority of the farmers belong to one association or the other, which could enhance their farming productivity. Majority (71.4%) of them are aware of climate change while 28.6% ware not aware, 41.4% of them practice mixed cropping while 30.0% practices inter cropping,

The result further revealed that 37.1% of the farmer had contact with extension agents, 37.1% of the farmers had 6-10 years of farming experience, 31.4% had 11-20 years while 8.6% had above 21years of farming experience with (11) mean years of farming experience, 34.3% of the farmers inherited their farm land while 2.9% source of farmland was trough communal, majority (88.6%) of the farmers applied fertilizer while 11.4% do not use fertilizer due to their inability to afford to buy it or due to the nature of their farm. However, 57.1% of them used in organic fertilizer while 31.5% used organic fertilizer, 97.2% had farm size between 0.1-4.99 hectares which connote small scale farming, 1.4% had between 5-9.99 hectares farm size (medium scale farming), while 1.4% of the farmers had farm size between 10.0 hectares and above (large scale farming). This shows that almost all of the farmer operates in a small-scale size of farming system, this in line with the findings of Oyewo *et al*., (2018) that majority of cassava farmers operate on a small scale farming system. 27.1% of the farmers source their credit through money lenders, 20.0% through cooperative society. The table also shows that 22.9% of the farmers incurred between ₦1000- ₦20,000 per planting season, 20.0% spent between ₦21,000- ₦40,000 while 5.7% spent between ₦201,000- ₦400,000 on their farm per planting season, 62.8% of the farmers harvested between 5-6 tons', 10.0% harvested between 3.0-4.0 tons while1 8.6% of them harvested 7 tons and above in maize produced per season.

Table 2: Farmers perception of climate change on maize production

Variables (N=70)	Frequency	Percentage (%)
Increased temperature	30	42.9
Decreased temperature	20	28.6
Altered temperature change	14	20.0
No change in temperature	12	17.1
Increased rainfall	30	42.9
Decreased rainfall	24	34.3
Change in timing of rains	23	32.9
Change in frequency of drought	24	34.3
No change in rainfall	11	15.7

(Multiple responses)

Table 2 shows the perception of climate change on the cultivation of maize by the farmers. This is multiple responses where farmers are given the option to choose more than one responses. The table shows that 42.9% of the farmers experience increased temperature and increased rainfall, 34.3% experienced decreased rainfall and change in frequency of drought, 32.9% experienced change in timing of rains while28.6% of farmers experience decrease temperature, it was also revealed that 20.0% of the farmers experienced altered temperature change. It was further realized that 17.1% of the farmers said that there is no change in temperature, while (15.7%) of farmers in the study perceived no change in rainfall pattern. This finding was in line with the work of Apata *et al.,* (2009).

Table 3: Farmers Adaptation strategies to climate change

Variables (N=70)	Frequency	Percentage	Ranking
Planting different crops	59	84.3	1st
Planting different crop varieties	58	82.9	2nd

Mixed farming	50	71.4	3rd
Ridges across the slope	41	58.6	4th
Cereal/ legumes intercropping	39	55.7	5th
Shifting cultivation	38	54.3	6th
Planting trees	34	48.6	7th
Use of organic fertilizers	31	44.3	8th
Zero tillage	28	40.0	9th
Irrigation	28	40.0	10th
Use of agricultural insurance	22	31.4	11th

(Multiple responses)

Table 3 shows the adaptation strategies to climate change by farmers in the study area. This is in multiple responses, 84.3% of the farmers adopted the practices of planting of different crops on their farmland which ranked 1st, 82.9% plant different crop varieties (ranked 2nd) as a means of adaptation strategies, 71.4% of the respondents practices mixed farming (ranked 3rd), 58.6% involve in making of ridges across the slope (4th). 55.7% engage in cereal/legumes intercropping (5th), 54.3% practices shifting cultivation (6th), 48.6% of them planted trees (7th). Also 44.3% of the farmers use organic fertilizers while 40.0% of the farmers practice irrigation and zero tillage. 31.4% uses agricultural insurance as their source of credit. This is an indication that every of the respondents adopt one or more adoptive measure to climate change in the study area. This is in line with Coster (2015) which stated that every farmer makes use of one or more adoptive strategies as a means of adaptation strategies to climate change in his study.

Table 4: Factors of maize production in the study area

Variables	Beta	Std Error	T-value	Significant
(Constant)	42.996	7.282	5.905	0.000
X_1 Edu level	-2.029**	1.124	-1.805	0.076
X_2 Association	-1.979	2.490	-0.795	0.430
X_3 Labour source	0.039	1.557	0.025	0.980
X_4 Ext Agent	8.188***	2.708	3.024	0.004
X_5 Yrs of farming	0.973***	0.176	5.540	0.000
X_6 Land source	-0.923	0.925	-0.998	0.322
X_7 Fertilizer app	-6.436**	3.015	-2.135	0.037
X_8 Credit source	0.071	0.870	0.081	0.935
X_9 Climatic condition	-0.258***	0.043	6.000	0.000
R^2	0.56			

Note **=5%, ***=1% Significant level

Regression table 4 revealed that access/contact with extension agent and years of farming experience were significant ($p<0.01$) and has positive relationship with maize output, the positive coefficient of years of farming experience and access to extension agent will bring about increase in the maize output, this corroborate the finding of Oke *et al*., (2022), farmers level of education and fertilizer application has negative coefficient and significant ($p<0.05$) to the maize output, this is not in line with *apriori* expectation. This therefore implies that farmer level of education and fertilizer application tends to decrease maize output; this may be as a result of low level of education, low level of adoption of modern technologies and farmers' awareness on means of mitigating climate change trough the application of fertilizer at the appropriate time and given quantity, climatic conditions also has negative effect on maize production in the study area. This may be due to the untimely raining and high level of temperature during the farming season. R^2 was 0.52 indicating that the model specified could only explain 52% level of variation. It was therefore concluded that educational level, extension agent contact, years of farming experience, fertilizer application and climatic conditions were the major variables influencing maize production in the study area which also correspond to the report of (Mani *et al*., 2022) that farming experience were among the factors affecting crop production

Conclusions and Recommendations

The research however concluded that less than half of the farmers (35.7%) used hired labour, more than half (57.1%) do not use organic fertilizer, majority of the farmers (71.4%) were aware of climate change, 84.3% adopt planting of different crops and varieties, practices zero tillage and mixed farming as means of climate change adaptation strategies. However, adoption of modern farming methods is still very low in the study area, leading to low maize yields. These findings showed that young people are better placed in adoption of new technologies than older people. It was also find out that farmers levels of education, extension agent contact, years of farming experience and fertilizer application were the major variable influencing maize output and Lack of credit facilities, lack of vital information and data regarding climate among others were the major constraint to the adoption of climate change and coping strategies by farmers in the study area.

Recommendations

Based on the findings of this study, the following recommendations are proffered.

- More efficient extension services to disseminate information on new technologies to farmers.
- Products of research findings should be show cased to farmers to be able to cope with climatic challenges and still be productive.
- The use of organomineral fertilizers instead of synthetic inorganic fertilizers that is hazardous to environment be encouraged.
- Fertilizer application should be done in the right manner and at a given quantities which conform to agronomic best practices be adopted.
- Mixed farming and adoption of planting different crops be adopted
- adoption of modern farming methods in maize production be adopted
- Artificial means of irrigation should be adopted by the farmers.

Reference

Apata, T.G Samuel, K.D. and Adeola A.O. (2009). Analysis of Climate change Perception and Adaptation among Arable food crop Farmers in South Western Nigeria Paper Presented at the Conference of International Association of Agricultural Economics pp. 2-9.

Awotide, Fashina, Olobonjo (2008): Factors influencing Adoption of high yielding maize varieties in South Western Ethiopia; An application of Logit. *Quarterly Journal of International Agriculture, 401,49-167.*

Chavas. DR, Izaurralde RC, Thomson AM, Gao X (2009) long term climate impacts on productivity in eastern china. Agric for Meteorol 149:128. Doi: 1016/*j. agrformet*.0.2.001

Coster, A.S (2015) Department of Agricultural Economic, University of Ibadan, Nigeria.
Economic Analysis and Determinants of Maize Production in Oyo State, Nigeria. *Nigerian Agricultural Journal*. 53(1): 60-62
Efficiency in Small-Scale Maize Production in Tafawa-Balewa Local Government of Bauchi State Nigeria. *Agrosearch.* 10(2):29-35

Gohari A, Eslamian S, Abedi- Koupaei J, Bavani AM, Wang D, Madani K (2013) climate change impacts on the crop production in Iran's Zayandeh Rud River basin. *Sci total Environ* 442; 405-419, doi: 10.1016/j.sci totenu.2012.10.029

IPCC, (2007). Summary for policy makers. In M.L. Parry, O.F. Canziani, J.P. palutikof, P.J. Van der Linder and C.E. Hanson (Eds), Climate change (2007): Impacts, Adaptation and vulnerability (Pp.7-22). Contribution of working group 2 to the fourth assessment report of the intergovernmental panel on climate change, Cambridge University Press, Cambridge, UK.

Jibowo, A.A (2000). Essentials of rural sociology, Gbemi Sodipo press, Abeokuta, Nigeria. Second impression, pp229-236.

Kandgi, T.S., Verchot, L., Aid Mackensen, J. (2006). Climate change aid variability in southern Africa: Impacts and adaptation in the agricultural sector, World Agroforestry centre and united nation environment programs report. pp.42.

Kang, Bhavdeep (2007). Women lead the way back to organic farming, IFOAM, www.ifoam.org/growing organic, viewed 28th October, 2009.

Mani, J.R, Issah, F.O, Abdussalam, Z and Damisa, M.A (2022). Factors Influencing Farmer

Medugu, N.I. (2008). Nigeria: Climate change. A threat to the country's development. Retrieved from http;//www.allafrica.com/Nigeria on 23rd of June 2008.

Mgbada, J.U; 2000: production of stable food crops by women in Enugu and Ebonyi state; lessons for enhancing poverty alleviation programme.in T.A. Olowu (ed) Agricultural Extension and poverty alleviation in Nigerian, proceedings of the 6th annual national conference of the agricultural extension society of Nigeria

Muller, C. W. Cramer, W.L.Hare, and H. Lotze-Campen, 2011; Climate change risks for African agriculture. Proceedings of the National Academy of sciences of the United States of America, 108 (11), 4313-4315.

Oke, F. O, Kareem, I.A., Bamigbade-Sanni, S.A, Oose, M.O and Olayode, A.K (2022).

Oyewo, I. O. Raufu, M.O. Oladosu, B.O. Adelalu, K.O. (2018) Climate Change and Adaptation Strategies: Farmers Perception in Oyo State, Nigeria. *Current Research in Agricultural Sciences*. 5(2):32-41

Oyewo, I.O, Raufu.M.O, A.A.A. Adesope, Akanni .O.F and Adio. A.A (2014) Factors affecting maize production among farmers in Oluyole Local government area of Oyo State. *Scientia Agriculturae.* 3 (2): 70-75

Participation in Maize Production in Kaduna Sate, Nigeria, 18(1):1-11.

Planton, serge, (France; editor) (2013). "IPCC", fifth assessment report p.145

Rahman, S.A and J.I Usman (2004): comparative analyzes of women participation in agricultural production in Northern and Southern Kaduna state, mobilizing investors for sustainable agricultural research development and production in Nigeria. Proceedings of the 30th annual conference of the agricultural society of Nigeria head at the college of Agriculture Lafia, Nasarawa state, October 17th-21st p103-113.

Salawu, A.S (2001). An evaluation of development communication content of Yoruba Newspapers, Ph.D. thesis, University of Ibadan, Nigeria.

Schlenker W. and Lobell D.B (2010). Robust negative impacts of climate change on African agriculture. *Environ Research Letters* 5(1):014010, 8pp

Shehu, U. A, Ibrahim, A, Hassan, T, and Bello, M. (2017). Analysis of Resource Use

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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Impact of Information on Improved Technologies on the Productivity of Small-Scale Farmers in Kwara State

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ABSTRACT

Low productivity and income of farmers has been ascribed to lack of adequate information and low utilization of improved technologies among small-scale farmers in Nigeria. Therefore, this study assessed the impact of information on improved technologies on the productivity of small-scale farmers in Kwara State. A three-stage random sampling technique was used to select 120 respondents. Data were collected through structured questionnaires and analysed using descriptive and inferential statistics. The study showed that the use of extension agents as a source of information on improved technologies was ranked first (mean= 3.56), and herbicides were found to be the most used among the selected improved technologies (mean = 3.63). Age, education, farming experience, and membership of a cooperative society were identified to be positively significant as factors determining the source of information used by farmers in accessing improved technologies at 5% level. The use of improved technologies had a positive and significant effect on the productivity of farmers. Inadequate capital (46.7%), illiteracy (35.0%) and poor access to improved technologies (29.2%) were severe constraints hindering the usage of improved technologies. Therefore, it is recommended that Agricultural programs should be aired in the local languages of farmers, for better understanding of information passed on technologies and practices.

Keywords: Information, improved technologies, productivity and small-scale farmers

INTRODUCTION

Agriculture plays a crucial role in the economy of developing countries with the majority of the population deriving their livelihood from the agricultural sector. Access to agricultural information plays a pivotal role in facilitating and enhancing the progress of agriculture and consequently determining the degree of productivity (Ndimbwa et al., 2020; Soyemi and Haliso, 2015).

The adoption of technological innovations in agriculture has garnered significant attention among development economists as it offers opportunities to increase production and productivity. Technological advancements in agriculture have the potential to revolutionize farming methods, improve farmers' access to marketing information, and ultimately enhance farm productivity. The adoption of innovative agricultural technologies can have a transformative effect on the lives of farmers in developing countries (Khanal et al., 2020).

The adoption of novel agricultural methods relies on the accessibility of information pertaining to such particular agricultural methods. For a new innovation to be embraced, farmers must be educated about its existence, application, and effects on their overall productivity levels. Agricultural information is the cornerstone of successful farmers' socio-economic development because it plays a key role in the access to and use of agricultural information for agricultural inputs, new innovations, market price,

transportation systems of yield, environmental protection techniques and practices, new agricultural technologies, food processing, and preservation (Mtega,2012).

Before the advent of modern information technology, farmers depended exclusively on extension agents and fellow farmers for acquiring agricultural knowledge. However, this source of information had a notable drawback in terms of the disparity between the number of farmers and available extension agents, as well as concerns regarding the reliability and credibility of information received from other farmers.

Numerous studies have emphasized the importance of access to timely and relevant information for small-scale farmers in improving agricultural practices and enhancing productivity.

One of such studies was the study by Kaske et al. (2017) who suggests that if we are to see substantial development in the agricultural sector, we have to ensure farmers' access to timely, reliable, and relevant agricultural information. As such, prosperity in the sector significantly depends on smallholder farmers' ability to access, acquire, and use relatable agricultural information (Ndimbwa et al., 2019).

Although there have been numerous advancements in information technologies and the availability of agricultural knowledge from various sources, smallholder farmers are not experiencing the full impact of these improvements. This lack of impact can be attributed to inefficiencies in communication and sharing of agricultural information among households. (Assefa, 2016).

In order for Nigeria farmers to compete effectively with farmers in other countries, there is a need to have adequate information and proper knowledge of improved technologies since the significance of information cannot be over emphasized on modern agriculture.

Therefore, the main objective of this study was to address the knowledge gaps that still exist concerning the effect of information on improved technologies on the productivity of small-scale farmers in Kwara state. The specific objectives were to:

1. measure the level of usage of improved technologies among small-scale farmers;
2. assess the sources of information available to the farmers in the study area;
3. examine the factors affecting the usage of the various sources of information on improved technology;
4. examine the impact of the usage of improved technologies on crop productivity; and
5. identify the constraints that hinder the use of improved technologies.

METHODOLOGY

Study Area

This study was carried out in the Kwara State, Nigeria. The state lies between atitudes 8° 30′N and longitude 4° 45'E (NBS, 2016). With a population of about2.37 million (NPC, 2006). Kwara state consists of 16 Local Government Areas and has a total land area of about 36,825 square kilometres with a total projected population of 4,719,844 people in 2021, and the large majority of individuals work in small-scale farming (NPC, 2022).

The state shares boundary with Osun, Ondo, Oyo, Kogi and Niger States in Nigeria and also an international border with the Republic of Benin along the north-western region of the country (Christiou, 2001).

The two main seasons in Kwara state are wet season which span between early April to late October and dry season between November to late March. The annual rainfall ranges from 1000 to 1500 millimetres and the average temperature ranges between 30 and 35 °C (Kwara State Ministry of Environment and Forestry, 2020).

Sampling Procedure

The sampling procedure involved three-stage sampling techniques; the first stage involved random selection of one (1) Local Government Area from each of the four (4) Agricultural Development zones; Kaiama (zone A), Patigi (zone B), Asa (zone C) and Ifelodun LGA from (zone D). The second stage involved random selection of twelve (12) farming communities; with three communities randomly selected from each (LGA). Third stage involved the random selection of ten (10) respondents from each of the selected farming communities. The sample size covered a total of 120 respondents.

Data Collection

The data used in this study were mainly primary data, collected through a well-structured questionnaire and supplemented with oral interviews with the respondents. Variables measured include socio-economic characteristics, sources of information on improved technologies, impact of improved technologies on productivity. Information on constraints affecting the use of different sources of information were also obtained.

Data Analysis

Data obtained were analyzed using descriptive and inferential statistical tool. The level of usage of improved technologies and sources of information on improved technologies were analyzed using the descriptive statistics while a 5-point Likert scale was used to measure the constraints hindering the usage of improved technologies. Multinomial logit model was used to examine the factors affecting the usage of the various sources of information on improved technologies.

The model is specified below:

$Y_t = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8\ e)$

Where;

Y_t = Sources of information on improved technology (t= number of information sources)

X_1 = Age of respondent (years)

X_2 = Household size (number)

X_3 = Educational status of respondent (years)

X_4 = Farming experience (years)

X_5 = Sex (1=if male, 0= female)

X_6 = Marital status (1=if married, 0=if otherwise)

X_7 = Cooperative membership (1=if yes, 0=if otherwise)

$X_{8=}$ Primary occupation (1=if farming, 0=if otherwise)

e = error term

Impact of usage of improved technology on productivity of farmers was analysed using analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

Socioeconomic Characteristics of Respondents

The socioeconomic characteristics of respondents are presented in Table 1.

The distribution of the respondents by gender shows that, 65% of the sampled respondents belong to the male gender group while the remaining 35% were from the feminine gender group. This shows the dominance of male in the study area.

The distribution of respondents based on their age indicates that 43.3% of the respondents were found to belong to the active agricultural age group of 41 – 50 years. This is a good indication as most of the captured respondents are still actively involved in agriculture. This differs from the findings of Afodu et al, (2021) who found that 30-39 age group were the active age where youthful energy permits people to exert a lot of agility on the farm and are most likely to adopt technologies.

It was discovered that only 15% of the respondents were single, 52.5% were married which is the most captured marital status in the study area.

The educational background of the respondents revealed that majority (45%) of the population had primary school certificate as their highest level of education, 33.3% had secondary education and 21.6% of the respondents were with no formal education. This implies that the majority of the farmers were illiterate. Since majority of the respondents were not well educated, it is expected that they would be

reluctant to adopt any technology brought to them. This corroborates the findings by Olumba and Rahji (2014) that the educational status of farmers positively influences their adoption of improved technologies.

In relation to the household size, majority of respondents (71%) were found to have a household size of 1 – 10 persons. Large household size is an indication that family labour is readily available. This result is similar to the findings of (Udemezue, 2013) who reported that the greater the number of helping hands a farmer has in his farm will motivate him to cultivate more hectares.

The occupation prevalent in the study area was found to be farming as 54.2% of the respondents were actively involved in farming as their primary occupation. 7.5% of the respondents were found to involve in activity other than farming, trading and civil service. The involvement of the respondents in farming activity was grouped into major and minor. Respondents' majoring in farming is 54.2% while 45.8% minor in farming activities.

Larger proportion (71%) of respondents had 1 – 10 years of farming experience while only 14.2% had above 20 years of farming experience.

49.2% of the respondents belong to a cooperative society while 50.8% of the respondent were non-member of a cooperative society. This shows that majority of the respondents didn't belong to a cooperative society despite the fact that farming is their major occupation and are actively involved with farming as their primary occupation.

Table 1: Socioeconomic Characteristics of the Respondents

Characteristics	Frequency	Percentage
Sex		
Male	78	65
Female	42	35
Age (Years)		
21 - 30	9	7.5
31 – 40	34	28.3
41 – 50	52	43.3
>50	25	20.8
Marital status		
Single	18	15
Married	63	52.5
Widowed	21	17.5
Divorce	18	15
Education status		
No formal education	26	21.6
Primary education	54	45
Secondary education	40	33.3
Household size		
1 – 10	71	59.2
11 – 20	40	33.3
>20	9	7.5
Primary occupation		
Farming	65	54.2
Trading	25	20.8
Civil servant	21	17.5
Others	9	7.5
Level of involvement in farming		
Major	65	54.2
Minor	55	45.8
Farming experience (years)		
1 – 10	71	59.1
11 – 20	32	26.7

>20	17	14.2
Membership of cooperative societies		
Yes	59	49.2
No	61	50.8
Total	**120**	**100**

Source: Field survey, 2016

LEVEL OF USAGE OF IMPROVED TECHNOLOGIES

The types of improved technologies selected for the purpose of this research were improved seeds, fertilizer, herbicide, tractor, irrigation, zero tillage and spacing technique. From the result obtained from the study, it was observed that the use of herbicide ranked first with a mean of 3.63 in their usage by farmers in the study area. It was discovered that 65.8% of the farmers were found to always use the technology in their farming activities with only 0.8% of the farmers acknowledging their non-usage of herbicide in their farming operations.

The use of improved seed ranked second with a mean of 3.43 based on the farmers usage of the technology, no farmer was found not using improved seeds on their farm. 42.5% of the farmers agree to always using improved seed in their farming operations. This might be as a result of the level of work that have been implemented in the development of the seeds, which might make the seeds to be disease resistance, and 57.5% of the farmers agree to the occasional usage of the improved seed technology as a part of their farming operation. No farmer was also found to be rarely using improved seeds technology.

Spacing technology with a mean value of 3.22 ranked third on the farmers usage of the technology in the study area. 46.7% of the farmers agreed to always using the technology, while 4.2% agreed to rare usage of the technology. The technology with the mean value of ranked fourth. Use of fertilizer was ranked fourth with a mean value of 2.64, 25% of the respondents agreed to always use the technology on their farms, while 37.5% of the farmers rarely use fertilizer.

The least used of all the selected technology was the irrigation method which had a mean of 2.05, with farmers as high as 59.2% agreeing to their rare usage of the technology. This might be as a result of the capital outlay involved in the acquisition of the technology and the high maintenance cost accompanying the usage of the technology.

Table 2: Level of Usage of Improved Technologies

Improved Technologies	Always Freq. (%)	Occasionally Freq. (%)	Rarely Freq. (%)	Not at all Freq. (%)	Mean	Rank
Improved seeds	51 (42.5)	69 (57.5)	0 (0.0)	0 (0.0)	3.43	2ND
Fertilizer	30 (25.0)	31 (25.8)	45 (37.5)	14 (11.7)	2.64	4TH
Herbicide	79 (65.8)	38 (31.7)	2 (1.7)	1 (0.8)	3.63	1ST
Tractor	24 (20.0)	30 (25.0)	55 (45.8)	11 (9.2)	2.55	5TH
Irrigation	5 (4.2)	20 (16.7)	71 (59.2)	24 (20.0)	2.05	7TH
Zero tillage	15 (12.5)	40 (33.3)	48 (40.0)	17 (14.2)	2.44	6TH
Spacing	56 (46.7)	47 (39.2)	5 (4.2)	12 (10.0)	3.22	3RD

Source: Field survey, 2016.

Table 3: Sources of Information Available to Farmers

Source of information	Always Freq. (%)	Often Freq. (%)	Rarely Freq. (%)	Not at all Freq. (%)	Mean	Rank
Friends/family	69 (57.5)	30 (25.0)	9 (7.5)	12 (10.0)	3.30	4TH
Television	32 (26.7)	48 (40.0)	3 (2.5)	37 (30.8)	2.63	6TH
Newspaper	16 (13.3)	25 (20.8)	23 (19.2)	56 (46.7)	2.01	7TH
Other farmers	87 (72.5)	11 (9.2)	2 (1.7)	20 (16.7)	3.38	2ND
Extension agents	78 (65.0)	30 (25.0)	9 (7.5)	3 (2.5)	3.56	1ST
Radio	85 (70.8)	11 (9.2)	5 (4.2)	19 (15.8)	3.35	3RD
Mobile phones	46 (38.3)	26 (21.7)	8 (6.7)	40 (33.3)	2.65	5TH

Source: Field survey, 2016.

SOURCES OF INFORMATION ON IMPROVED TECHNOLOGIES AVAILABLE TO FARMERS

The information source sometimes determines the credibility, reliability and acceptance of the information. And it is a common belief that information is life, without information, live seizes to exist. Information is needed to make decisions on farm operation and information is also the fuel of development. Farmers adopting improved technologies and practices typically rely on particular information sources before their adoption; their choice is motivated either by the perceived quality of the information or by the trust they have in the source.

For the course of the study, the information sources selected are radio, television, newspaper, mobile phones, extension agents (EA), family/friends and other farmers. These are not the only information source, but these were selected based on the scope of the study.

From the result in Table 3, the use of extension agents ranked first as majority of farmers; about 65% make use of this medium as a source of information on improved technologies. The high percentage of farmers who make use of extension agents could be as a result of the ability of these farmers to have face-to-face contact with this source of information. This indicates that other respondents preferred to exchange agricultural information within themselves and also via direct contact with extension officers. Such finding implies that still, the methods used by some of the farmers are ineffective because it takes time for agriculture information to spread from farmer to farmer, and also original information can be altered during the process of passing it from the first person to the last one, also, agricultural information can reach to users as secondary or passive and that can affect the quality of the intended message from the source. This finding is related to the 2017 FAO report which revealed that farmers get information through extension officers and farmer to farmer exchange. This could also be attributed to the fact that no cost implication is involved in using this source of information.

The use of other farmers ranked second with 72.5% of the respondents agreed to always using fellow farmers as a source of information. The use of radio ranked 3rd with about 70.8% of the farmers agrees to always using this medium in getting information on improved technologies.

The use of family/friends ranked 4th with about 57.5% of the sampled respondents agrees to always using this source of information. At the 5th position is the use of mobile phones with about 38.3% while the use of the use of television ranked 6th with about 26.7% of farmers make use of this source of information.

The use of newspaper ranked 7th with about 13.3% of farmers agreed to always using this source of information. This could be associated with the illiteracy of farmers and the information provided by this medium is not available in local languages of rural farmers.

FACTORS INFLUENCING USAGE OF INFORMATION SOURCES ON IMPROVED TECHNOLOGIES

In order to identify the determinants of usage of information sources, multinomial logit model was fitted to determine farmers' preference of one information source over another. According to the model, the decision to choose a particular information source were determined using their socioeconomic characteristics such as sex, age, marital status, educational level, household size, level of involvement in farming, farming experience and membership of cooperative society. Further analysis to determine

the proportion of the effect of the factors on the usage of the information sources was provided by analyzing the marginal effects.

The sources of information available to the farmers were grouped into five;

- Electronic media which consist of radio and television
- Mobile phone;
- Extension agents and;
- One-on-one interaction which consist of family/friends and other farmers;
- Print media: Newspaper as base outcome

As shown in the multinomial logit result presented in Table 4, four socioeconomic characteristics (age, education, farming experience, cooperative membership) were significant factors influencing choice of information source on improved technologies.

To begin with, age of the farmers had a negative and significant effect on the usage of electronic media and negatively significant for mobile phones as a source of information on improved technologies at 5%. The negative coefficient of age indicates that the probability of using mobile phone as a major source of information on improved technologies decreases with age relative to the base category at 0.15% base on the result of the marginal effect presented in Table 4. This implies that younger farmers are likely to prefer use of mobile phones as source of information on improved technologies.

On the other hand, the negative coefficient indicates that age reduces the probability that respondents would remain in category 1 (electronic media). This implies that the probability of older farmers using electronic media reduces with age at 3.6% as obtained from the marginal effect result. This could be attributed to the fact that as age increases; a farmer's planning horizon shortens, making the farmer less likely to spend time and/or money searching for information about new technologies.

Duration of farming experience is negatively significant to the usage of mobile phone and one-on-one interaction with other farmers at 5% as sources of information on improved technologies. The result of the marginal effect indicates that farming experience reduces the probability of using mobile phone at 0.13% and one-on-one interaction at 0.09% relative to the base category. This could be attributed to the fact that the longer the farming experience, the less farmers search for information on improved technologies since they are adapted to the old ways of doing things. This result supports the finding from Schnitkey *et al*. (1992) who reported that age is correlated with farming experience and it is possible that as experience with improved farming technology increases, the utility from improved technology information-source use decreases, given that information had already been acquired through experience.

Education of farmers had a positive impact on the usage of all the sources used in acquiring information about improved technologies at 5%. Years of formal education attained by respondents increased the probability of using all the available sources of information on improved technologies relative to the base category. This implies that farmers with higher level of education are more likely to use electronic media, print media and mobile phone as major sources of information. On the other hand, farmers with low level of formal education are less likely to select the mentioned sources instead they would prefer to use extension agents and other farmers as major source of information on improved technology.

The result of the current research reveals that farmers with higher education level tend to use different sources in accessing information on improved technology. This goes in line with the findings of Just *et al*. (2002) who reported that farmers with more education may have more analytical capability to use unprocessed information and translate it into an input used to make productive decisions. Therefore, farmers with higher levels of education are more likely to make informed decision on improved technologies in order to boost their production.

The positive coefficient of membership of cooperative society increases the probability of using any of the sources of information on improved technologies at 5% significance level. Being a member of cooperative society increases the probability of using mobile phone, extension agents and one-on-one interaction with other famers. This could be attributed to the fact that Cooperative is regarded as an instrument for socioeconomic transformation. Agricultural cooperatives are also responsible for educating farmers on how to enhance their productivity and subsequently farmers' income. In view of this, they educate farmers on the invention of new improved technologies. It also increases farmers

awareness of improved technologies and consequently increases their search for information on improved technologies in order to boost their productivity.

Table 4: Multinomial Logit Estimation Result for Factors Influencing Usage of Information Sources

Characteristics	**Category 1 (electronic media)**		**Category 2 (mobile phone)**		**Category 3 (extension agents)**		**Category 4 (one-on-one interaction)**		**Base outcome**
	Coefficient (marginal dy/dx)	z	Coefficient (marginal dy/dx)	z	Coefficient (marginal dy/dx)	z	Coefficient (marginal dy/dx)	z	
Sex	1.4162 (0.2013)	1.76	0.0062 (0.1375)	0.01	0.5771 (0.0245)	0.78	0.3216 (0.0087)	0.35	-2.3211
Age	-0.2055** (-0.0363)	2.00	-1.0230** (-0.0015)	-2.79	0.0205 (0.0249)	0.28	-0.0584 (-0.0009)	-0.69	-0.8554
Marital Status	-0.0809 (-0.1317)	-1.08	0.5575 (0.0190)	1.07	0.1192 (0.0965)	0.23	0.9109 (0.0235)	1.40	-1.5067
Education attained	0.6000** (0.0257)	-1.86	0.3718** (0.0344)	-1.17	0.7724** (0.0722)	-2.43	0.7685** (0.0152)	-1.97	-2.5127
Household size	0.0529 (0.0048)	0.56	-0.0084 (-0.0117)	-0.09	0.0715 (0.0099)	0.78	0.0759 (0.0024)	0.66	-0.1919
Involvement in farming	0.1268 (-0.0967)	0.18	0.9892 (0.1229)	1.31	0.5239 (0.0067)	0.73	1.6461 (0.0529)	1.42	-3.2860
Farming experience	-0.0359 (-0.0052)	-0.45	-0.0101** (-0.0013)	-0.12	-0.0468 (-0.0084)	-0.61	-0.1632 (-0.0099)	1.88	0.2560
Membership of cooperative	0.4599 (0.0469)	0.64	0.5468 (0.0294)	0.75	1.0299** (0.0958)	1.45	2.0544** (0.0829)	2.14	-4.0910

The reference category is newspaper
** Regression is significant at 5%
Number of observation =120
LR chi^2 (32) = 87.76
Probability > chi^2 = 0.0000
Log likelihood = -143.80059
Pseudo R^2 = 0.2338

IMPACT OF IMPROVED TECHNOLOGIES ON PRODUCTIVITY

The productivity of the farmer in relation to their level of usage of improved technologies was measured with analysis of variance. The farmers were placed in the respective groups based on their level of usage of improved technologies.

The result indicates a change in the level of output of the productivity of the farmers across the groups based on their level of usage of improved technology.

From the result presented in Table 7, the low and medium users of improve technology were found to have similar outputs with the high users having the highest output. The implication of this result is that the output of the farmers using improved technologies the least is lowest when compared with the output of the medium and high users though the difference in the output of the medium and low users was not high enough to cause a significant difference at $p < 0.05$.

From the result, it can be seen that the use of improved technologies in the farm practices of the farmers enhance production. This is evident in the mean output of the various production groups. This shows the relevance of advances made in the invention of improved technologies on the productivity of the farmers in the country.

Table 5: Impact of Improved Technology on the Productivity of Farmers

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4.588E11	2	2.294E11	38.839	.000
Within Groups	6.911E11	117	5.907E9		
Total	1.150E12	119			

GROUP	OUTPUT
Low users	141750[a]
Average users	186750[a]
High users	316570[b]

Outputs group with different superscripts are significantly different at $p < 0.05$

CONSTRAINTS HINDERING USAGE OF IMPROVED TECHNOLOGIES

Different constraints were faced by farmers while accessing improved technologies but a few of these were selected for the purpose of this study which were illiteracy of farmers, insufficient capital, poor access to improved technologies, lack of technical know-how and adaptability of improved techniques to the local environment. The constraints were ranked according to the mean value.

From the result presented in Table 5, it was observed that the major challenge faced by the respondents in the use of improved technologies was inadequate capital with mean of 4.26. This constraint was ranked 1st, about 46.7% of farmers strongly agreed to the severity of this constraint while just 2.5% strongly disagree to the severity of insufficient capital as a constraint hindering the usage of improved technologies. This corresponds with the findings of Okonji and Awolu (2020) who reported that inadequate capital constituted a very serious constraint to accepting improved technologies in maize production.

Illiteracy of farmers ranked second with mean of 4.15 with about 35% of farmers strongly agreed to the severity of illiteracy among the rural farmers as a constraint hindering the use of improved technologies and about 5.8% disagreed to the severity of illiteracy.

About 29.2% of farmers strongly agreed to the severity of poor access as a major factor hindering the usage of improved technology.

Table 6: Constraints Hindering the Usage of Improved Technologies

Constraints	SA Freq. (%)	A Freq. (%)	N Freq. (%)	D Freq. (%)	SD Freq. (%)	MEAN	RANK
Capital	56 (46.7)	48 (40.0)	10 (8.3)	3 (2.5)	3 (2.5)	4.26	1ST
Poor access to improved technologies	35 (29.2)	66 (55.0)	6 (5.0)	6 (5.0)	7 (5.8)	3.97	3RD
Lack of technical-know-how	30 (25.0)	62 (51.7)	11 (9.2)	7 (5.8)	10 (8.3)	3.79	4TH
Illiteracy	42 (35.0)	63 (52.5)	8 (6.7)	7 (5.8)	0 (0.0)	4.15	2ND
Adaptability	21 (17.5)	39 (32.5)	13 (10.8)	28 (23.3)	19 (15.8)	3.13	5TH

Source: Field survey, 2016.

CONSTRAINTS HINDERING THE USAGE OF THE VARIOUS SOURCES OF INFORMATION

From the survey, seven (7) problems were identified; the constraints were ranked based on their mean value. The identified constraints include cost of accessing information, poor radio and television signal, inadequate to lack of rural electricity, odd hours of agricultural information aired on the radio and television, language of presentation, problem of reliability of information source and inability to read and write. Five-point Likert scale was used to determine the relative severity of each of the identified constraints.

Table 7: Constraints to the usage of information sources on improved technologies

Constraints	VS Freq. (%)	S Freq. (%)	N Freq. (%)	MS Freq. (%)	NS Freq. (%)	Mean	Rank
Cost of accessing information	34 (28.3)	22 (18.3)	0 (0.0)	29 (24.2)	35 (29.2)	3.48	3RD
Poor radio and television signal	28 (23.3)	8 (6.7)	10 (8.3)	25 (20.8)	49 (40.8)	2.96	6TH
Inadequate to lack of rural electrification	39 (32.5)	31 (25.8)	1 (0.8)	38 (31.7)	11 (9.2)	3.80	2ND
Odd hours of agricultural information aired on radio and television	11 (9.2)	17 (14.2)	13 (10.8)	38 (31.7)	41 (34.2)	2.77	7TH
Language of presentation	22 (18.3)	27 (22.5)	1 (0.8)	16 (13.3)	54 (45.0)	3.13	5TH
Problem of reliability of information source	19 (15.8)	44 (36.7)	0 (0.0)	32 (26.7)	25 (20.8)	3.46	4TH
Inability to read and write	27 (22.5)	35 (29.2)	0 (0.0)	15 (12.5)	43 (35.8)	3.83	1ST

Source: Field survey, 2016.
VS = Very Severe
S = Severe
N = Neutral
MS = Mildly Severe
NS = Not Severe

From the results presented in Table 4, illiteracy of farmers ranked 1st with a mean value of 3.83 among the identified constraints. About 22.5% of farmers consider illiteracy as very severe constraints while majority of respondents 35.8% consider this as not severe. This probably affected their decision in sourcing information from printed media since no newspaper presents agricultural information in local languages understand by the farmers.

The problem of inadequate rural electricity ranked 2nd with mean value of 3.80, about 32.5% of farmers consider this constraint as very severe while 25.8% consider it as a severe constraint. About 31.7% of respondents identified this as mildly severe while 9.2% agreed to the non-severity of this constraint. Erratic power supply experienced by the farmers in the study area could be a big handicap to the effective utilization of mass media and electronic media by famers. This outcome explains the constraints faced by farmers in accessing information from mobile phone, television and radio as majority of the farmers complained of no electricity to charge their mobile phones or watch agricultural programs on television set.

The cost of accessing information ranked 3rd with a mean value of 3.48 on the scale of severity. It was observed that about 28.3% of farmers consider the cost of accessing information as a very severe constraint while 18.3% respondent identified this as severe constraints. This probably influenced their decision of which medium to use in seeking information about improved technologies. This explains why majority of the farmers prefer extension agents to other sources of information since no cost implication is involved in using this medium.

Therefore, level of education, inadequate to lack of rural electricity and inadequate fund were identified to be the major constraints faced by farmers in accessing agricultural information on improved technologies.

Conclusion

Based on the outcome of the research it can be concluded that the adoption of improved technologies has a beneficial and substantial effect on productivity, although the magnitude of this impact is directly related to the extent to which these improved technologies are employed.

From the research findings majority of the sampled respondents primarily depend on extension agents for information on improved technologies. This is due to the fact that media broadcasts and publications do not generally present information in local languages spoken by rural farmers. The study identified capital, illiteracy and poor access to improved technologies as major setbacks hindering the usage of improved technologies.

Recommendations

Based on the findings of this study, the following recommendations are made; Agricultural programs should be aired in the local languages of farmers, for better understanding of information passed on technologies and practices. It is also recommended that farmers should be motivated to form agricultural societies; this will help address the problem of insufficient fund faced by farmers in accessing improved technologies.

Government should make effort to address the technological needs of the rural farmers by providing improved technologies to farmers at subsidized rate. This will greatly improve the productivity of farmers and consequently their overall standard of living.

REFERENCES

Afodu, O.J., Akinboye, O.E., Akintunde, A.O., Ndubuisi-Ogbonna, L.C., Shobo, B.A., Oyewumi, O.S., (2021). Assessing The Impact of Technology Adoption on Productivity of Plantain Farmers in Nigeria, Agricultural SocioEconomics Journal, 21(4), 319-324 http://dx.doi.org/10.21776/ub.agrise.2021.021.4.8

Assefa, M. (2016). Access to and utilization of agricultural information by smallholder coffee farmers in deder district, eastern harangue zone, Oromia national regional state. Thesis, haramaya University, Haramaya, Ethiopia.

Just D., Wolf S.A., Wu S. and Zilberman, D.. 2002. "Consumption of Economic Information in Agriculture." *American Journal of Agricultural Economics* 84(1): 39-52.

Kaske, D., Mvena, Z., & Sife, A. (2017). Mobile phone usage for accessing agricultural information in Southern Ethiopia. *Journal of Agricultural and Food Information, 19*(3) 284-298. https://doi.org/10.1080/10496505.2017.1371023

Khanal, A., Regmi, P. P., Kc, G. B., Kc, D. B., & Dahal, K. C.. (2020, January 1). Factor Affecting Adoption of IPM Technology; an Example from Banke and Surkhet District of Nepal. https://scite.ai/reports/10.11648/j.ijae.20200506.19

Kwara State Ministry of Environment and Forestry. (2020). Retrieved from https://kwarastate.gov.ng/ministry/lorem-ipsum/

Mtega, Wulystan P. (2012). Access to and usage of information among rural Communities: a cases study of Kilosa District Morogoro Region in Tanzania. Volume 7, No.1, the Canadian journal of Library an information Practice and Research.

Ndimbwa, T, Ndumbaro, F., & Mwantimwa, K. (2019). Delivery mechanisms of agricultural information and knowledge to smallholder farmers in Tanzania: a meta–analysis study. *University of Dar es Salaam Library Journal, 14*(2), 87-98. https://www.ajol.info/index.php/udslj/article/view/203821

Ndimbwa, T., Mwantimwa, K., & Ndumbaro, F. (2020). Channels used to deliver agricultural information and knowledge to smallholder farmers. IFLA Journal, 47(2), 153-167. https://doi.org/10.1177/0340035220951828.

NBS (2016). Annual abstract of statistics. National Bureau of Statistics. Federal Republic of Nigeria, FCT, Abuja, p 3.

NPC (2022). Projected population of Kwara State in 2021. National Population Commission. Retrieved from https://nationalpopulation.gov.ng/

Olumba, C. C., & Rahji, M. A. Y. (2014). An analysis of the determinants of the adoption of improved plantain technologies in Anambra State, Nigeria. Journal of Agriculture and Sustainability, 5(2).

Schnitkey, G., M. Batte, E. Jones, J. Botomogno. 1992. Information preferences of Ohio commercial farmers: Implications for extension. *American Agricultural Economics Association.* 74: 486-497.

Soyemi, O, D., & Haliso, Y. (2015). Agricultural information use as determinant of farm income of women in Benue State, Nigeria. *Research on Humanities and Social Sciences, 5*(18), 1-6. https://www.iiste.org/Journals/index.php/RHSS/article/view/26076.

Udemezue, J. C. (2013). Adoption of Faro-44 rice production technologies by farmers in Anambra State. Unpublished M.Sc thesis submitted in the Department of Agricultural Extension, University of Nigeria, Nsukka.

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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Effect of Farmer-Herder Conflict on Food Security of Pastoral and Agro-Pastoral Households in Kwara State, Nigeria

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Abstract

Inspired by the low food security status and vulnerability among pastoral and agro-pastoral households, we estimated pastoral-farmer conflict, determined food security status, appraised the outcome of pastoral- farmer conflict on food security and describe the survival game plans adopted by pastoral and agro-pastoral households to alleviate the effect of food insecurity in Kwara state, Nigeria. Purposive and random sampling methods were deployed to choose 120 respondents. The main tools of analysis are descriptive statistics, food safety index and logistic regression. The study showed that 37.2.5% of respondents were food secure while 62.8% were food insecure. In addition, pastoral-farmer conflict, age, herd size, migration, distance to grazing area, and number of animals sold to alleviate the outcome of food insecurity were the important drivers of food security in the area. Moreover, selling of animals, embracing litigation, being industrious, herders' experience, agro-pastoralism, satisfying other parties and seeking for supports from friends, relatives and government are the most effective survival game plans adopted by households. In view of the foregoing, government must encourage ranching and adoption of Rural Grazing Area (RUGA) to mitigate pastoral-farmer conflict. Schemes and game plans designed at increasing herd size should be supported.
Keywords: Fight, food safety index, pastoralist, RUGA settlement and survival game plans

1. Introduction

Pastoralism is a process of flocking animals while the pastoralists are those whose main sustenance is livestock flocking (Bhasin, 2011). The Fulani ethnic group are traditional pastoralists and they possessed most of the livestock in Nigeria. They are found within arid and semi-arid regions and migrate from one part of the country to another hunting for grasses and water for their animals and in the process farmers' plots are damaged leading to conflicts between farmers and herders.

Pastoral-farmer conflict is still frequent in most parts of the country (Shehu *et al*; 2020). Conflict is a fight between competing users (Dietz and Albert, 2016). It could could be facilitated by increasing population and climatic changes, which have forced farmers to plough more lands that are meant for grazing and cattle routes thereby causing more enmity among the users. The tenacious opposition between herders and farmers however, have resulted into detestation, bitterness and commotions in substantial parts of the country. This fight have grown tremendously, open out and escalate over the last five years and today constitutes a serious threat to our national existence. Many people were maimed, villages were burnt and so many users lost their lives and properties due to conflict. Frequent retaliation

attacks and murdering aggravates the harmonious resolution of the conflicts. Community intimidation and organized crimes are becoming the standard and have escalated into a fatal illegal activity. Consequently, losses have been on the increase and the victims are on both sides (Shehu *et al*; 2020). Conflicts have indicated high tremendous ability to worsen the food crisis, disrupt free movement and harmonious relationship that exists among the different resource group users in the country (Moritz, 2016).

Food security exists when sufficient, safe, and nutritious food is available to a target population at all times, so that basic dietary needs for a healthy and active life are met (FAO, 2006). Food must be obtainable, attainable and well make use of for food security to occur at all levels. Food obtainability means that adequate, safe and nourishing food is either locally manufactured or imported. Food attainability may not translate to food attainability. For food to be attainable, farmers and pastoral households must have enough purchasing power to purchase required amount and standard food items at all times. Furthermore, food utilization entails consuming adequate amount and standard food intake (Shehu, *et al*; 2019). Food insecurity emerges when there is poor food availability, accessibility and utilization. Food insecurity if left unaddressed, could raise susceptibility to illness and lowers productivity.

Food insecurity is still a threat among pastoral and crop farming households in Nigeria (Shehu *et al.,* 2020). The incessant fights between these two agricultural resource-users over rangeland resources, worsen food insecurity situations in the country. Numerous studies have emanated on factors influencing food security of farming households (Agwu 2014; Ahmed *et al.*, 2016; Shehu *et al.*, 2020; Shehu *et al.*, 2022). Surprisingly, data quantifying the outcome of conflict on food security of pastoral households are rare in the literature. Thus, this research was done to provide answers to the following research questions:

Research Questions:
1. What is the value of loses due to conflict per respondent?
2. What is the food safety index of respondent?
3. What is the influence of conflict on food safety index?
4. What are the survival game plans deployed by pastoral and agro-pastoral households?

Objectives of the Study
The specific objectives are to:
i. quantify loses due to conflict among respondents
ii. measure the food security status of the respondents
iii. determine the influence of conflict on food security
iv. identify the survival game plans deployed by respondents in the area.

2. Materials and methods

2.1. Study area

This study was done Kwara located on latitude (8Â° and 10Â°N) and longitudes (3Â° and 6Â°E). It is within the North Central Nigeria. It is bordered in the east, south, north and west by Kogi, Osun, Niger, and Republic of Benin respectively. The mean temperature and rainfall falls within 27ºC - 35ºC and 1,000-1,500mm respectively. The state has wet and dry seasons. The wet season comes within April-October while the dry season falls within November-March. The state is blessed with large volume of water bodies with an evaluated population of 3.2 million (NPC, 2016). The state is classified into four using ecological, cultural and agriculturl project administrative amenity. These are: Zone A: Baruteen and Kaima Local Government Areas (LGAs); Zone B: Edu and Patigi LGAs; Zone C: Asa, Ilorin East, Ilorin South, Ilorin West and Moro LGAs and Zone D: Ekiti, Ifelodun, Irepodun, Offa, Oyun, Isin and

Oke-Ero LGAs (KWADPs, 2010). Kwara inhabits people of different traditions, cultures and ethnic backgrounds such as: the Yorubas, Hausas, Fulanis, Nupes and Barubas (Figure1).

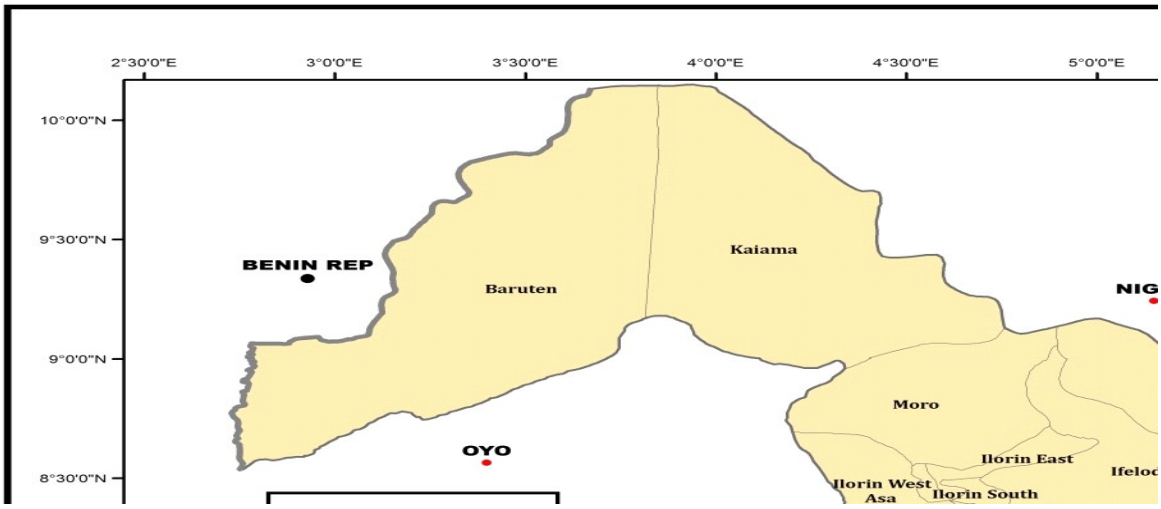


Fig 1. Map of Kwara state

2.2. Data collection and sampling methods

Kwara had experience many cases of pastoral-farmer conflict in the last few years. The state has 16 local government areas (LGAs), 10 out of 16 LGAs are frequently linked with the conflict (Adisa, 2012). Firstly, 6 LGAs out of the 10, were chosen at random, namely: Asa, Patigi, Ifelodun, Ekiti, Isin, and Oke-EroLGAs. Therafter, villages where conflicts are well pronounced were picked, purposively. Hence, Alapa in Asa, Oro Ago in Ifelodun, Motokun in Patigi, Obbo Aiyegunle in Ekiti ,Isanlu-Isin in Isin and Odo-Owa in Oke-Ero LGAs were selected. The lists of all concerned pastoral and agro-pastoral household heads were gotten from the village leaders and 20 persons were picked at random from each village to make up 120 respondents.

2.3. Analytical techniques

This study deployed descriptive statistics, food safety index and logistic regression to attain the objectives. To describe the socio-economic features and the adopted survival game plans, statistical tools and a Likert type-scale were deployed respectively. The classification into food secure and food insecure was done using food safety index as shown below:

$$Si = \frac{PFC}{2/3MPFC} \qquad [1]$$

Where:
Si = food safety index
PFC = per capita food costs
$MPFC$ = mean per capita food costs

If $Si \geq 1$= household is said to be food secured and if $Si < 1$= household is food in secured (Salau *et al.*, 2019).
Binary logistic regression model was deployed to verify the outcome of pastoral-farmer conflict on households' food security as shown below:

$$Q = ho + h_1p_1 + h_2p_2 + \cdots + h_kp_k + u \qquad [2]$$

Where

Q= binary outcome of food safety status, where food-secure household takes the value of 1and 0 if otherwise
ho= Constant
$h_1, h_2,\ldots,hk$ = the regression coefficients, which interpret the effect of p on Q
p= descriptive factors
k = amount of descriptive factors
u = error term
The descriptive variables are:
p_1 =pastoral- farmer conflict (proxy by total loss due to conflict in Nigerian Naira)
p_2 =value of animals sold to alleviate the outcome of food insecurity (Nigerian Naira)
p_3= herd size (number)
p_4= herding experience of the household head (years)
P_5=household distance to grazing area (km)
P_6=migration (Yes = 1; No = 0)

The survival game plan of the pastoralists and agro pastoralists were estimated using 15 items on a 3 point Likert-type scale. The items include 10 problem-designed survival game plans (PDSGP), 3 feeling-designed survival game plans (FDSGP) and 2 social support seeking survival game plans (SSSGP) as corroborated by Adisa, (2012).

3. Results and Discussion

3.1. Socio-economic features of marketers

All 100%) of the respondents were males (Table 1). It suggests that gender sensitivity is inclined towards men than women among pastoral and agro-pastoral households. The average age of household head is 43.3 years. Implying that respondents are still young and could withstand the rigours that are associated with livestock flocking. Age is a significant variable that may affect the ability and cleverness towards attaining the food needs of the family (Shehu *et al;* 2019). Household size connotes the entire number of people living and feeding in the same household. Most (73.3%) family sizes falls within 1-5 persons while 26.7% have household sizes between 6-10 members. The average household size is 4 persons. Furthermore, majority (56.7%) of the respondents had quranic education while 13.3% had secondary education. Education is essential in managing risks and uncertainties that are linked with pastoralism and technology adoption in the industry. According to Onoja *et al*; (2012), people that are educated are better endorsers of transformations. Most (55.0%) respondents falls between 31-60 years, while 18.3% of them have between 61-90 years of herding experience with an average of 43 years. Experience could assist in reducing risks and uncertainties that are associated with livestock herding. Most (62.5%) of the respondents have herd sizes between 31-60 cattle, 10.8% have herd sizes between 61-90 cattle. The average herd size is 41 cattle. Most (71.7%) respondents were married, married households usually have larger household size than other households. This could constitute a threat to food security in the area.

Table 1. *Socio-economic features of households*

Characteristics	Frequency	Percentage
Age (years)		
1- 30	30	25.0
31-60	69	57.5
61-90	21	17.5
Education qualification		
Quranic education	62	56.7
Primary education	42	35.0
Secondary education	16	13.3
Marital Status		
Single	22	18.3

Married	86	71.7
Divorced	12	10.0
Household size		
1 – 5	88	73.3
6- 10	32	26.7
Herding experience (years)		
1 – 30	32	26.7
31- 60	66	55.0
61- 90	22	18.3
Herd size		
1 – 30	32	26.7
31- 60	75	62.5
61- 90	13	10.8
Migration		
Yes	55	45.8
No	65	54.2

Source: Field survey, 2022

3.2 Food security situation of respondents

The average per capita food costs (MPCFC) of respondents was estimated to be ₦4001.122. The households whose per capita food costs (PCFC) lies below and above ₦4001.122 were tagged as food insecure and secure respectively (Shehu *et al.,* 2019). Table 2, indicated that 37.2% of the respondents were food secure while 62.8% were food insecure.

Table 2. Households' food safety index

Item	Food secure (%)	Food insecure (%)	All
Proportion of households	37.2	62.8	100
Number of households	48	72	120

Source: Field survey results, 2022

3.3. Factors affecting food safety index

The Nagelkerke R Square value of 0.691 was obtained, indicating that 69.1% of the entire variation in food safety index is explained for by the evaluated explanatory variables (Table 3).

Table 3. Logistic regression

Variable	Coefficient	Standard Error	Significance
pastoral- farmer conflict (p_1)	0.000035	0.000016	0.027865**
number of animals sold per year (p_2)	0.325956	0.122379	0.007733***
herd size (p_3)	0.050409	0.022418	0.024537**
age of the household head (p_4)	-0.040615	0.021033	0.053481*
household distance to grazing area (p_5)	-0.304722	0.127098	0.016505**
migration (p_6)	4.115215	0.755741	0.000000***
Constant	-6.960727	2.255057	0.002024***

* **, *** Significant at 10%, 5% and 1% respectively

The coefficient of pastoral-farmer conflict was positive and significant at 5%. This indicates that the more the conflict, the better the chance of being food secured. This is because most households often get some form of relief packages or supports from relations, well-wishers, government and non-government organizations when conflict occurs. The number of animals sold to alleviate the outcome

of food insecurity was also important at 1%. This suggests that the more the number of animals sold the more food secured the household. Herd size is positive and important at 5%, indicating that the larger the herd size, the more food secured the household. The possibility of being food secure rises as the households' livestock ownership increases. This is because livestock are livelihood assets for the pastoral and agro-pastoral households. In fact, their ability to withstand shocks is directly linked to their livestock holding. The coefficient of age and distance to grazing area are negative and significant at 10% and 5 % level respectively. This connotes that, an increase in the age of the household head increases the likelihood of the household to be food secure among pastoral and agro-pastoral households. This finding disagrees with those of Shehu *et al*; 2020, in their study on the effects of farmer-herder conflict on farming households' food security in Kwara State, Nigeria. Distance to grazing area has negative connection with household food security. This suggests that the probability of being food secure decreases as the distance to grazing areas increases. The herder will incur more expenses on feeding his livestock rather than members of his family. Moreover, the coefficient of migration is found positive and important at 1%. Implying that migration is a viable survival game plans to alleviate food insecurity in the area.

3.4 Survival game plans adopted by households

Table 4 indicates that the game plans deployed are selling of animals (MS = 2.19), embracing litigation (MS = 2.15), being industrious (MS = 2.07), herders' experience (MS = 2.05), agro-pastoralism (MS = 2.04), appeasing other parties (MS = 2.03), and seeking for supports from friends, relatives and government (MS = 2.01) are the most effective game plans deployed by the respondents and are ranked 1st, 2nd , 3rd, 4th, 5th, 6th and 7th position respectively. Other non-effective game plans are borrowing from banks to buy foods (MS = 1.78), diversification (MS = 1.68), praying to God for calm (MS = 1.08) and accepting conflict as destiny (MS = 1.77).

Table 4. Survival game plans

Survival game plans	**Mean**	**STD**
Problem-designed survival game plans (PDSGP)		
Industrious	2.07	0.632
Utilizing herding experience	2.05	0.634
Take money from banks or relatives	1.78	0.578
Selling of animals	2.19	0.694
Agro-pastoralism	2.04	0.635
Purchasing food	1.98	0.655
Migration	2.12	0.667
Relying on local charms	1.38	0.534
Diversification	1.68	0.622
Fencing of ranch	1.48	0.534
Feeling-designed survival game plans (FDSGP)		
Accepting as destiny	1.77	0.588
Praying to God for calm	1.08	0.544
Satisfying other parties	2.03	0.677
Social support seeking survival game plans (SSSGP)		
Embracing litigation	2.15	0.672
Seeking for supports from friends, relatives, and governments	2.01	0.734

Source: Field Survey, 2022

4. Conclusion

Pastoral-farmer conflict is still prevalent in the country and foretells terrible outcome for food security and rural development. This study quantified pastoral-farmer conflict, measured food security status, examined the outcome of the conflict on food security and describe the survival game plans adopted by

respondents to alleviate the outcome of food insecurity. Interestingly, most of the respndents were food insecure. Pastoral-farmer conflict, age, herd size, migration, distance to grazing area, and number of animals sold to alleviate the outcome of food insecurity were the significant drivers of food security. Furthermore, selling of animals, embracing litigation, being industrious, herders' experience, agro-pastoralism, appeasing other parties and seeking for supports from friends, relatives and government are the most effective survival game plans deployed to alleviate the outcomes of conflict. Consequently, to mitigate the outcomes of the conflict, government must initiate and encourage the establishment and use of cattle ranching and Rural Grazing Area (RUGA). Since, herd size is direlectly related to food security, shemes and game plans towards increasing herd size should be intensified.

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6. References

Adisa, R.S. 2012. Land Use Conflict Between Farmers and Herdsmen –Implications for Agricultural and Rural Development in Nigeria, Rural Development - Contemporary Issues and Practices, Dr. Rashid Solagberu Adisa (Ed.), ISBN: 978-953-51-0461 2, InTech, Available from: http://www.intech open.com/books/rural-development contemporary

Ahmed, F.F; Eugene, C.E and Abah, P.O. 2016. Analysis of food security among farming households in Borno State, Nigeria. *Journal of Agricultural Economics, Environment and Social Sciences 1(1):130-141*

Bhasin, V. 2011. Pastoralists of Himalayas, Journal of Human Ecology, 33 (3): 147-177.

Dietz, T.S.S and Albert, M. 2016. The European union and border conflict. The transformation power of integration, *International Journal for United Organizations,* 60(3): 563-593.

FAO, 2005. Food and agricultural organization. The state of food insecurity in the world, 2005, Rome, 2.

Ifeoma, J.I and Agwu, E.A. 2014. Assessment of Food Security Situation among Farming Households in Rural Areas of Kano State, Nigeria. Journal of Central European Agriculture. 15(1): 94-107

KWADP, 2018. Kwara State Agricultural Development Projects, Progress Report 2000. From<Kwaraadp.com> (Retrieved on 4 June 2018).

Moritz, M. 2016. Understanding Herder-Farmer Conflicts in West Africa.Outline of a Procession Approach. Journal of Society for Applied Anthropology in Human Organization, 69(2 765-769.

NPC, 2016. National Population Commission, 2016. Nigeria Population Census Figures, Abuja; National Population Commission Publication.

Onoja, A.O; Achike, A.I 2012. Resource Productivity in Small-Scale Catfish (Clariasgariepinus) Farming in Rivers State, Nigeria: A translog Model Approach: Journal of Agriculture and Social Research 11(2): 201.

Shehu, A.S; Ifeoluwa T.O and Dasola, G.A 2022. Analysis of food security status among garri processors in Oyo State, Nigeria Food Security in Kwara State, Nigeria. *Trop. Agric . 99(3): 282-291.*

Shehu, A.S; Robiu, O.A and Nofiu, B.N 2019. The Effect of Sustainable Land Management Technologies on Food Security in Kwara State, Nigeria. Journal of Agricultural Sciences. 64(2): 202-214.

Shehu, A.S; Ibrahim, F.A; Isac, A.A and Nofiu, B.N 2020. Effects of Conflict between Pastoralist and Crop Farming Communities on Households' Food Security in Kwara State, Nigeria. *J. Agric. Environ. Sci. 5(2): 1-8.*

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Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

Effect of Farm Household Resilience on Food Security in Kwara State, Nigeria

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Abstract
This study examined the effect of farm household resilience on food security in Kwara State, Nigeria. A large number of Nigerian are food insecure and resilience plays an important role in farm households food security. A semi-structured questionnaire was employed to elicit information from 300 respondents obtained through a multi-stage random sampling technique. From the results, it was observed more than 80% of the households were male-headed and the mean age was 56 years. The average household size was 7 and the majority of the respondents had at least primary education. More than half of the respondents had farming as their major occupation and the average years of farming experience was 23 years. The mean household resilience of 0.31 suggests that the farm household resilience is poor in the study area, the study further revealed more than 70% of the households were food insecure. The probit regression result shows that resilience and farming as a major occupation had a positive association with food security whereas was sex negative with food security. This study recommends that farm households should get information on improved farming technologies and Government should provide external support to the households in order to enhance their resilience.
Keywords; resilience; farm households, food security; probit regression; Kwara state.

Introduction

Food security is a long-standing challenge to global health, nutrition and productivity. Food security is important for economic growth, development, and sustainability (Perez-Escamilla 2017; Fanzo, 2019). The number of individuals who suffered from hunger rose from 8.4% in 2019 to 9.9% in 2020 globally, in addition 828 million people around the world were hungry as at 2021, rising by 150 million from 2019 and 46 million from 2020 (FAO, IFAD, UNICEF, WFP, WHO.,2022), which suggests food insecurity is exacerbating around the globe. Globally, 2.3 billion people in 2021, an increment of 350 million in comparison with the year before the start of COVID-19 experienced moderate and severe food insecurity. Africa currently has 256 million hungry individuals, comprising of 239 million living in Sub-Saharan region and 17 million in the North of Africa (FAO, AU, UNECA., 2019). From 2004 to 2006, 9.1 million Nigerians were malnourished, between 2016 to 2018, this amount went up by 25.6 million (FAO et al, 2019), and from 34.7% in 2015 to 58.5% in 2020, Nigeria has experienced an upsurge in the overall prevalence of mild to severe food insecurity. Nigeria's rate of severe food insecurity has risen considerately (World Bank, 2020).

Nigeria was declared food insecure based on a report by FAO as the overall number of persons that are malnourished increased by 25.6 million in 2018 (FAO, 2019). Nigeria continues to be among the top food insecure countries worldwide and is highly affected by changes in the climate, recession, and insurgency (Kralovec, 2020). Prolonged and periodical food insecurity has been rampant all across

Nigeria and has intensified by the effects of insurgency, communal strife and pastoralist/farmer conflicts, kidnaping etc. (Famine Early Warning Systems Network., USAID, 2020). Differential vulnerabilities of farm households to food insecurity may be based on socio-demographics (which includes but is not limited to age, education, employment, and marital status), healthcare and water safety, disasters from natural causes and fluctuations in the climate, political instability and terrorism which may greatly affect a farm household's food security level.

Nigeria's food insecurity issues have continued to be a persistent and increasing challenge, as the government continues to face difficulties in tackling it due to the fact that the country has failed to adequately meet its national dietary requirements (Osabohien et al. 2018). Poor diets significantly affect farm households in Nigeria as there is increased susceptibility to diseases and parasites, malnourishment as a result of lack of required nutrients, reduced strength for labour-intensive tasks, a general loss of vigour, reduced attentiveness and vitality which leads to reduced productivity resulting in poor food insecurity.

Shocks may emanate from climatic changes, economic and political instability which may affect households' food security levels as well as interfere with their regular operations and activities. Resilience is measured by how well farm households adopt various mechanisms to handle shocks. Resilience is a novel concept that emerged in the last ten years. In this context, resilience refers to a farm household's ability to handle risk and adapt to shocks and stress in consideration of the available resources and options. The capability of being able to not only withstand the effect of shocks but also adapt and change as a result of or in anticipation of these shocks is referred to as resilience (Doherty et al., 2019). According to FAO, 2020 people who have resilient livelihoods are better able to prepare for and handle shocks, whether they are frequent, prolonged, or unexpected. A farm households' ability to plan for, adapt, or recover from a food insecurity crisis in a prompt, successful and sustainable manner is referred to as resilience to food insecurity. A farm household can be better prepared for shocks related to food insecurity by being resilient. Households that are resilient may have a variety of livelihood strategies, access to essential services, social safety nets, and adaptive abilities. Despite increased interest in the concept of resilience of households and how it affects food security, empirical study in this area is still limited, especially in relation to Kwara State. This study aims to gain a deeper understanding of the effect of farm household resilience on food security. The results from this study provides useful information on the food security and resilience status of farm households in Kwara State which will further promote a greater awareness of the role of farm household resilience in ensuring food security. Food insecurity in Nigeria has aggravated social vices as members of households are forced to resort to illegal means of acquiring food. Banditry, unemployment, low productivity and malnutrition which are resultant effects of food insecurity, this scourge can therefore be reduced if the farm households have capacity to endure and deal with the shock of food insecurity. Hence, this study assesses the effects of farm household resilience on food security. Understanding how farm household resilience and food security are linked is important for designing effective strategies to address food insecurity in the country.

Methodology

Research Design

The research design adopted for this study is survey method. A semi-structured questionnaire was employed to obtain required information from the respondents in the study area. The adoption of this design allowed the researcher to establish the effect of farm household resilience on food security in Kwara State using the opinion of respondents obtained with an instrument regarded as questionnaire.

Area of Study

Kwara State is located in Southwest Nigeria, surrounded by Kogi State, Niger State Ekiti, Osun and Oyo states. Kwara state comprises of 16 local government areas. Kwara State's economy is mostly agriculture based. Kwara State is located in a tropical climate zone and experiences dry and wet seasons

(Olanrewaju, 2009). Kwara State experiences rainfall in the summer, with yearly rainfall ranging from 1000 mm to 1500 mm. Temperatures are usually high and fall between 250C and 300C in the rainy season and between 330C and 340C in the dry season. Kwara State is one of the least densely populated states in Nigeria.

Method of Data Collection

A semi-structured questionnaire is the instrument that was employed for data collection in this study. The questionnaire comprised of continuous and categorical data which included socio-economic characteristics, assets, adaptive capacity, social safety net and other variables. The semi-structured questionnaire was administered to farm households in Kwara State with the aid of an enumerator.

Sampling Techniques and Sample Size

A multi-stage sampling technique was adopted in this study

Stage 1: From the 16 LGAs in Kwara State, 5 LGAs were purposively selected because these LGAs have farming as their primary occupation.

Stage 2: 6 communities were randomly selected from each of the 5 LGAs

Stage 3: 10 households were randomly selected from the 6 communities selected.

The sample size of this study was therefore 300 respondents

Model Specification

The resilience status of the farm household was estimated using the Resilience Index Measurement Analysis (RIMA) framework developed by the FAO in 2008 and modified in 2016. Data on the resilience level of households was gotten through a RIMA questionnaire. RIMA encompasses four pillars namely access to basic services, assets, social safety nets, and adaptive capacity, and the variables that make up each of the pillars is presented in Table 1, 2, 3, and 4 respectively.

Access to Basic Services (ABS)

Table 1: Access to Basic Services

1. Major source of water for drinking for the members of the household	[5= household water distribution/borehole [4= public taps [3= wells [2= spring/river [1= rainwater collection
2. Main type of toilet facility used by members of the household.	[5= flush toilet [4= ventilated improved pit latrine [3= composting toilet [2= pit latrine slab [1= bush
3. Major source of energy used in the household for lighting	[5= generator

	[4= electricity distribution company of Nigeria [3= battery powered lamps [2= lanterns [1= candles
4. Distance from household dwelling to the closest accessible/functioning service	[measured in kilometres] • Primary school • Public hospital/health facility • Market
5. Type of material used in construction of house structure	[4= cement [3= brick [2= raffia [1= mud

Source: FAO, 2016.

Assets (AST)

Table 2: Assets

1. Agricultural wealth index	[numbers] • Tractor • Plough • Harrow • Planter • Tiller • Harvester • Boom sprayer • Sprinkler • Chainsaw • Seed drill
2. Wealth index	[numbers] • Car • Mobile phones • Computer • Blankets • Mosquito nets • Fan • Television • Washing machine • Air conditioner • Boilers

	• Heaters • Blender • Microwave • Rice cooker
3. Total land owned	[hectares]
4. Tropical livestock unit	[numbers] • Cattle • Sheep • Goat • Pig • Poultry • Donkey • Camel • Turkey • Guinea fowl • Duck

Source: FAO, 2016.

Social Safety Nets (SSN)

Table 3: Social Safety Nets

1. Total amount of formal/public transfers that was given to the members of the household in the last 12 months.	[in monetary value [relief food [cash assistance [safety net programs like community development program, youth empowerment and social support operation, job and youth employment (N-power) [pension
2. Total value of informal or private transfers obtained by the members of the household in the last 12 months?	[remittances [food or grain gift

Source: FAO, 2016.

Adaptive Capacity (AC)

Table 4: Adaptive Capacity

1. Number of years the household head attended formal education	[number]

2. Participation in income generating activities besides farming	[number]
3. Crop diversification index	
4. Total number of people bringing in income in the household	[number]
5. Total number of people in the household	[number]

Source: FAO, 2016.

Variables that make up each of the pillars were run through a factor analysis to generate a score or an index for each of the pillars. Furthermore, each of the scores for each of the pillars were also run through factor analysis to generate a unique score for each of the households which will represent the resilience level. The resilience index or score was transformed into a standardized value that runs between 1 and 0. The transformation was done through a minimum-maximum scale. The scaling is expressed as follows:

$$\text{New R} = \frac{R - R_{min}}{R_{max} - R_{min}}$$

The new resilience index (R) was used to categorize the household as poor, moderate and high resilience using the approach below:

a) Poor resilience with average scores of 0-0.33

b) Moderate resilience with average scores of 0.34-0.66

c) High resilience with average scores of 0.67-1.00

Food security status of the farm household was estimated using the FAO's Food Insecurity Experience Scale (FIES) established in 2014. Through a 12-month recollection timeframe, FIES gathers personal memories of events and behaviours linked to having access to food as a result of a shortage resources, FIES consists of 8 questions to which respondents must respond yes/no. It is the first tool employed on an international scale to quantify food insecurity at the individual level (Smith et al., 2017). Food insecurity was classified into three sections: 1) food secure with average scores of 0-3; 2) moderate food insecurity with average scores of 4-6; and 3) severe food insecurity with average scores of 7-8.

Table 5: Food insecurity Experience Scale Questions

FIES questions	Responses
You were worried you would not have enough food to eat	Yes (1), No (0)
You were unable to eat healthy and nutritious food	Yes (1), No (0)
You ate only a few kinds of foods	Yes (1), No (0)
You had to skip a meal	Yes (1), No (0)
You ate less than you thought you should	Yes (1), No (0)
You ran out of food	Yes (1), No (0)
You were hungry but did not eat	Yes (1), No (0)
You went without eating for a whole day	Yes (1), No (0)

Source: FAO 2014

The primary focus of this study is to assess whether farm households in Kwara State are food secure or food insecure. Therefore, the FIES was regrouped into a dichotomous variable. Households that have scores that ranges between 1-8, that is, that have mild to severe food insecurity are grouped as food insecure. While those that have 0 score, that is, do not have the experiences of any form of food insecurity are classified as food secure.

The effects of resilience on food security was assessed using probit. The probit model assumes that Y^*can be specified as follows:

$Y_i^* = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_k x_{ki} + v_i$

$Y_i = 1$ if $Y^* > 0$

$Y_i = 0$ if $Y^* \leq 0$

The probit model specified in this study to analyse the effect of household resilience on food security can be expressed as follows:

$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + v$

where:

i = index respondent or individual respondent

n = sample size

Y_i = food security level

x_i = explanatory variables which are:

x_1= resilience level

x_2= age of the household head (in years)

x_3 = sex of the household head; 1 if male, 0 otherwise

x_4 = income of the household

x_5 = food expenditure of the household

x_6 = educational qualification of household head

x_7 = household size

x_8 = marital status of household head; 1 if married, 0 otherwise

x_9 = membership of cooperatives

x_{10} = access to consumption credit

v = error term

Results and Discussions

Socio-economic Characteristics of the Farm Household

The result in Table 6 shows that about 15% of the respondents were female while 85% of the respondents were male. This result indicates that a large number of the households are headed by males which possibly has an important influence on the resilience level and food security status of the household. Also, agricultural production requires the use of energy and males can carry out more energy requiring tasks compared to females. This follows the results of (Kehinde et al., 2019) who reported that men are more involved in farming operations because of the stress involved in it. The mean age of 56 years showed that the respondents are still part of the active population however, they are leaning towards retirement age and this has an impact on their level of productivity. This also has an impact on their food security status as consumption will be affected negatively due to reduced income level. This finding corroborates (Kehinde et al., 2019) who found that an average farmer in their study is around 51 years' old. The mean household size is 7 which indicates that majority of the respondents have a large household size. This means that members of the household could be used as source of labour in the household which would increase the productivity of the household leading to increased income, better consumption and increased food security status. Although large household size may also have a negative effect on the food security status of the farm household. This is because most of the foods produced in the farm household will be consumed due to the large household size. The amount of food taken in by each person in the household will also be affected as lesser food will be available to each person within the household.

Majority (58%) of the respondents' main occupation is farming compared to other forms of occupations which are trading, civil servant, artisan which take up 30%, 8% and 4% of the respondents respectively. This suggests that those respondents with farming as a main venture are likely to be more efficient in their farming operations which leads to better outputs, income and increased food security. The study results as shown in Table 5 revealed that the average years of farming experience is 23 which indicates that most of the respondents have a long farming experience. This suggests that the farmers in the study

area can be characterized as experienced, seasoned, and knowledgeable farmers. This is in line with the results of (Ridwan et al., 2021) whose study showed that the average farming experience is 21 years among vegetable farming households in Kwara State.

The result of the educational status of the household heads showed that more than 60% of the respondents attended at least primary school, this implies that larger proportion of the respondents had basic education and could read or write. This may result in better adoption of new technologies in agriculture, proper application of fertilizers which may result in increased income and increased food security. Also, more than 65% of the respondents in the last production year had no contact with extension agents, this result could mean that a large number of the respondents did not have access to information on new technology, planting techniques and improved varieties. This may thereby affect their adoption of improved practices and production output thereby reducing the chances of being food secure. For example (Anang et al., 2020) opined that farmers in Northern Ghana who had no contact with extension agents had a lower revenue from farming and low food security.

About 79% of the respondents do not have access to credit, this may limit their access to production input and thereby hamper the productivity level of the farmers which may ultimately affects their food security status. This result follows (Hamdiyah, 2020) who observed low access to credit among farm households in Upper East Region.

Table 6: Socio-economic characteristics of the farm households

Variables	Frequency	Percentage (%)
Sex		
Female	44	14.67
Male	256	85.33
Age (years)		
31-40	15	5
41-50	84	28
51-60	113	37.67
>60	88	29.33
Mean	56	
Household size		
1─3	1	0.33
4─6	189	63
>6	110	36.67
Mean	7	
Educational status		
No formal education	103	34.33
Primary school	109	36.33
Secondary school	64	21.33
Tertiary	24	8
Access to credit		
No	236	78.67
Yes	64	21.33
Major occupation		
Farming	174	58
Trading	90	30
Civil servant	24	8

Artisan	12	4
Contact with extension agents		
No	206	68.67
Yes	94	31.33
Farming experience		
≤10	7	2.33
11─20	150	50
21─30	102	34
31─40	34	11.33
>40	7	2.33
Mean	23	

Source: Field Survey, 2023

Resilience Profile of the Farm Households

The resilience profile of the farm households is presented in Table 7. It revealed that about 57% of the respondents have a poor resilience level, 42% of the respondents are moderately resilient, and around 1% of the respondents fall in the high resilience status. The mean resilience is 0.31 which also confirms that the majority of the households have poor resilience. The implication of this result is that farm households in the study area are not better prepared for shocks. This can thereby affect their food security status as the impact of shocks on their food production will leave them under-nourished. This also implies that majority were households that do not have access to basic infrastructure or receive assistant from government or non-governmental organisations or do not own enough assets that will enable them to be resilient against food system shocks. The resilience capacity of these households could be developed through asset accumulation and by having diverse sources of income in order to improve their net worth. some form of external support to recover for government and non-governmental organisations could also help to strength resilience status. External support may come through input subsidy cash transfers, relief food etc. This result follows the findings of (Maltou et al., 2019; Fikru et al., 2023) whose outcome of the study indicated that the majority of the households in Frances Baard District Municipality, South Africa and Damot Pulasa district, Southern Ethiopia respectively were not resilient.

Table 7: Resilience index of the farm households

Resilience index	Frequency	Percentage (%)
Poor	170	56.67
Moderate	126	42
High	4	1.33
Total	300	100
Mean Resilience	0.31	

Source: Field Survey, 2023

Food Security Status of the Farm Households

From the results in Table 7, the prevalence of food insecurity among the farm households was 73.67% while 26.33% of the respondents were food secure which implied that majority of the households in the study were food insecure. This means that a greater portion of the respondents lacked access to food or were unable to access food which may be due to lack of resources. From the results of this study, it can be said that a large number of the farm households were worried that they would not have enough food to eat. This may be due to the large household size of the respondents. This may therefore have implications on the productivity of the household which will affect their income. It can also be seen that

a large proportion of the households were unable to eat healthy and nutritious foods. This affected the productivity level of the members of the households and also made them susceptible to sickness. Majority of the respondents also ran out of food. This may have been due to the fact that the productivity level of the members of the household was low and so they could not produce enough food or work as hard as they should to earn income. Also, majority of the households ate less than they thought they should and this may be attributed to insufficient resources for food expenditure. This is consistent with (Samuel et al., 2021) who indicated that a majority (63.3%) of Nigerian households had worries of not feeding as they should due to insufficient money for food expenditure. This result is in line with (Sani and Kemaw 2019; Ridwan et al., 2021) who reported hat most of the households were food insecure in their study conducted in Western Ethiopia and Nigeria respectively.

Table 8: Food security status of the farm households

Food security status	Frequency	Percentage (%)
Food insecure	221	73.67
Food secure	79	26.33
Total	300	100

Source: Field Survey, 2023

Effect of Resilience on Food Security

The effects of household resilience on food security is presented in Table 9. The result in the table below revealed that resilience was statistically significant with food security. The coefficient shows that resilience was positively related to food security. Therefore, an increase in resilience status will improve the food security. The marginal effect shows that a unit increase in resilience will increase food security status by 65%. The findings corroborate (Nathan et al., 2021) who observed that households that have low resilience are susceptible to food insecurity in Uganda. Sex was observed to have a negative significant coefficient with food security and this suggests that female headed households have a higher likelihood to be food secure than male counterparts in the study area. The results of the marginal effect revealed that show that female headed households have 21% more chance of experiencing food security compared to male headed households. This result concurs with (Maltou and Bahta 2019) who found out that female headed household were more food secure than their male folks, however it negates the findings of (Wondim et al., 2022)

Farming as major occupation is statistically significant positive relationship with food security. Households whose major occupation is farming are likely to have a better food security status than households whose major occupation is not farming. The marginal effect shows that respondents whose major occupation was farming have 11% more chance of being food secure in comparison to households whose major occupations is not farming. This may be because they devout more time to production of food for members of the household compared to others whose major occupation is not farming. According to (Adanech et al., 2022) households that are involved in livestock farming with a large flock size are better opportunity of being more food secure and livestock farming and ownership was seen to be positively significant with food security.

Table 9: Effect of resilience on food security and marginal effect after probit

Food security	Coefficient	P>|z|	Standard error	Marginal effect
Resilience index	2.071061	0.001***	0.19844	0.6555833
Sex	-0.5947569	0.006***	0.8109	-0.2100388
Age	-0.0005721	0.965	0.0041	-0.0001811
Household size	-0.0008762	0.961	0.00562	-0.0002774
Farming experience	-0.0057229	0.671	0.00426	-0.0018115

Farming as sole occupation	0.376305	0.041**	0.05506	0.1163093
Contact with extension agents	0.1105256	0.54	0.05864	0.035463
Access to credit	0.239559	0.232	0.06869	0.0791518
Amount spent on food	-1.45E-08	0.986	0.00000	-4.59E-09
Constant	-0.9440184	0.131		

Source: Authors' data analysis, 2023

Note: *** = significant at 1%, ** = significant at 5%.

Conclusion

The study assessed the effect of household resilience on food security in Kwara State. Primary data was collected with the aid of a semi-structured questionnaire, which was used to obtain information from 300 households. The results from the socio-economic characteristics analysis indicate that a large number of the households are run by males with an average age of 56 years indicating that majority of them were part of the active population but are leaning towards retirement age. The mean household size in this study was 7 which meant that a greater proportion of the respondents had large household size. 58% of the respondents were majorly farmers, 30% were traders, 8% were civil servants and 4% were artisans. The average years of farming experience was 23 years and majority of the respondents attended only primary school indicating that majority of the respondents are literate. Also, most of the respondents did not have access to credit.

It is also observed that majority of the farm households have poor resilience to shocks and are food insecure. Probit was used as the tool of analysis to evaluate the effect of resilience on food security and it was observed that resilience and farming as a major occupation was positively significant with food security making those that have farming as a major occupation more resilient. Sex was observed to have a negatively significant association with food security, which means households that are led by females have the potential of being more food secure than male-headed households. Resulting from the finding of this study, the following recommendations were made;

- Male-headed households can be trained on how to be more productive in order to improve their food security status.
- Because majority of the respondents that have farming as their major occupation are more food secure, not disputing the fact that diversification is good, those that have multiple sources of income should be trained on how to better manage their time and balance their farming occupation with other occupations in order to increase productivity on the farm leading to a better food security status.
- Extension agents can also provide training and information to farmers regarded improved farming techniques and technologies.
- Government can also be a source of external support to the households by providing credit, infrastructure, cash transfers and subsidizing the rates of inputs.

References

Adanech B., Marisennayya S., and Elias B. (2022). Status of household food security, its determinants and coping strategies in the Humbo district, Southern Ethiopia. *Journal of Agriculture and Food Research.* https://doi.org/10.1016/j.jafr.2022.100461.

Anang, B. T., Backman, S., and Sipilainen, T. (2020). Adoption and income effects of agricultural extension in northern Ghana. *Scientific African, 7(2020), e00219.* https://doi.org/10.1016/j.sciaf.2019.e00219

Doherty, B., Ensor, J., Heron, T., and Prado, P. (2019). *Food Systems Resilience: Towards an Interdisciplinary Research Agenda. Emerald Open Research, 1,4*. https://doi.org/10.12688/emeraldopenres.12850.1.

Fanzo, Jessica. (2019). *Healthy and Sustainable Diets and Food Systems: The Key to Achieving Sustainable Development Goal 2? Food Ethics* 4: 159–74

FAO, IFAD (International Fund for Agricultural Development), UNICEF (United Nations Children's Fund), WFP (World Food Programme) and WHO (World Health Organization). (2019). *The State of Food Security and Nutrition in the world 2019: Safeguarding against economic slowdowns and downturns.* Rome: FAO

FAO, IFAD, UNICEF, WFP, WHO, (2020). *The State of Food security and Nutrition in the world. Transforming Food Systems to Deliver Affordable Healthy Diets for All.* FAO, Rome.

Fikru B., Marisennayya S., Elias B., and Temesgen T. (2023). Rural household resilience to food insecurity and its determinants: Damot Pulasa district, Southern Ethiopia. J*ournal of agriculture and food research*. https://doi.org/10.1016/j.jafr.2023.100500.

Hamdiyah A. (2020). Farm households' flood adaptation practices, resilience and food security in the Upper East region, Ghana. *Heliyon, Volume 6, Issue 6,* https://doi.org/10.1016/j.heliyon.2020.e04167.

INDDEX Project (2018*), Data4Diets: Building Blocks for Diet-related Food Security Analysis. Tufts University, Boston, MA*. https://inddex.nutrition.tufts.edu/data4diets. Accessed on 29th November 2022.

Kehinde A. D., Adeyemo R., and Ogundeji A. A. (2019). *Does social capital improve farm productivity and food security? Evidence from cocoa-based farming households in South-western Nigeria.* https://doi.org/10.1016/j.heliyon.2021.e06592.

Kralovec, S. (2020). Food insecurity in Nigeria-An analysis of the impact of climate change, economic development, and conflict on food security.

Maltou, R. and Bahta, Y.T., (2019). Factors influencing the resilience of smallholder livestock farmers to agricultural drought in South Africa: Implication for adaptive capabilities. *Jàmbá: Journal of Disaster Risk Studies.* 11(1), a805. https://doi.org/ 10.4102/jamba.v11i1.805.

Nathan S., Rehema K., Blessing A., Adesoji A., and Justin K. (2021). How Specific Resilience Pillars mitigate the Impact of Drought on Food Security; Evidence from Uganda. *PRCI. Michigan State University and Cornell University.*

Olanrewaju, R. M. (2009). Climate and the Growth Cycle of Yam Plant in the Guinea Savannah Ecological Zone of Kwara State, Nigeria. *Journal of Meteorological and Climate Science*, 43-48.

Osabohien, R., Evans O., and Ese U. (2018). Food security, institutional framework and technology: Examining the nexus in Nigeria using ARDL approach. *Current Nutrition & Food Science* 14: 154–63.

Ridwan M., Abraham F., Olubunmi A., and Omotesho. (2021). *Food security status: its drivers and coping strategies among vegetable farming households*. https://doi.org/10.46909/cerce-2020-035.

Samuel, F. O., Eyinla, T. E., Oluwaseun, A., Leshi, O. O., Brai, B. I., & Afolabi, W. A. (2021). Food access and experience of food insecurity in Nigerian households during the COVID-19 lockdown. *Food and Nutrition Sciences*, *12*(11), 1062-1072.

Sani, S. and Kemaw, K. (2019. Analysis of household food insecurity and its coping mechanisms in Western Ethiopia. *Agricultural and Food Economics, 7(5), 1–20*. https://doi.org/10.1186/s40100-019-0124-x.

Smith MD., Rabbitt MP and Coleman-Jensen A. (2017). Who are the world's food insecure? New evidence from the Food and Agriculture Organization's Food Insecurity Experience Scale. *World Dev.* 2017;93:402–12.

Wondim A., Kefale E., Genenew A., and Belete M. (2022). Determinants of food security status of household in Central and North Gondar Zone, Ethiopia. *Cogent Social Sciences*. 8:1, 2040138. https://doi.org/10.1080/23311886.2022.2040138

World Bank. (2020). *The World Bank in Nigeria*. Online: https://www.worldbank.org/. Accessed on 14th October, 2022.

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Assessment of Artisanal Fishers` Livelihood Coping Strategies and Capacity Building Needs in Kogi State, Nigeria

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ABSTRACT
This paper assessed artisanal fishers` livelihood decisions and capacity building needs in Kogi State, Kogi State, Nigeria. The study participants were 399 artisanal fishers in fishing communities around River Niger and Benue River banks in Kogi State. The study participants were selected using multistage sampling technique. The study utilized both descriptive statistics and logit regression model. The result of the study showed the mean age of 43 years, average years of formal education of 10 years, average household size of 8 persons, average fishing experience of 21 years and income of N105,978.70. The factors influencing the artisanal fishers` livelihood decision include age, years of formal education, years of fishing experience, Type of fish work, access to credit, and membership of association. Also, the livelihood coping strategies employed by the fishers include praying to God ($\bar{x}$=4.05, std.dev =+1.31), Reliance on traditional weather forecasting ($\bar{x}$=3.73, std.dev =+1.44), spending longer time fishing ($\bar{x}$=3.65, std.dev =+1.15), and increasing food stock during period of boom ($\bar{x}$=2.86, std.dev =+1.14). More than half of the respondents (59.40%) had high training needs in the study. The study concluded that many of the artisanal fishers in the survey had high-capacity building needs.
Keywords: Artisanal Fishers; Livelihood coping strategies, Capacity Building Needs

Introduction

According to a survey, the global value chain for fish reported that about 200 million individuals who are both directly and indirectly involved in fishing related activities ranging from fishing through to distribution. According to the aforementioned estimate, women account for a sizeable component of the labor force, making up around 50% of those employed in the secondary sector (Montfort, 2015) and about 14% of those in the primary sector (FAO, 2018). Many artisanal fishermen depend on these activities for their livelihoods, and many of them frequently dwell in areas susceptible to catastrophic events. Fisheries and aquaculture play a significant role in the livelihoods of many people throughout the world as well as the security of food and nutrition.

According to FAO (2018), the combined global production of the two industries reached its peak in 2016 and totaled 171 million tonnes, with captured fisheries accounting for 53% of this total and aquaculture 47%. Thus, fisheries and aquaculture have a critical role in many riverine coastal, and inland regions among others, in ensuring food security and generating livelihoods, and food, but their ability to withstand climate shocks is constrained, especially in developing regions where reli ance on fisheries is highest (Barange et al., 2014).

Report shows that About 11 percent of the global population, or about 767 million people, live in extreme poverty, and 815 million go hungry every day (FAO *et al.*, 2017). Many of these people can be found in small-scale fishing and fish farming communities where they are commonly marginalized politically, economically and socially. Generally, the poor state of the resource base of artisanal fishing households limits their capacity to absorb climate shocks (Barange *et al.*, 2014). Small-scale and artisanal fisheries and fishers are identified as being particularly vulnerable to the impacts of climate change with the supply of fish steadily on the decline. This is largely due to the low catch levels of the traditional fishing techniques and other related factors (Okeowo et al.,2015). For instance, increasing water temperatures leading to changes in fish species, potentially from higher to lower value species, changes in precipitation (as rain or snow) and consequently water flows, and more frequent and intense extreme events such as floods. In some cases, decreased precipitation and more extreme events have negatively impact fish habitats.

Fisheries and aquaculture as a means of livelihood for communities that depend on the sector for their livelihoods, given the numerous challenges confronting fishing and residents of fishing communities need to be empowered through capacity training to increase their production and efficiency. which include improved technologies to increase efficiency in the use of inputs --- equitable access to fisheries as a means of eradicating hunger and poverty and supporting sustainable development. creation of alternative livelihoods, product beneficiation, capacity-building to enhance resilience in different ways, and improving the economic stability of small-scale fishers and those involved in associated activities through, for example, improved access to credit, microfinance, insurance services and investment.

In Nigeria, farming as a source of income has failed to bring about the enough income for farm households (Babatunde, 2013). This situation applies to artisanal fishing due to the subsistence nature of artisanal fishing in Nigeria. Livelihood diversification refers to the ways by which households raise income and reduce environmental risks (Sekumade & Osundare, 2014). Livelihood diversification therefore refers to attempts by individuals to make a living for themselves outside their main means of livelihood. For fishing communities residents, it includes off-fishing activities which are under taken to generate additional income. The concept of livelihood diversification decision among fishing households in fishing communities includes all economic activities, except fishing. Nigerian fisheries sub-sector comprised of artisanal, industrial and cultured fisheries. The artisanal division covers the activities of small-scale fisheries operating in creeks, lagoons, inshore water and the inland rivers. The artisanal fishery is characterized by low capital outlay, low operational costs, low technology application and it is labor intensive (Bolarinwa, 2014). The artisanal fishery provides income and employment for the fisherfolks and supplies cheap protein for the populace. Sustainable artisanal fishery practices are idea and hygienic fish capturing, handling, processing, preservation and marketing. Knowledge and adherence to sustainable fishing practices would make fish to be available continually in the water bodies, ensure the production of good quality fish products and would maximize the profit of the fisherfolks. Capacity building is the acquisition of skills and knowledge required to perform a task better (Ifabiyi, Banjoko and Komolafe, 2017). The capacity of artisanal fisheries to play its triple role of a food supplier, employment provider and income earner in the Nigerian economy depends on the adoption of appropriate management strategies that will ensure their sustainability in the face of intense fishing pressure.

There are increasing evidences that capacity building aids development. According to Hornby, (2006) capacity is the ability, skills and experience that an individual need to get a specific task or job done. Capacity building is the process of improving the abilities, skills and character possessed by an individual for proficiency in a given task. Olaitan, *et al.,* (2009) stated that capacity building is the process of acquiring information, skills and attitude that is needed to get a particular task done. Capacity building is the effort geared towards improving the level of knowledge, skills and attitude possessed by an individual for proficiency in a given task or job. Capacity building would improve the skills, knowledge and attitude of the fisherfolks. Capacity building needs is the skill, knowledge and attitude an individual requires to overcome problem as well as to avoid creating problem situation (Owona *et al.,* 2010). Capacity building needs also refers to additional specific information, knowledge and skills required to perform certain operation or activities (Ifabiyi, 2019).

i. describe the Socio-economic characteristics of artisanal fishing fishers in Kogi State, Nigeria.

ii. examine the livelihood coping strategies employed by the Artisanal fishers in the study area;
iii. examine the factors influencing livelihood decisions of Artisanal fishers in the study area;
iv. identify the Capacity building needs of Artisanal fishers in the study area;
v. examine the determinants of the level of Capacity building needs of Artisanal fishers in the study area;

Methodology

Kogi State lies between longitudes 5º40'E and 7º49'E; and latitudes 6º 33'N and 8º44'N. It is bounded to the South by Anambra and Edo States; and to the North by Niger, Nassarawa and Federal Capital Territory; to the East by Benue and Enugu States. On the Western flank it shares a common border with Ondo, Ekiti and Kwara States (Kogi A.D. P, 1993). Going by the 2006 population census, the state pooled a population of 3,278,487 representing 2.34% of the Nigerian population. About 70% of the people live in the rural areas and mostly engage in one form of agricultural practice or the other. Kogi State Agricultural Development Project (KADP) delineated the zones into 6 blocks and 48 extension cells per zone. The study utilized a multistage sampling technique to select study sites and respondents for the study. First, the list of LGAs having Niger and Benue rivers was obtained and seven (7) LGAs were randomly selected. The second stage, involve proportional sampling of fishing communities with the seven selected LGAs. In the third stage, 399 artisanal fishers were randomly selected from the fishing communities. The data for this study was primary data. The primary data was elicited through the use of well-structured questionnaire to fisherfolks. The questionnaire was administered through the help of well-trained research assistance. The study utilized both descriptive statistics, logit regression model and mean score from Likert rating type of scale.

Model Specification

The study utilized binary logit regression model. We assume that the model is specified as shown;
Y* can be specified as follows:

$$Y^* = X'\beta + \varepsilon,$$

Where *Y* can be viewed as an indicator for whether this latent variable is positive:

$$Y = 1_{\{Y^* > 0\}} = \begin{matrix} 1 \ if\ Y^* > 0\ i.e. -\varepsilon < X'\beta, \\ 0 \qquad otherwise. \end{matrix}$$

Where

$$Yi = li\left(\frac{P_i}{1-P}\right) = \beta + \beta 1X1 + \beta 2X2 + \cdots + \beta iXi + \text{Ur}$$

Y =Vector of dependent variable (1=livelihood decision to participate in no agricultural activities, if otherwise=0). The model is also applies to the livelihood decision to participate in non-fishing activities = 1, if otherwise =0).
X_i =Vector of explanatory variables;

Measurement of variables

X_1 = Age of Household head (Years),
X_2 = Gender (1=male, 0=female),
X_3 = Years of formal education (years),
X_4 = Household size (actual number),
X_5 = Years of fishing experience (Years),
X_6 = Membership of association (1=member, 0=non-member),
X_7 = Type of fish work (1=fresh fish, 0=smoked and dried),
X_8 = Access to credit (1 if yes, 0 if otherwise)
U_i = Error term

To estimate the factors influencing artisanal fishers` capacity building needs in the study was estimated using Binary logistic regression where dependent variable (Yi) = Capacity Building Needs (High Need = 1, Low Need = 0)

Measurement of variables

X_1 = Age of Household head (Years),
X_2 = Gender (1=male, 0=female),
X_3 = Years of formal education (years),
X_4 = Household size (actual number),
X_5 = Years of fishing experience (Years),
X_6 = Membership of association (1=member, 0=non-member),
X_7 = Type of fish work (1=fresh fish, 0=smoked and dried),
X_8 = Access to credit (1 if yes, 0 if otherwise)
X_9 = Household income (Naira)
U_i = Error term

Results and Discussion

Table 1: The Socio-economic characteristics of the Artisanal fishing household heads

Variable	Observation	Mean	Std. Dev.	Min	Max.
Age	399	43	12	14	75
Years of formal Education	399	10	5	0	25
Household size	399	8	5	1	20
Years of fishing experience	399	21	11	0	60
Average annual income	399	105,978.7	226,899.2	4000	250,000

Source: Author's Field Survey 2023

The result of the study showed the mean age of 43 years, average years of formal education of 10 years, average household size of 8 persons, average fishing experience of 21 years and income of N105,978.70. From the result in Table 1, it can be inferred that the fisherfolks were still in their productive age. The respondents cannot be said to be largely illiterates given the average years of formal education. Majority of the respondents were experienced in fishing business. They are expected to be productive given their experience.

Table 2: Factors influencing the Livelihood Decision to participate in Non-Agricultural and Non-fishing activities among Artisanal fishers in the study area

Variables	Coef.	Std. Err.	p-value	Coef.	Std. Err.	p-value
Age	0.0532	0.0138	0.000	0.01499	0.0130	0.250
Gender	-0.0628	0.3233	0.846	0.3896	0.3174	0.225
Years of Sch	0.0535	0.2180	0.014	-0.0342	0.0226	0.130
Household size	-0.0987	0.0264	0.000	-0.0039	0.0258	0.878
Yrs of Experience	-0.0456	0.0137	0.001	0.02960	0.0142	0.037
Membership Ass	0.05674	0.2577	0.826	-0.4987	0.2574	0.053
Type of fish work	0.4664	0.1969	0.018	-0.2861	0.1860	0.124
Access to Credit	0.5322	0.2311	0.021	-0.1789	0.2318	0.440
_-cons.	-1.9910	0.7261	0.006	0.0043	0.7020	0.995
No. of Observ.	399				399	
LR Chi (8)	63.78				42.99	
Prob >Chi2	0.000				0.000	
Pseudo R2	0.1155				0.0811	
Loglikelihood	-244.12				-243.65	

Source: Author's Field Survey 2023, Note: ***, **, *, Significant at 1%, 5% and 10% levels respectively.

The result of the binary logistic regression model showing the factors influencing the respondent's decision to participate in non-agricultural and non-fishing activities by the artisanal fishers in the study. The result revealed Pseudo R2 =0.116, p<0.001 and R2=0.0811, p<0.01 respectively for decision to participate in non-agricultural and non-fishing activities by the artisanal fishers. The Pseudo R-squared value for both models showed a low predictive value in the decision to diversity their livelihood as explained by the independent variables. According to Martin, (2012) and Adisa et al.,(2021), both studies reported in fields that attempt to predict human behavior typically have low R2 values as humans are harder to predict than physical processes. The result revealed that age, Years of formal education, household size, years of fishing experience, Type of fish work, credit access and membership of association were significant factors influencing the decision to diversify into non-agricultural and non-fishing activities. The coefficient of age was positive and significant at 1%, implying that age influences the probability of the decision to diversify livelihood into non-agricultural activities by 0.0532. This implies that as the household heads or fishers

The result implies the decision to engage in non-agricultural activities increases with age. The coefficient of years of formal education was positive and significant at 5%, implying that the years of formal education influences the probability of the decision to participate in non-agricultural activities by 0.0535. The result suggests the decision to participate in non-agricultural activities increases with years of formal education in the study. This result is consistent with the findings of Asmah (2011), Shaha (2010) and Babatunde (2009).

The coefficient of household size was negative and significant at 1%, implying that the household size in the study has inverse relationship with the decision to participate in non-agricultural activities. by 0.0987. The negative contribution of household size is as inconsistent with the expected a prior expectation which is that having more persons in a household infers more responsibility to cope with and the need to access different income sources. The result is not consistence with the work of Oluwatayo (2009). The coefficient of years of fishing experience was negative and significant at 1%, implying that the years of fishing experience in the study, inversely influences the probability of the decision to participate in non-agricultural activities by 0.0456.

The coefficient of type of fishing work carried out was positive and significant at 5%, implying that the years of fishing experience in the study, directly influences the probability of the decision to participate in non-agricultural activities by 0.4664. The coefficient of access to credit was positive and significant at 5%, implying that the artisanal fishers` access to credit in the study, directly influences the probability of the decision to participate in non-agricultural activities by 0.5322. However, the result for decision to participate in non-fishing related activities revealed that the coefficient of years of fishing experience was negative and significant at 5%, implying that the years of fishing experience in the study, inversely influences the probability of the decision to participate in non-fishing related activities by 0.037. This implies that as people get older, their participation in various livelihood strategies decreases. In other words, younger households are more likely than older households to be involved in non-farm and/or combination of activities. The results of this study found to consistent with the findings of (Dinku,2018; Abera et al. (2021). The coefficient of membership of association was positive and significant at 10%, implying that the membership of cooperative society increased the probability of participation in non-fishing related activities by 0.2574.

Table 3: Mean Distribution of livelihood coping strategies employed by the Artisanal fishers in the study

Livelihood Coping Strategies	Mean	Std. Dev.	Rank	Remark
Longer time fishing in good weather.	3.65	±1.15	3	Major
Practice of other fisheries-related employment (e.g. fish drying and fish vending).	2.47	±1.27	5	Minor
Engage in non-fishery labour (e.g.tricycle driving and construction work such as painting and carpentry).	1.75	±1.25	6	Minor
Small business operation (e.g Provision store).	1.60	±0.99	7	Minor

Diversification of food sources (e.g. drying fish).	2.73	±1.26	5	Minor
Reliance on traditional weather forecasting.	3.73	±1.44	2	Major
Praying to God.	4.05	±1.31	1	Major
Increase food stocks during boom.	2.86	±1.14	4	

Source: Field Survey (2023).

The result in Table 3 showed that the major livelihood coping strategies in the study were Praying to (mean score=4.05), Reliance on traditional weather forecasting (mean score=3.73), and spending longer time fishing in good weather (mean score=3.65).

Table 4: Percentage Distribution of Respondents based on Perceived Areas of Capacity Building Needs of the Respondents on Fishing Practices.

Fishing Tasks	Yes (Training needed)	No (Not needed)
Identification and sorting of fish	238(59.65%)	161(40.35%)
Handling and transportation of captured fish from landing site	188(47.12%)	211(52.88%)
Use and repair of nets, cage and traps	210(52.63%)	189(47.37%)
Use and maintenance of multiple hooks on a line	198(49.62%)	201(50.38%)
Canoe use and maintenance	182(45.61%)	217(54.39%)
Icing of fish	222(55.64%)	177(44.36%)
Outboard engine use and repairs	269(67.42%)	130(32.58)
Rescue, resuscitation and safety skill	289(72.80%)	108(27.20%)
Use of chorkor smoker	238(59.65%)	161(40.35%)
Drying of fish	135(33.83%)	264(66.67%)
Salting of fish	133(33.33%)	266(66.67%)
Branding/packaging of processed fish	298(74.69%)	101(25.31%)
Management of storage pest	321(80.45%)	78(19.55%)
Fish marketing and distribution	267(66.92%)	132(33.08%)
Record keeping	325(81.45%)	74(18.55%)
Credit Acquisition	329(82.46%)	70(17.54%)
Maintaining personal and environmental health hygiene	307(76.94%)	92(23.06%)
Local weather forecasting	215(53.88%)	184(46.12%)

Source: Field Survey (2023).

Table 4 showed that about 82.46% of the artisanal fishers in this study required capacity building on credit acquisition, 81.45% of the respondents required capacity building on Record keeping, 80.45% of the artisanal fishers in this study required capacity building on management of storage pest, 76.94% of the artisanal fishers in this study required capacity building on maintaining personal and environmental health hygiene an 74.69% of the artisanal fishers in this study required capacity building on branding and packaging of processed fish. 72.80% of the artisanal fishers in this study required capacity building on rescue, resuscitation and safety skill as well as 67.42% required capacity building training in outboard engine use and repairs.

Table 5: Distribution of Respondents based on Level of Capacity Building Needs on Artisanal fishing practices

Capacity Building Needs Level	Frequency	Percentage
Low Needs	162	40.60
High Needs	237	59.40

Source: Author's Field Survey, 2023.

Table 5, shows the result of the distribution based on Level of Capacity Building Needs on Artisanal fishing practices in this study. High Needs – individuals that requires capacity building scored more than 9 fishing tasks. Low Needs – scored less than 9 capacity building in fishing responsibilities. From

the result, majority (59.40%) had high training needs in the study while less than half of the respondents in the study had low training needs.

Table 6: Result of Logistic Regression Analysis to Identify Determinants of the Artisanal Fishers' Capacity Building Needs on Fishing Practices

Variables	Coef.	Std Err.	Z	P>/z/
Age	0.0323227	0.0147209	2.20	0.028
Gender	-.3616122	.2408112	-1.50	0.133
Marital Status	-570387	.3898665	1.46	0.143
Years of formal education	.0505232	.0213254	2.37	0.018
Household size	-.0275651	.0259834	-1.06	0.289
Years of experience	-.0.410448	.0134638	-3.05	0.002
Membership of Association	-.0338749	.2515282	1.79	0.073
Access to credit	-415493	.2315282	1.79	0.073
Average income	3.56e-07	5.81e-07	0.61	0.539
Cons	-9465966	-8674688	-1.09	0.275
No. of Observation	399			
LR Chi2 (9)	30.68			
Pro>Chi2	0.0003			
Pseudo R-Square	0.057			

Source: Author's Field Survey 2023, Note: ***, **, *, Significant at 1%, 5% and 10% levels respectively.

The result of the binary logistic regression model showing the factors influencing the level of Capacity building needs of the artisanal fishers in the study area. The result revealed Pseudo R2 =0.06, $p<0.001$. The Pseudo R-squared value of 5.7% percent showed a low predictive value in the capacity building need is explained by the independent variables. According to Martin, (2012) and Adisa et al.,(2021), studies in fields that attempt to predict human behavior typically have low R2 values as humans are harder to predict than physical processes.

The result on table 6 showed that age has a positive coefficient (0.03232) and also a determinant of capacity building needs on fishing practices ($p<0.05$). The result in Table 6 revealed that the years of formal education has a positive coefficient (0.50523) and also influences the capacity building needs on fishing practices ($p<0.05$). This implies that an increase in the years of formal education will increase the probability of the fisher folks' capacity building needs. The finding of the study is consistent with the result of a similar study by Adisa et al.,(2021), that Education enable a fisher to make independent choice and act on the basis of the decision. The result further reveals that the years of fishing experience has a negative coefficient (-0.04105) and also a determinant of capacity building needs on fishing practices ($p<0.01$). This implies that wealth of experience has influence on the fisher folks' skills. This is consistent with a prior expectation as the fisher folks must have acquired enough fishing skills over time. This finding is consistent with Alarima *et al.,* (2011) and Adisa et al.,(2021), both studies reported that training needs of rice farmers in Nigeria decreases with increase in the years of farming experience. The result in Table 6 showed that access to credit has a positive coefficient (0.41549) and also a determinant of capacity building needs of fishing practices ($p<0.10$). This is because credit access and utilization allow the possibility to invest in non/off-farm activities. The result is consistent with the findings of Eshetu and Mekonnen, (2016); Gebru et al.,(2018); Shikur and Leza,2021; Dinku,(2018); and Abera et al.,(2021).

Conclusion

The paper assessed the livelihood decision, coping strategies and capacity building needs of artisanal fishers in Kogi State, Nigeria. We found that the farmers were still in their productive age, that the fishers can no longer be described as illiterate going by their average years of formal education. The artisanal fishers have fairly large family size and very experience in fishing business. Based on the findings of the study, the factors influencing the artisanal fishers` livelihood decision include age, years of formal education, years of fishing experience, Type of fish work, access to credit, and membership of association. Also, the livelihood coping strategies employed by the fishers include praying to God, Reliance on traditional weather forecasting, spending longer time fishing and increasing food stock

during period of boom. More than half of the respondents (59.40%) had high training needs in the study. The study concluded that the majority of the artisanal fishers had high-capacity building needs in the study. Based on the findings of the study, the study recommends the provision of training in the areas where the fishers had high-capacity building needs and while doing that attention should be given to the determinants of the capacity building needs of the artisanal fishers in the planning and implementation of such interventions on artisanal fisheries.

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Reference

Abera, A., Yirgu, T. & Uncha, A. (2021). Determinants of rural livelihood diversification strategies among Chewaka resettlers' communities of southwestern Ethiopia. Agric & Food Secur 10, 30.

Adisa, R.S., Ifabiyi J.O., Gbenga, O., (2021). Determinants of Capacity Building Needs of Artisanal Fishers in Kogi State, Nigeria. Journal of Asian Rural Studies, 2021, 5(1): 78-89.

Alarima, C. I. Kolawole, A., Fabusoro, E., Ajulo, A. A., Masunaga, T. and Wakatsuki, T. (2011). Knowledge and Training Needs of Farmers Adopting Sawah Rice Production Technology in Nigeria. *Journal of Food, Agriculture & Environment 9* (3&4), 183-188.

Asmah, E.E. (2011). Rural livelihood diversification and agricultural household welfare in Ghana. *Journal of Development and Agricultural Economics*, *3*(7), 325-334.

Babatunde, H.J.(2013). Non-farm inequality and land in rural Egypt. *Economic Development and Cultural Change,* 50(2), 339-363.

Babatunde, R.O., and Qaim, M. (2009). Patterns of income diversification in rural Nigeria: determinants and impacts. *Quarterly Journal of International Agriculture*, 48(4), 305-320.

Barange, M., Merino, G., Blanchard, J.L., Scholtens, J., Harle, J., Allison, E.H., Allen, J.I, Holt, J. & Jennings, S. 2014. Impacts of climate change on marine ecosystem production in societies dependent on fisheries. *Nature Climate Change,* 4: 211–216.

Bolarinwa, J.B (2014).Public relations and extension services in Nigerian Fisheries Industry, *International Journal of Agricultural Research,*9(7):327-330.

Dinku, A. M. (2018). Determinants of livelihood diversification strategies in Borena pastoralist communities of Oromia regional state, Ethiopia. Agric & Food Secur 7, 41.

Eshetu, F., & Mekonnen, E. (2016). Determinants of off farm income diversification and its effect on rural household poverty in Gamo Gofa Zone, Southern Ethiopia. Journal of Development and Agricultural Economics, 8 (10), 215–227.

FAO (2018). The State of World Fisheries and Aquaculture 2018 – Meeting the Sustainable Development Goals. Rome, Italy.

Gebru, G. W., Ichoku, H. E., & Phil-Eze, P. O. (2018). Determinants of livelihood diversification strategies in Eastern Tigray Region of Ethiopia. Agriculture and Food Security, 7 (1), 62.

Hornby, A.S. (2006). Oxford Advanced English 5th Ed London University Press.

Ifabiyi J.O., (2019). Capacity Building Needs of Fisherfolks in Kogi and Kwara State, Nigeria. Unpublished Ph.D Thesis, University of Ilorin, Ilorin, Nigeria.

Ifabiyi, J.O., Banjoko I.K. and Komolafe S.E. (2017). Assessment of the Training Needs of Artisanal Fishers' in Asa Local Government Area of Kwara State, Nigeria. *Nigerian Journal of Rural Extension and Development Vol. 11.*

Martin, K.G. (2012). Assessing the Fit of Regression Models. Correll Statistical Consulting United State News No 68.

Monfort, M.C.(2015). *The role of women in the seafood industry.* GLOBEFISH Research Programme Vol. 119, Rome, FAO. 67 pp.

Olaitan, S.O., Alanbe, M.O., and Nwobu, V.I. (2009). Capacity Building Needs of Teachers of Agriculture for Effective Teaching in Basic Schools in Abia State; A paper presented at the Annual conference of Faculty of Education, University of Nigeria, Nsukka, Nigeria.

Oluwatayo, I.B. (2009). Poverty and income diversification among households in rural Nigeria: A gender analysis of livelihood patterns. In *Conference Paper*, 41.

Owona, N. P. A, Nyaka, N. A., Ehabe, E. E., Chambon-Poveda, B. & Bruneau, J. C. (2010). Assessment of training needs of rubber farmers in the south-west region of Cameroon. *African Journal of Agricultural Research 5*(17), 23-31.

Saha, B., and Bahal, R. (2010). Livelihood Diversification Pursued by Farmers in West Bengal. *Indian Research Journal of Extension Education*, *10*(2), 1-9.

Sekumade, A.B. and Osundare, F.O.(2014). Determinant and effects of livelihood diversification on farm households in Ekiti State, Nigeria. *Journal of Economics and Sustainable Development,* 5(5), 1-2.

Shikur, S., Haji, J., & Leza, T. (2021). Factors affecting choice of livelihood strategies in Peri-Urban Communities of Hossana Town, Southern Ethiopia. East African Journal of Sciences, 15 (2), 129–140.

T. A. Okeowo, J. B. Bolarinwa & Dauda Ibrahim (2015). Socioeconomic Analysis of Artisanal Fishing and Dominant Fish Species in Lagoon Waters of EPE and Badagry Areas of Lagos State. International Journal of Research in Agriculture and Forestry Volume 2, Issue 3, March 2015, PP 38-45.

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Price and Output Forecast of Ginger in Nigeria for the Period 2021-2025: Auto-Regressive Moving Average (ARIMA) and Artificial Neural Networks Methodology (ANN) Approach

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ABSTRACT

The study forecasts the price and output trend of ginger in Nigeria for the period 2021–2025 using the auto-regressive integrated moving average (ARIMA) and artificial neural network (ANN) methodologies. Secondary data was used for this study. The empirical findings of the ARIMA and ANN models revealed that ARIMA (6, 1, 5) and ARIMA (9, 1, 5) are the best-fit forecasting models for the output and price of ginger, respectively. The ANN model with the network structure 1-10-1 (1 input layers, 10 hidden layers, and 1 output layer) with iteration 12,000 was the predictive model with the most accurate output prediction. The forecast of ginger output shows a continued increase in ginger production on a yearly basis from 608080.4 MT in 2021 to 719967.6 MT in 2025. This is also applicable to the result of ANN (1-10-1) which also shows a continued increase in ginger output from 764790.095 MT in 2021 to 774051.551 MT. The forecast for the price of ginger from ARIMA (9, 1, 5) shows an expected high but steady price increase from ₦803.37 in 2021 to ₦851.40 in 2025 as compared with the ANN (1-16-1) with a slow but steady price increase from ₦581.13 in 2021 to ₦585.48 in 2025. From this study, it can be concluded that Nigeria has comparative advantages in growing ginger. It is recommended to focus on enhancing ginger productivity by providing an enabling environment for farmers and stakeholders in the ginger sub-sector.

Keywords: Ginger, price, output, forecast, trends

INTRODUCTION

Nigeria is the second-largest producer of ginger in the world (after India). Nigerian ginger is among the best in the world, with its aroma, pungency, and high oil and oleoresin content as distinct features. Kaduna stands as the highest producer of the crop, while Nasarawa, Gombe, Bauchi, and Benue, among other states, are the major producers (National Agricultural Extension and Research Liaison Services (NAERLS), 2020; Sodangi, 2020). The country could use ginger to position itself in different ways, like in the domestic, regional, and European Union markets (EU market) (Obinatu, 2016). In the EU market, the scope is to expand Nigeria's current fresh and dried ginger exports by focusing, among others, on quality improvements and meeting the mandatory EU market requirements, as well as exploring opportunities for certification and gaining access to niche market segments. Ginger (Zingiber officinale) is a perennial herb revered as one of the most popular and valued spices in the world (Sodangi, 2020). The most useful part of this plant is the underground rhizome. Besides being used as a spice, dry ginger is also used to produce oil, oleoresin, essences, soft drinks, and non-alcoholic beverages. According to Pakhuan and Sukanlaya (2021), ginger has manifold medicinal properties as a carminative and stimulating agent of the gastro-intestinal tract. Despite all the potentials and opportunities of having such a long history with a diversified conducive agro-ecology base, this spice sub-sector potential remains unexploited in Nigeria. The sub-sector is still not organized or packaged,

low in productivity, and inefficient (Sodangi, 2020). The challenge of the low price of the ginger products also tends to repel most of the Nigerian farmers from continuing the farming of ginger (Nmadu and Marcus, 2011).

The Nigerian ginger market is highly volatile, with daily price fluctuations due to inadequate government intervention in creating a fixed price model. Even with its large production, Nigeria is only a small contributor to global ginger exports, at just 3.5% of the total volume in 2019. Though, studies have been conducted on ginger value chain, production efficiency and factors influencing the choice of marketing outlets by ginger farmers by Nmadu and Marcus (2012) and Ayodele and Sambo (2014) among others. However, there is a scanty study on the price and output forecast of ginger using the ARIMA and ANN models in Nigeria. This study therefore helps us to assess the forecast of ginger as a spice crop in a given period and also provide a framework for meeting the increase in production with a view to drawing valid conclusions and appraising the behavior of its supply in the context of raising demand.

Therefore, this study was undertaken to provide the needed information to guide policy on the development of the expected price and output trend of ginger in the near future in Nigeria. The objective of this study was to forecast the price and output trend of ginger in Nigeria for the period 2021–2025. This coincided with the objectives and targets of the National Development Plan (NDP, 2021–2025) in Nigeria.

RESEARCH METHODOLOGY

Study Area

This study was conducted in Nigeria. Nigeria is located in West Africa on the Gulf of Guinea and is one of the largest countries in Africa, occupying a geographical area of about 923,770 square kilometers with an estimated population of 223,804,632 and a population growth rate of 2.4% (United Nations, 2022). It lies along latitudes 9° 04' 39.90" N and longitudes 8° 40' 38.84" E. It is bounded by the Atlantic Ocean to the south and by the Sahelian countries of Niger and Chad to the North. Nigeria operate operates Federal system of government with 36 States and Federal Capital Territory and 774 Local Government Areas (LGAs). Nigeria, by virtue of its location, enjoys a warm tropical climate with relatively high temperatures throughout the year and two seasons: the rainy or wet season that lasts from mid-March to November in the south and from May to October in the north, and the dry season that occupies the rest of the year. Secondary data, such as price and output of ginger, were sourced from the Food and Agriculture Organization's (FAO) website and the National Agricultural Extension Research Liaison Services (NAERLS) from 1990–2020. The data collected were analyzed using ARIMA and ANN methodologies to forecast both output and price from 2021 to 2025, respectively.

Model Specification

ARIMA has three parts like Auto Regressive (AR), Integrated (I) and Moving Average (MA) (p,d,q.).The general form can be written as described by (Thapa *et al*., 2022) as follows:

$$\Delta^d y_t = \delta + \theta_1 \Delta^d y_{t-1} + \theta_2 \Delta^d y_{t-2} + \dots\dots\dots \theta_p y_{t-p} + e_{t-1} \propto_2 e_{t-2} \propto_\infty e_{t-2} \quad (1)$$

Where; Δ^d = differencing of order d, i.e. $\Delta y_t = y_t y_{t-1} \Delta^2 y_t = \Delta y_t - \Delta_{t-1}$,

y_t = Price at year t,

$y_{t-1} \dots\dots y_{t-p} =$ Previous observations (lags) of actual prices and output ginger

$\delta_1 =$ Constant

$\theta_1, \theta_2 \dots \theta_p$ = Coefficients of the lagged prices and output for the year under study (2021-2025) similar to regression coefficient of the Auto-Regression process (AR) of order "p" and is written as:

$$y = \delta + \theta_1 y_{t-1} + \theta_2 y_{t-2} + \dots \theta_p y_{t-p} + e_i, \quad (2)$$

Where;

y = forecast prices (2000-2025)

$y_{t-1} =$ lagged prices,

$\delta =$ costant, e_t is a forecast error

$e_{t-1,} \dots\dots e_{t-2,} e_{t-p}$ = Previous forecast error of prices and output

$\propto_1 - \propto_p$ = Moving Average (MA) coefficients that needs to be estimated from the year 2021-2025

ARIMA and TDNN models were used to obtain a robust and efficient forecasting. The time series data was decomposed into a linear and a nonlinear component following (Naveena *et al*., 2017; Šeregelj *et al*., 2023), given as:

$Y_t = L_t + N_t$ (3)

Where;

Y_t = Observed time series data

L_t = Linear auto-regressive component

N_t = Non-linear component

In this approach, the ARIMA model was applied to the data series to fit the linear part, and the residuals were modeled using a neural network based on the evidence of non-linearity for the series. Let r_t be the residual at time *t* of the linear component, then

$r_t = Y_t - \widehat{L_t}$ (4)

Where, $\hat{L}_t$ is the estimate of the linear auto-regressive component of the data series, for non-linear component, the neural network model is given as:

$\hat{\hat{r}}_t = f(r_{t-1,} r_{t-2,.} \ldots, r_{t-p})$ (5)

Where, p is the number of input delays and f is the nonlinear function. So the combined forecast is given by Equation (5):

$Y_t = \hat{L}_t + \hat{r}_t + \varepsilon_t$ (6)

Where; ε_t is the error-term of the combined model at time t.

RESULTS AND DISCUSSION

Ginger forecasting using the ARIMA model

Unit Root Test of the ARIMA Model

The result of the unit root test is shown in Table 1. The application of most time series models requires data to be stationary (Almuammar and Fasli, 2019). The ADF and the Philip-Perron test were applied to test the stationarity of all the data sets considered in this study. It was observed that the output and price of ginger were not stationary at this level (p-values > 0.05). However, the data sets were stationary after the first difference (p-values < 0.05). Thus, it was confirmed that the first differences for all series were perfect for modeling and forecasting..

Table 1: Estimate of unit root of the ARIMA

Variables	Order	Exogenous	ADF test (P-value)	Critical value at 5%	Phillip-Perron test (P-value)	Critical value at 5%
ΔQT_t	1(1)	Constant	-5.3206 (0.0002)	-2.9678	-5.6299 (0.0001)	-2.9678
		Constant and Trend	-5.8259 (0.0003)	-3.5742	-5.8776 (0.0002)	-3.5742
ΔPG_t	1(1)	Constant	-5.2619 (0.0002)	-2.9719	-7.6717 (0.0000)	-2.9678
		Constant and Trend	-5.2186 (0.0012)	-3.5806	-9.2605 (0.0000)	-3.5742

Source: Analysed result from time series data 1990-2020 using EVIEWS 10

Identification of the ARIMA models

Building an ARIMA model for any given time series involves the following four steps: identification of the model, estimation of parameters, diagnostic checking, and forecasting (Box-Jenkins, 1976). The first, which is otherwise imperative, is to verify if the mean, variance, and autocorrelation of the time series are consistent throughout the established interval. Therefore, two-time-series plots, the auto-correlation function (ACF), and the partial auto-correlation function (PACF) graphs were generated to test the seasonality and stationarity. ACF is a statistical metric that determines whether the prior values are related to the latest values, while PACF is the value of the correlation coefficient between its time lag and the variable. Both are imperative in detecting misspecification: the model performance being measured by Akaike information criteria expression and the Bayesian Information Criterion of Schwarz

(BIC).The auto-correlation function (ACF) and partial auto-correlation function (PACF) were used as tools for identifying the parameters of the model. The ACF and PACF at first difference for both ginger output and price are presented in Tables 2 and 3, respectively. In the observed structure of the production series for ginger output in Tables 3.2 and 3, both the ACF and the PACF have a significant spike at lag 5, and only the PACF has significant spikes at lag 6, indicating ARIMA models of ARIMA (5, 1, 5) and ARIMA (6, 1, 5).A diagnostic check on the selected model does not show any significant spike on the correlogram Q-statistics, and all the series are not significant as captured in the correlogram squared residuals test statistics.In the observed structure of the price of ginger series in Table 3.3, only the ACF and the PACF have a significant spike at lags 5 and 4, respectively, giving rise to ARIMA (4, 5). The correlogram Q-statistics test shows a significant spike of the PACF at lag 9, while all the series are not significant as captured in the correlogram squared residuals test statistics. Since there was a significant spike in the correlogram Q-statistics of the PACF, ARIMA (9, 1, 5) was also selected as a model.

Table 2: Correlogram of the output of ginger (Q_t) for model Identification at 1(1)

Autocorrelation	Partial Correlation	No.	AC	PAC	-Stat	Prob
**|. |	**|. |	1	-0.278	-0.278	2.9393	0.086
.|. |	.*|. |	2	0.001	-0.083	2.9393	0.230
.|** |	.|** |	3	0.266	0.265	5.7923	0.122
.*|. |	.|. |	4	-0.175	-0.032	7.0659	0.132
.|*** |	.|*** |	5	0.359	0.357	12.628	0.027
**|. |	**|. |	6	-0.301	-0.260	16.662	0.011
.|. |	.*|. |	7	-0.037	-0.123	16.724	0.019
.|*. |	.*|. |	8	0.113	-0.174	17.339	0.027
.*|. |	.|*. |	9	-0.129	0.089	18.175	0.033
.*|. |	**|. |	10	-0.098	-0.291	18.669	0.045
.*|. |	.|. |	11	-0.132	-0.018	19.612	0.051
.|*. |	.|. |	12	0.088	-0.003	20.047	0.066
.*|. |	.|. |	13	-0.090	0.028	20.524	0.083
.*|. |	.*|. |	14	-0.087	-0.111	20.987	0.102
.|. |	.|. |	15	-0.022	0.029	21.018	0.136
.|. |	.*|. |	16	-0.021	-0.085	21.048	0.177

Source: Analysed result from time series data 1990-2020

Table 3: Correlogram of the price of ginger (PG_t) for model Identification at 1(1)

Autocorrelation	Partial Correlation	No.	AC	PAC	Q-Stat	Prob
**|. |	**|. |	1	-0.246	-0.246	2.3025	0.129
.*|. |	**|. |	2	-0.187	-0.264	3.6797	0.159
.|. |	.*|. |	3	0.045	-0.090	3.7604	0.289
**|. |	***|. |	4	-0.241	-0.350	6.1957	0.185
.|*** |	.|** |	5	0.394	0.261	12.911	0.024
.|. |	.|. |	6	-0.041	0.010	12.985	0.043
.*|. |	.|. |	7	-0.148	0.017	13.995	0.051
.|. |	.*|. |	8	0.033	-0.068	14.047	0.081
**|. |	**|. |	9	-0.263	-0.221	17.495	0.042
.|*. |	**|. |	10	0.108	-0.208	18.101	0.053
.|. |	**|. |	11	-0.002	-0.266	18.102	0.079
.|*. |	.|*. |	12	0.152	0.170	19.405	0.079
.|. |	.|. |	13	-0.005	-0.018	19.406	0.111
**|. |	.|. |	14	-0.244	-0.018	23.088	0.059
.|*. |	.|. |	15	0.112	0.000	23.905	0.067
.|*. |	.|*. |	16	0.114	0.176	24.797	0.073

Source: Analysed result from time series data 1990-2020

Output of the identified ARIMA Models

Table 4 describes the output of the identified ARIMA (5,1,5); ARIMA (6,1,5) for the production series of ginger output (qt); ARIMA (4,1,5); and ARIMA (9,1,5) for the price of ginger (pg), as suggested by their respective ACF and PACF structures. Given the selection criteria set in the methodology, it could be observed that ARIMA (6,1,5) for ginger output and ARMA (9,1,5) for the price of ginger were preferred to others in each of the respective categories because of their high numbers of significant coefficients, lowest volatility of 4.41E+09 for ginger output and 11052.42 for the price of ginger, highest R-Squared values of 0.316503 and 0.243612 in each of the categories, and the lowest AIC and SBIC of 25.33075 and 25.50850 for ginger output, respectively, and 12.42108 and 12.59884 for the price of ginger, respectively.. The selected model used for ARIMA forecasting was ARIMA (6,1,5) for ginger output and ARIMA (9,1,5) for the price of ginger. This result is similar to the findings of Badmus and Ariyo (2011), who reveal that ARIMA (1, 1, 1) and ARIMA (2, 1, 2) are the most suitable ARIMA for the cultivation area and production of maize in Nigeria. This further collaborated with Pani *et al.* (2019), who reported that ARIMA (1, 1, 1) is the most appropriate model to foretell future prices of groundnut in Odisha states of India in 2019.

Table 4: Output of the Identified ARIMA models

	Ginger Output (Qt)		Price of Ginger (PG)	
Variables	**ARIMA (5, 1, 5)**	**ARIMA (6, 1, 5)**	**ARIMA (4, 1, 5,)**	**ARIMA (9, 1, 5)**
Sig. coefficients	1	2	2	2
Sigma^2 (volatility)	4.90E+09	4.41E+09	11861.74	11052.42
R-Squared	0.240572	0.316503	0.188225	0.243612
AIC	25.42599	25.33075	12.46898	12.42108
SBIC	25.60372	25.50850	12.64674	12.59884

Source: Analysed result from time series data 1990-2020

Diagnostics Testing of the Selected ARIMA Models

In order to be sure that the selected model has adequately captured all the inherent structure of differenced ginger output and price series, the correlogram Q-statistics and the correlogram squared residuals diagnostic procedures were employed in each of the models to determine the presence of significant spikes in the correlogram.

The Correlogram Q-Statistics

The Q-statistics for each of the ARIMA (6, 1, 5) and ARIMA (9, 1,5) are presented in Tables 5 and 6. The result showed that the spikes remain within the 95% confidence interval for both ACF and PACF. This also confirms that all the structures within the equation were adequately accounted for by the models.

Table 5: Correlogram Q-statistics plot for ARIMA (6,1,5)

Autocorrelation	Partial Correlation	No.	AC	PAC	Q-Stat	Prob
.*| . |	.*| . |	1	-0.198	-0.198	1.4965	0.000
.*| . |	.*| . |	2	-0.077	-0.121	1.7295	0.000
. |*** |	. |*** |	3	0.424	0.404	9.0010	0.003
.*| . |	. | . |	4	-0.201	-0.063	10.695	0.005
. | . |	. |*. |	5	0.059	0.077	10.843	0.013
. | . |	**| . |	6	-0.053	-0.273	10.969	0.027
. | . |	. | . |	7	-0.053	0.035	11.097	0.049
. | . |	.*| . |	8	-0.003	-0.126	11.098	0.085
.*| . |	. |*. |	9	-0.072	0.099	11.353	0.124
. | . |	.*| . |	10	-0.026	-0.122	11.389	0.181
.*| . |	. | . |	11	-0.105	-0.056	11.985	0.214
. | . |	. | . |	12	0.060	-0.010	12.189	0.273
. | . |	. | . |	13	-0.037	0.025	12.270	0.344
.*| . |	. | . |	14	-0.082	-0.036	12.686	0.392
. | . |	.*| . |	15	-0.008	-0.129	12.690	0.472
. | . |	. | . |	16	-0.046	-0.061	12.833	0.540

Source: Analysed result from time series data 1990-2020

Table 6: Correlogram Q-statistics plot for ARIMA (9, 1, 5)

Autocorrelation	Partial Correlation	No.	AC	PAC	Q-Stat	Prob
. |***** |	. |***** |	1	0.711	0.711	19.737	0.000
. |**** |	. |*. |	2	0.553	0.097	32.042	0.000
. |*** |	. |. |	3	0.441	0.035	40.109	0.000
. |** |	. |. |	4	0.336	-0.024	44.938	0.000
. |*** |	. |** |	5	0.367	0.221	50.897	0.000
. |*. |	***| . |	6	0.163	-0.379	52.106	0.000
. |. |	.*| . |	7	0.005	-0.141	52.108	0.000
.*| . |	.*| . |	8	-0.125	-0.145	52.871	0.000
.*| . |	. |. |	9	-0.197	0.031	54.844	0.000
.*| . |	. |*. |	10	-0.106	0.156	55.432	0.000
.*| . |	. |. |	11	-0.119	0.061	56.214	0.000
.*| . |	. |. |	12	-0.117	0.055	56.990	0.000
.*| . |	. |*. |	13	-0.092	0.088	57.494	0.000
. |. |	. |. |	14	-0.065	0.031	57.759	0.000
. |*. |	. |. |	15	0.074	0.068	58.120	0.000
. |*. |	. |. |	16	0.132	-0.020	59.311	0.000

Source: Analysed result from time series data 1990-2020

Correlogram squared residuals test

The residuals are not only random but are also independent of each other. The structures of each of the residual plots show no defined pattern as they randomly hover around zero. Tables 7 and 8 show the residual plots for ARIMA (6,1,5) and ARIMA (9,1,5). The result of the test shows that all the probability levels of the variables captured in the tables were not significant, hence the application of the selected model.

Table 7: Correlogram squared residuals plot for ARIMA (6,1,5)

Autocorrelation	Partial Correlation	No.	AC	PAC	Q-Stat	Prob
. |** |	. |** |	1	0.302	0.302	3.4809	0.062
. |. |	.*| . |	2	-0.023	-0.126	3.5020	0.174
. |*. |	. |** |	3	0.163	0.233	4.5725	0.206
. |** |	. |** |	4	0.324	0.223	8.9648	0.062
. |*. |	. |. |	5	0.120	-0.026	9.5848	0.088
. |. |	. |. |	6	-0.052	-0.063	9.7034	0.138
. |. |	. |. |	7	0.018	-0.020	9.7185	0.205
. |*. |	. |. |	8	0.109	0.013	10.288	0.245
. |. |	. |. |	9	-0.004	-0.058	10.289	0.328
.*| . |	. |. |	10	-0.070	-0.009	10.545	0.394
. |. |	. |. |	11	-0.057	-0.056	10.722	0.467
. |. |	. |. |	12	-0.028	-0.036	10.768	0.549
. |. |	. |. |	13	-0.064	-0.036	11.006	0.610
. |. |	. |. |	14	-0.064	0.007	11.255	0.666
. |. |	. |. |	15	-0.064	-0.027	11.523	0.715
.*| . |	. |. |	16	-0.066	-0.024	11.820	0.756

Source: Analysed result from time series data 1990-2020

Table 8: Correlogram squared residuals for ARIMA (9, 1, 5)

Autocorrelation	Partial Correlation	No.	AC	PAC	Q-Stat	Prob
**| . |	**| . |	1	-0.225	-0.225	1.9303	0.165
. |. |	. |. |	2	-0.010	-0.064	1.9343	0.380
. |. |	. |. |	3	-0.033	-0.053	1.9783	0.577

. |*. |	. |*. |	4	0.141	0.128	2.8145	0.589
. | . |	. |*. |	5	0.010	0.076	2.8192	0.728
.*| . |	.*| . |	6	-0.188	-0.172	4.3998	0.623
**| . |	***| . |	7	-0.238	-0.349	7.0214	0.427
. |*. |	. | . |	8	0.209	0.045	9.1205	0.332
.*| . |	.*| . |	9	-0.123	-0.089	9.8789	0.360
.*| . |	.*| . |	10	-0.076	-0.092	10.179	0.425
. | . |	. | . |	11	-0.021	0.022	10.201	0.512
. | . |	.*| . |	12	-0.002	-0.093	10.202	0.598
. |*. |	. |*. |	13	0.192	0.087	12.366	0.498
. | . |	. | . |	14	-0.054	0.024	12.543	0.563
.*| . |	. | . |	15	-0.066	-0.058	12.821	0.616
. | . |	.*| . |	16	0.013	-0.144	12.833	0.685

Source: Analysed result from time series data 1990-2020

3.6 Network structure and Model Identification of the ANN Training

The results of the ANN model for the network training are indicated in Table 9. All trainings were subjected to a learning rate of 0.05 with a momentum of 0.5 for both output and the price of ginger. After several trainings with different network architectures based on our ANN algorithm, the network structure that returns the smallest network error (0.136530) was noted to give the best forecasting accuracy with the test data. It was observed that the network structure 1-10-1 (1 input layers, 10 hidden layers, and 1 output layer) with iteration 12,000 was the predictive model with the most accurate output prediction. However, in terms of the price of ginger, the smallest network error (1.571596) with the network structure 1-16-1 (1 input layers, 16 hidden layers, and 1 output layer) and iteration 5,000 was noted to give the best forecasting accuracy with the test data. The two-network structure for output and price of ginger was adopted for the ANN forecasting model.

Table 9: Network Training for Ginger Out and price

Network	**Ginger Output**		Network	**Price of Ginger**	
Structure	Iteration	Network Error	Structure	Iteration	Network Error
1-10-1	10,000	0.137391	1-5-1	2,000	1.599873
1-10-1	5,000	0.139902	1-5-1	5,000	1.577707
1-12-1	10,000	0.139263	1-10-1	2,000	1.602732
1-12-1	5, 000	0.140860	1-10-1	5,000	1.578618
1-5-1	10,000	0.137685	1-12-1	2,000	1.607841
1-5-1	5,000	0.139743	1-12-1	5,000	1.578454
1-10-1	12,000	0.136530	1-16-1	2,000	1.617408
1-5-1	12,000	0.137861	1-16-1	5,000	1.571596
1-12-1	12,000	0.137471			

Learning Rate = 0.05 Momentum = 0.5

Sources: Analysed Result from time series data 1990-2020 (Zaitun time series)

The Predictive Strength of the ARIMA and ANN Model for the Output of Ginger from 2000 - 2025

Table 10 shows the predicted values for ginger output. Since ARIMA (6, 1, 5) and ANN (1-10-1) with iteration 12,000 proved to be a good fit to the model (1990–2020), the models were deployed to predict the selected out of sample series from 2021 to 2025 at a 95% confidence interval. According to the results, both the ARIMA and ANN models used for the output of ginger have a low forecast error, but the ANN model has a lower forecasting error than the ARIMA model. Further results show that the forecasting accuracy level of the ANN model compared with that of the ARIMA model is not quite significant. It can be argued that both models achieved good forecast performance judging from the forecast errors of both models, which are quite low. However, the performance of the ANN model is better than that of the ARIMA model in terms of forecasting accuracy on many occasions from the test data for ginger output. This finding agrees with the work of Chrisy *et al*. (2022) where a statistical test

was carried out, and the result also showed that there is no significant difference between the actual and predicted values of the two models, as the values of ANN and ARIMA are 0.439 and 0.604, respectively. Notwithstanding, ANN was still better.

Table 10: Sample of Predicted result of ARIMA (6, 1, 5) and ANN (1-10-1) for ginger output.

	ARIMA(6,1,5) Predictions for Ginger Output			ANN(1-10-1) Predictions for Ginger Output		
Sample period	Actual values	Predicted values	Forecast Error	Actual values	Predicted values	Forecast Error
2000	142000	150829.6	-0.062	142000	135749.13	0.044
2001	114000	179921.1	-0.578	114000	148625.4	-0.304
2002	105000	196209.3	-0.869	105000	122001.96	-0.162
2003	110000	236515.0	-1.150	110000	114314.36	-0.039
2004	117000	242435.5	-1.072	117000	118533.98	-0.013
2005	125000	273349.7	-1.188	125000	124657.25	0.003
2006	134000	296065.5	-1.209	134000	131967.67	0.015
2007	162390	315936.7	-0.946	162390	140595.13	0.134
2008	145070	340823.1	-1.349	145070	170633.94	-0.176
2009	168800	356301.5	-1.110	168800	151797.62	0.101
2010	172223	385249.1	-1.237	172223	178006.4	-0.034
2011	260179	404406.3	-0.554	260179	182030.86	0.300
2012	380000	426774.9	-0.123	380000	303399.51	0.202
2013	413382	450257.8	-0.089	413382	488128.95	-0.181
2014	496920	471776.2	0.051	496920	534252.94	-0.075
2015	604900	496979.8	0.178	604900	629758.01	-0.041
2016	774887	516907.4	0.333	774887	711548.28	0.082
2017	700000	540670.0	0.228	700000	774604.61	-0.107
2018	734634	563174.6	0.233	734634	754096.45	-0.026
2019	927041	585242.7	0.369	927041	764731.85	0.175
2020	734295	608080.4	0.172	734295	794717.14	-0.082

Sources: Analyses output from time series 1990-2020

Table 11 shows the predicted values for the price of ginger. Since ARIMA (9, 1, 5) and ANN (1-16-1) with iteration 5,000 proved to be a good fit to the model (1990–2020), the models were deployed to predict the selected out of sample series from 2020 to 2025 at a 95% confidence interval. According to the results, both the ARIMA and ANN models used for the price of ginger also have a low forecast error, but the ANN model has a lower forecast error than the ARIMA model.

Further result also shows that the forecasting accuracy level of the ANN model compared with that of the ARIMA model in terms of the price of ginger is not also quite significant. It can also be argued that both models achieved good forecast performance judging from the forecast error of both models which are quite low, however, the performance of ANN model is better than ARIMA model in terms of forecasting accuracy on many occasions from the test data for the price of ginger. This finding agrees with the work of (Ayodele *et al .,* 2014) which shows that ANNs outperformed ARIMA in predicting stock price movement direction as the latter was able to detect hidden patterns in the data used.

Table 11: Sample of forecasted result of ARIMA (9, 5, 1) and ANN (1-16-1)

	ARIMA (9, 1, 5) forecast for price of Ginger			ANN (1-16-1) predictions for price of ginger		
Sample period	Actual values	Predicted values	Forecast Error	Actual values	Predicted values	Forecast error
2000	450.000	528.86	-0.175	450.000	581.05	-0.291
2001	450.000	550.29	-0.223	450.000	529.19	-0.176
2002	654.000	532.93	0.185	654.000	529.19	0.191
2003	654.000	613.16	0.062	654.000	583.57	0.108

2004	662.970	674.58	-0.018	662.970	583.57	0.119
2005	690.500	684.86	0.008	690.500	582.36	0.157
2006	480.000	701.04	-0.461	480.000	577.76	-0.204
2007	398.500	640.60	-0.608	398.500	553.46	-0.389
2008	483.000	632.03	-0.309	483.000	467.16	0.033
2009	524.700	652.67	-0.244	524.700	555.43	-0.059
2010	610.000	662.55	-0.086	610.000	575.59	0.056
2011	385.000	683.84	-0.776	385.000	587.03	-0.525
2012	385.000	676.37	-0.757	385.000	447.18	-0.163
2013	379.540	674.45	-0.777	379.540	447.18	-0.178
2014	562.970	687.60	-0.221	562.970	438.81	0.221
2015	676.330	699.02	-0.034	676.330	584.55	0.136
2016	524.700	733.01	-0.397	524.700	580.28	-0.106
2017	666.279	751.72	-0.128	666.279	575.59	0.136
2018	683.640	761.81	-0.114	683.640	581.87	0.149
2019	500.000	775.09	-0.550	500.000	579.02	-0.158
2020	666.290	784.99	-0.178	666.290	565.20	0.152

Sources: Analyses output from time series 1990-2020

The Out of Sample Forecasting for ARIMA and ANN Model from 2021-2025

The result of the out-of-sample forecast of both the ARIMA and ANN models for ginger output and price is indicated in Table 12. According to the results of ARIMA (6, 1, 5), the forecast of ginger output shows a continued increase in ginger production on a yearly basis from 608080.4 MT in 2021 to 719967.6 MT in 2025. This is also applicable to the result of ANN (1-10-1) which also shows a continued increase in ginger output from 764790.0953 MT in 2021 to 774051.5505. However, the increment associated with the output of the ginger forecast from the ARIMA model was lower than the forecast from the ANN model.

The increase in the future of ginger supply as observed in Table 12 may have occurred because ginger rhizome is a highly sought-after commodity in Asia, Europe, and America; it is widely used in food seasonings; and the root crop is increasingly seeing local and global demands. Farmers have also taken it seriously to add value to their crop in order to unlock potential to earn substantial dollars for the country. Additionally, ginger farming has been introduced to other states, just as a few states cannot feed the whole world with ginger.

Likewise, in recent years, interest in ginger in any of its various forms has been increasing as it is seen as a preventive or therapeutic agent. As such, Nigeria's production and sales will also be on the increase to meet both local and international demands. This coincided with the objectives and targets of the National Development Plan (NDP, 2021–2025). The broad objective of the agriculture plan is to increase the sector's productivity to drive economic growth and meet domestic demand for food. This further stated that by 2025, Nigeria's agricultural productivity is expected to increase as technology, innovation, and climate-smart practices are introduced to ensure the continuous availability of affordable and nutritious food.

The forecast for the price of ginger from ARIMA (9, 1, 5) shows an expected high but steady price increase from ₦803.3715 in 2021 to ₦851.404 in 2025 as compared with the ANN (1-16-1) with a slow but steady price increase from ₦581.1313 in 2021 to ₦585.4804 in 2025.. The price change as captured in the model was steady, therefore ginger farmers will find it easier to respond positively to a change in ginger output as a result of the changes in ginger price in the future. This is in line with the study of Marcus (2019), who opined that ginger farmers find it difficult to predict the price of ginger in a situation of price fluctuation and, as such, maintain an increase in production within some given period of time when the price change is steady.

Although the ginger market valuation is expected to reach USD 3.42 billion by 2023, at a CAGR of 6.6%, According to Expert Market Research, however, the global ginger market size attained a value of USD 5.78 billion in 2022, while the market is projected to grow further at a CAGR of 4.5% to reach a value of USD 7.53 billion within a forecast period of 2023–2028.. However, the study already reveals

that the forecast error for both the ARIMA and ANN models is moderately low, as the predicted values are close to the actual values and move in the direction of the forecast values in many instances, thereby providing insight that the agriculture sector remains a critical lever for ensuring economic development and the wellbeing of Nigeria's populace. With a focus on increasing sector productivity and value addition, Nigeria will transform agriculture into a more significant component of its concentric diversification agenda, resulting in inclusive growth and development.

Table 3.12: Out of Sample Forecast of the ARIMA and ANN Model from 2021- 2025

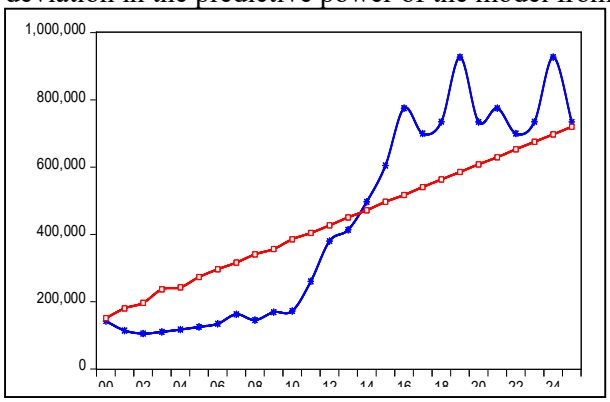
Year	ARIMA Forecast		Year	ANN Forecast	
	Qt	Pg		Qt	Pg
2021	629474.5	803.3715	2021	764790.0953	581.1313
2022	652935.4	820.1181	2022	772122.3266	585.2562
2023	674894.0	832.4239	2023	773670.3426	585.4703
2024	697345.3	845.2415	2024	773987.1425	585.4799
2025	719967.6	851.4048	2025	774051.5505	585.4804

Sources: Analyses output from time series 1990-2020

The Forecasting Trend of the ARIMA and ANN Model for the Output of Ginger

The ARIMA (6,1,5) and ANN (1-10-1) distributions of the historical series of the actual and forecasted ginger output indicators are shown in figures 1a and 1b. The forecast captured the period from 2000 to 2025. The result of the ARIMA (6,1,5) for ginger output shows the forecast graph in red and the actual output in blue. There was a wide deviation in the predictive power of the model from 2000 to 2012; the prediction from 2012 to 2014 was almost exact and became exact in 2015; there was a slight deviation in the forecasting strength of the model from 2015 to 2024 and became exact in 2025.

The result of the ANN (1-10-1) for the output of ginger also shows the forecast output graph in red and the actual output of ginger in blue. The forecasting power of the model indicates a closer range and similar predictions than the ARIMA model with the same and similar predictions of the actual ginger output flows from 2002 to 2010, with only a few cases, of close-range deviation. There was a close deviation in the predictive power of the model from 2010 to 2013, 2015, 2016, 2018, 2021, and 2023.



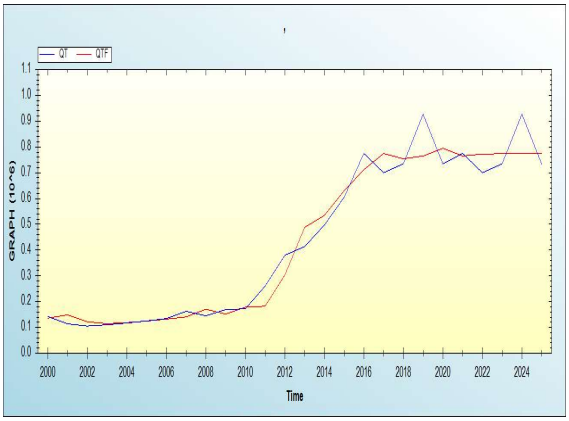


Figure 1a: Fitted forecast of ARIMA (6, 5, 1)

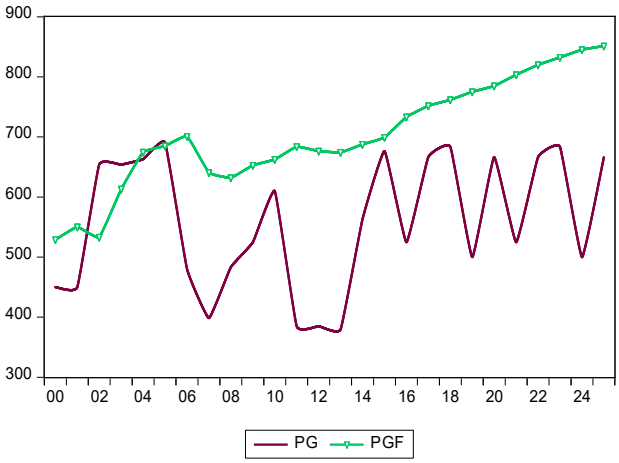
Figure 1b: Fitted Forecast of ANN (1-10-1)

Sources: Analyses output from time series 1990-2020

The Forecasting Trend of the ARIMA and ANN Model for the Price of Ginger

The ARIMA (9,1,5) and ANN (1-16-1) distributions of the historical series of the actual and forecasted ginger price indicators are shown in figures 2a and 2b. The forecast captured the period from 2000 to 2025. The result of the ARIMA (9, 1, 5) for the price of ginger shows the forecast graph in light green

and the actual price of ginger in dark brown. The forecasting power of the model indicates the same and similar predictions of the actual price in 2002 and between 2004 and 2006. There was a wide deviation in the predictive power of the model from 2007 to 2015, 2017 to 2019, and between 2020 and 2025. The predictions for 2010, 2015, 2017, 2021, and 2022 were slightly off from the actual values.
The result of the ANN (1-16-1) for the price of ginger also shows the forecast output graph in red and the actual output of ginger in blue. The forecasting power of the model indicates a closer range and similar predictions than the ARIMA model. There was a wide range deviation of the predictive power from the year 2000 and became exact mid-2001 and 2002; the deviation became wider between 2002 and 2005 and became exact mid-2005 and 2006. The trend continues from mid-2005 to 2007 and becomes exact in mid-2007 and in 2008.
A close deviation was observed between 2008 and 2009 becoming exact at 2010. Further result shows a wide range of deviation from 2010 to mid-2014, the deviation from the actual values follows a similar pattern, becoming exact at 2015, mid 2016, 2018, 2019, mid 2020, mid 2021, mid 2023 and 2024.



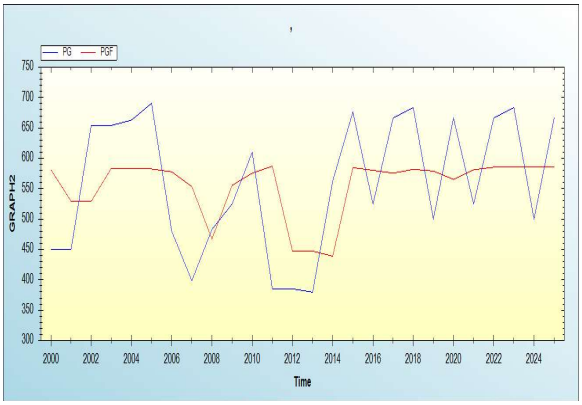


Figure 2a: Fitted forecast for ARIMA (9, 1, 5) Figure 2b: Fitted forecast for ANN (1,16,1)
Sources: Analyses output from time series 1990-2020

Conclusion and Recommendations

The study analyzed the forecast trend of price and output prediction of Nigeria's ginger subsector from 2021 to 2025. The study reveals a consistent increase in both price and output of ginger in Nigeria throughout the forecast period. The price change, as captured in the model, was steady; therefore, ginger farmers will find it easier to respond positively to a change in ginger output as a result of the changes in ginger price in the future.
The performance of the ANN predictive model developed in this study was more accurate than the conventional ARIMA model. These findings revealed that both the ARIMA model and the ANN model can achieve good forecasts in application to real-life problems and thus can be effectively and profitably employed for stock price and output prediction.

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

i. More effort should be put into the production of ginger, as past productions affect the future quantity produced.
ii. Formation of more public and private digital commodity marketing boards like AFEX to complement those abolished during the SAP period in order to improve effective marketing and pricing policies that would increase farmers' sensitivity to price movement at various markets.

iii. . More government commercialization policy that will identify ginger as a potential focal crop for the export market should be created and implemented consistently to maintain a steady pattern in ginger production.

iv. The use of ARIMA and ANN models in forecasting should be encouraged and exploited in order to obtain a more accurate prediction of future values, taking advantage of the ANN model as an efficient tool for investors to take precautions against potential investments.

REFERENCES

Almuammar, M. and Fasli, M. (2019). Deep learning for non-stationary multivariate time series forecasting. In *2019 IEEE international conference on big data (Big Data)*. Pp 2097-2106).

Ayodele, T. J. and Sambo, B. E. (2014). Ginger (*Zingiber officinale Roscoe*). Production Efficiency and Constraints among Small-Scale Farmers in Southern Kaduna. *Nigeria. Journal of Agricultural Scienc*e, 6 (8), 141 – 148.

Badmus, M. A. and Ariyo, O. S. (2011). Forecasting cultivated areas and production of maize in Nigerian using ARIMA Model. *Asian Journal of Agricultural Sciences*, 3 (3): 171 – 176.

Christy, O. N., Umar, Y. H. and Agbailu, A. O. (2022). A comparative study of Autoregressive Integrated Moving Average and Artificial Neural Networks models. *Studies*, 5 (3): 54 – 74.

National Agricultural Extension and Research Liaison Services (NAERLS) (2020). Agricultural Performance Survey of 2020 Wet Season in Nigeria. Pp 2 – 297.

Nmadu, J. N. and Marcus, P. L. (2013). Efficiency of Ginger production in selected Local government Areas of Kaduna State. *International Journal of Food and Agricultural Economics*, 1 (2): 39 – 52.

Pakhuan, W. and Sukanlaya, C. (2021). Impacts of the Covid-19 pandemic: Supply chains, labour and Food security in North-east Thailand. *Journal of Forest and Societ*y, 5 (1): 120 – 135.

Šeregelj, V., Tumbas Šaponjac, V., Pezo, L., Kojić, J., Cvetković, B. and Ilic, N. (2023). Analysis of antioxidant potential of fruit and vegetable juices available in Serbian markets. *Food Science and Technology International*, 10820132231158961

Sodangi, I. A. (2020). Effect of cultivars on the growth and yield of ginger in Kafanchan, Kaduna State, Nigeria. *Science World Journal*, 15 (4): 132 – 134.

Thapa, R., Devkota, S., Subedi, S. and Jamshidi, B. (2022). Forecasting area, production and productivity of vegetable crops in Nepal using the Box-Jenkins ARIMA model. *Turkish Journal of Agriculture, Food Science and Technology*, 10 (2): 174 – 181.

United Nation (UN, 2022). World population prospects 2022. Department of Economic and Social Affairs, Population Division.

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16th – 19th October, 2023

Theme: *Competitive Agricultural Industry: Policies, Designs, and Infrastructure*

The Impact of Yam Value Chain on Profitability in Kwara State, Nigeria

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Abstract

The development of dynamic agricultural value chains has been acknowledged to offer considerable scope in improving the livelihood of the chain actors. This study analyzed the profitability and marketing margins obtained by actors at various nodes of the chain; and examined the organizations of the value chain, linkages among the key actors and the challenges faced by actors in the value chain in Baruteen Local Government Area (LGA) of Kwara State. A three-stage sampling technique was used to select 120 respondents consisting of 40 producers, 20 processors, and 60 market agents from whom data for the study were collected using three sets of structured questionnaires. The collected data were subjected to four analytical tools including; descriptive statics, budgetary, marketing channels and Chi Square analyses.

Findings revealed significant difference in the net income of the value actors, with the processors having the highest share ₦3,558,630, followed by the marketing agents ₦1,426,497 and the least ₦26,773.34 by the producers. It was also revealed that marketing margins differed among the actors with yam marketers obtaining higher prices and profit margins per kg of yam. The identified constraints affecting yam value chain were inadequate market information, inadequate storage facilities, inadequate transport facilities, unfavourable government policies, high cost of production, and inadequate record keeping.

The study recommends the need for capacity-building among yam value chain participants to promote yam value addition, inclusion of smallholder farmers in the value chain by scaling up their level of awareness. Extension training on record keeping for effective resource management and increased income and encouragement on formation of Yam farmer's cooperative society to improve access to affordable agricultural inputs to reduce cost of production.

Keywords: *Yam, Value Chain, producers, processors and marketing agents*

Introduction

The term value chain was first popularized in a book published in 1985 by Michael Porter who used it to illustrate how companies could achieve "competitive advantage" by adding value within their organizations. Increasingly, the value chain approach is being used to guide and drive high -impact and sustainable initiatives focused on improving agricultural productivity, competitiveness, entrepreneurship, and growth of small and medium enterprises (SMEs) (Word Development Report, 2008). Value chains are key framework for understanding how inputs and services are brought together and used to grow, transform, or manufacture a product; how the product then moves physically from the producer to the consumers; and how values increase along the way (Zamora, 2016) The value chain perspective provides an important means to understand business to business relationship that connect the chain, mechanisms for increasing productivity and add value. It can contribute to business initiation and better linking of small businesses with the market (*Anandajayasekeram, P. and BerhanuGebremedhin, (2009)*.

Value chain approaches have been utilized by development practitioners and researchers alike to capture the interactions of increasingly dynamics complex markets in developing countries like Nigeria and to

examine the inter-relationships between diverse activities involved in marketing channel (Kaplinsky,2000; 2004; Dlan and Humphrey, 2000; Pietrobelli and Saliola, 2008; GTZ,2007)
Moreso, going beyond firm- or activity – specific, analysis of value chain allows for an assessment of the linkages between and amongst productive activities.
Value chain analysis –(VCA) is a continuous process of identifying and evaluating the primary and supporting activities, required to add value at each step the product flows, to create value for customers. VCA also provides basic understanding needed for designing and implementing appropriate development programs and policies to support market participation. An important aspect of value chain approach is that it considers both the vertical relationship among actors in the chain as well as horizontal impacts on the actors in the chain, such as input and finance provision, extension support and the general enabling environment. The focus of the current study is the vertical relationship among actors in the yam value chain in Nigeria
Yam (Dioscorea species) is in the class of tubers serving as an important staple food crop and cash crop in Nigeria. Yam with an annual production of about 50 million Tonnes, making 70%of global yam production, and valued at $13.6 billion, is central to conversations around food security in Nigeria. According to the International Institute of Tropical Agriculture (IITA, 2013), yam is an integral vehicle for food security, source of income, and employer of labour in the producing areas in Nigeria. The permanent secretary Federal Ministry of Agriculture and Rural development, Ernest Umakhihe (2022) confirmed that Nigeria is the leading producer of fresh yam globally. However, Despite the large yam market in Nigeria and its socio-cultural significance, the yam value chain – from farm to market – is rife with challenges. The challenge of demand-supply deficit (Verter & Becvarova, 2015) traced to postharvest losses, low shelf life, inadequate investment capital, and lack of access to profitable marketing. Also, the challenge of traditional, ad hoc method of yam transactions between farmers and traders where crops are produced, without farmers having a clear idea in advance of when, to whom and at what price they are going to sell their crops.
These challenges, combined with the current economic conditions across the country, threaten to further impoverish yam farmers in rural areas and push yam prices further beyond the reach of the average Nigeria These therefore, call for studies on sustainable handling of food crops and a better approach to food transactions. Farmers only need to produce what will meet the requirements of buyers rather than relying on markets to absorb what they produce. Creation of awareness and documentation of the potentials of value chain will be of immense assistance in this regard. This study therefore, seeks to provide some empirical evidence on the economic impact of value chain on yam production in Kwara State, Nigeria to assist in appropriate formulation of policies which will expose smallholders to the potentials of value chain. The research therefore set out to answer the following questions:

Research Question

This study aims to provide answers to the following research questions:

- Who are the major actors in the yam value chain?
- what are the marketing margin and profitability along the value chain?
- What are the principal constraints and challenges facing the value chain actors'?

To answer the questions the following objectives were considered.

The broad objective: of the study is to analyze the impact of value chain the profitability of yam production in Kwara State, Nigeria. The specific objectives are:

- To analyze the profitability and marketing margins obtained by actors at various nodes of the yam value chain from production to consumption.
- Identify constraints and challenges faced by value chain actors.

Research Methodology

The study was carried out in Baruteen Local Government Area of Kwara State (9°35'N3°15'E) being the leading yam producing community in the State. Primary data were obtained through structured questionnaires administered to 120 value chain actors in the study area. A three-stage sampling technique was employed in the selection of the respondents. The first stage entailed purposive selection of Baruteen LGA being the largest yam producing community in the state. This was followed by the use of a stratified sampling technique to divide the yam value chain actors into strata; each stratum

represents yam producer, yam processors and marketing agent (wholesaler and retailers). Thereafter, random sampling on the basis of percentage proportionate to size was used to select 120 respondents consisting of 40 producers, 20 processors, and 60 market agents. Collected data were subjected to both quantitative and qualitative analysis to achieve the specific objectives of the study. The qualitative analysis employed descriptive statistics including; percentages, frequency distributions and mean flow charts to capture the socio-economic characteristics of the respondents and also to indicate the organization and linkage among key chain actors, as well as the challenges facing yam value chain actors. The quantitative analysis involved the use of marketing margin and profitability analyses to describe profitability and marketing margins at each node in the chain.

Profitability was measured through; Net Farm Income, Benefit Cost Analysis, and Returns on investment analyses.

Net Income (NI) =TR-TC (TFC+TVC)

Where; TR=Total Revenue; TC=Total Cost; TFC=Total Fixed Cost; TVC= Total Variable Cost.

Rate of return (ROR) $= \frac{Total\ Revenue\ (TR)}{Total\ cost\ (TC)}$ X 100

It measures the return to a segment of the value chain actors as a result of spending a unit cost on production

Rate of Return on Investment (RORI) $= \frac{Net\ farm\ income}{Total\ cost}$ X 100

Measures the actual gain per Naira invested

Benefit Cost Ratio: B.C Ratio= $\frac{\sum \frac{Bt}{(1+r)^t}}{\sum \frac{Ct}{(1+r)^t)}}$

Benefit/Cost ratio is the ratio of discounted costs to discounted revenue and is given by the formula above. It shows whether the enterprise is making a profit or loss or breaking even

Profit margin analysis

Profit margin is the difference between revenues, (Quantities × prices the customer pay) and the sum of all costs incurred with the production and delivery of the product/service including fixed costs, variable costs and intermediate costs. Profit margin aimed at determining net returns obtained by actors at various nodes of the yam value chain from production to consumption. At each stage of the yam value chain, profit margin was obtained by subtracting the estimated total cost, fixed as well as variable costs of production/ processing/ marketing from the value of total output as shown in the following formula:

PMi= TRi - (TVCi + TFCi)

Where;

PMi= Profit margin at stage i

TRi= Total revenue at stage i

TVCi= Total variable cost at stage i

TFCi= Total fixed cost at stage i

i = represent stages along

Marketing margin analysis

Marketing margin measures the share of the final selling price that was captured by a particular agent in the value chain. It is the cost of providing a mix of market services by market participants. The margin is calculated by finding the price variations at different nodes in the chain and then comparing them with the final price paid by the consumer.

The consumer prices were held as common denominators in calculating all gross marketing margins (Mendoza and Rosegrant, 1995).

. The total gross marketing margin (TGMM) and the actor's gross marketing margins (GMM) were calculated using the following formula:

TGMM $= \frac{CP-P}{CP}$ X 100 …….. …….(1)

GMMi $= \frac{SPi-SPi}{CP}$ X 100 ……..(2)

Where: TGMM = Total gross marketing margins in (%)

CP = Consumer price in Naira
PP = Producer price in Naira
GMMi = Gross marketing margin of ith agent at a given point in the value chain in (%)
SPi = Selling price by ith agent at a given point in the value chain in naira
SPi-1 = Selling price by a preceding agent (i – 1), is the buying price paid by ith agent at a preceding point in the value chain in Naira

Results and Discussion

This section describes the socio-economic characteristics of the yam value chain actors, challenges faced by the respectful value chain actors as well as the profitability and marketing margins of value chain actors at each node of the chain.

Table 1: Socio economic characteristics of the yam producers, yam processors and marketing agents

	YAM PRODUCERS (N=40)		YAM PROCESSOR (N=20)		MARKETING AGENTS (N=60	
	FREQUENCY	PERCENTAGE (%)	FREQUENCY	PERCENTAGE (%)	FREQUENCY	PERCENTAGE (%)
GENDER						
MALE	29	72.5	11	55	39	65
FEMALE	11	27.5	9	45	21	35
AGE						
20-30	21	52.5	7	35	25	41.7
31-50	19	47.5	13	65	35	58.3
MARITAL STATUS						
SINGLE	26	65	9	45	33	55
MARRIED	14	35	11	55	27	45
FAMILY SIZE						
1 – 10	24	60	9	45	50	83. 4
11 – 20	16	40	11	55	10	16.6
EDUCATIONAL STATUS						
NO FORMAL	12	30	4	20	9	15
FORMAL	28	70	16	80	51	85
YEARS OF EXPERIENCE						
1-10	18	45	8	40	31	52
11 – 20	22	55	12	60	49	48
SOURCE OF INVESTMENT						
FAMILY &FRIENDS	36	90	17	85	43	71.7
LOAN FROM BANK	1	2.5	2	10	10	16.7
COOPERATIVES	3	7.5	1	5	7	11.6
FARMLAND SIZE			SCALE OF OPERATION			
≤1 Ha	15	37.5	SMALL = 3	15	-	-
>1-5Ha	20	50	MEDIUM= 13	65	-	-

>5-10Ha	5	12.5	LARGE = 4	20	-	-

Source: Field survey, 2020

Table.1 reveals that both male and female farmers were involved in production' processing and trading. They were between the age bracket of 20 and 30 years This may have resultant improvement in yam value addition because youths with more strength and agility are into yam business. Majority of them were married with large household sizes ranging between 10 and 20 across board to provide cheap family labour. High percentage of the respondent had formal education ranging from primary to tertiary levels and had at least 6 years' experience in their various activities. Both education and experience imply positive effect on their productivity.

Majority of the actors are small and medium scales and they source their investment through personal savings

Measures of Profitability of the Value Chain Actors in the Study Area

Table 2 The cost, benefit and net income of the value chain actors in yam production.

Variables	Producers	Processors	Marketers
Value of cost and benefit	₦	₦	₦
Average revenue	132,050	25,835,950	10,442,125
Average variable cost	91068	22,265,010	-
Average fixed cost	14,208.6	12,310	-
Average total cost	105,276.6	22,485,770	9,015,628
Gross margin (TR-VC)	122882	33,570,940	-
Net farm income (ATR -ATC)	26,773.4	3,558,630.00	1,426,496.667

Source: Field survey, 2020

Tables 2 shows the cost, benefit, and net farm income of the value chain actors (producers, processors and marketing agents) respectively. Analysis indicated that average net income obtained by the actors in the chain varied significantly from one another. The yam producers had an average net farm income of ₦26,773.34 while the processors and marketing agents had ₦3,558,630, and ₦1,426,496.667 respectively. The result implies that the processors had higher Net Income than both the producers and the marketers. This may probably be a reward to value addition activities in processing and also take care of additional cost incurred in processing. Yam produce is bulky and perishable, to increase the shelf life, retain yam quality and present in the forms that best suits the consumers the processors need to be engaged in various forms of activities such as transportation, storage and paying of wages, all with cost implications. The net farm income of the marketers is the next after processors; this is because Marketing agents also perform additional functions including that of place and time. They gather yam produce either directly from the farmers or the processors and distribute to consumers at different locations and appropriate time. They need to provide suitable transportation and storage facilities for these purposes with their associated costs. The net income of the producers is the least. This is because they often sell off their produce immediately after harvesting probably because they do not have appropriate storage facilities (as expressed by most of the respondents) for fresh yam which is bulky and perishable in nature.

Table 3: Summary of Economic Indicators of Yam Value Chain

	VALUE CHAIN ACTORS		
INDICATORS	**PRODUCERS**	**PROCESSORS**	**MARKETING AGENTS**
NET FARM INCOME (₦)	26,773.40	3,558,630	1,428,496.67
RETURN ON INVESTMENT (%)	164.72	111.14	114.38
RATE OF RETURN ON INVESTMENT (RORI)	0.65	0.11	0.14
BENEFIT COST RATIO	1.65	1.11	1.14

The results of the various economic indicators are as presented in Table 3. The rate of return analysis shows the return to each segment of yam value chain in the study area as a result of spending a unit cost (₦100) on their enterprises This implies that spending (₦100 on yam production or processing or marketing will make a return of ₦165 for the producer, ₦111 for the processor and ₦114 for the marketer. This finding implies that despite high cost of production and marketing, yam production is highly profitable it makes more return than processing and marketing. The finding is in line with AIIT submission in 2011

Also, from the Table, Rate of return per unit of capital investment shows the actual gain made per naira invested by each segment of the yam value chain. This implies therefore that yam producers, processors and marketers made a gain of 65k, 11k and 14k per Naira spent on their enterprise. RORI is used for investment decision by comparing the return with the ruling market interest rate. When ROCI is higher than the ruling market interest rate, it implies that the investment is worthwhile. The business is profitable. But if otherwise it is better to keep the money in the bank or invest in another business enterprise. Since the market interest rate in the year under consideration is 10% (i.e. 10k on every Naira kept in the bank) which is lower than any of the ROCI calculated, it shows that yam venture is profitable. This conclusion was supported by the responses of the producers who indicated that they were satisfied with their work and had no plan changing to other occupation or business.

Benefit-Cost Ratio of yam production enterprise is 1.65, 1.11 of yam processing, and 1.14 of marketing agent. The rationale behind benefit cost analysis is to determine the level of solvency of each enterprise. It shows the capability of each enterprise to offset their cost of production. Since B/C ratio is more than one in all the enterprises, it implies that yam ventures are profitable and solvent. The ventures are capable of offsetting their cost of production and still remain in business

Marketing Margin:

Table 4: Marketing Margin among the Value Chain Actors

	Price at different level (₦/yam bag)				
Value Chain → Actors	Producer's Farm Gate Price	Processor's price	Market price	Gross Margin	Total gross margin (%)
Yam price	250	500	650		
Farm Gate vs processor				250	50
Processor vs marketer				150	23.08
Marketer vs Farm Gate				400	61.50

The result shows that each value chain actors earn different price margin for the duties they perform in the marketing channel. These include transportation, storage, wages etc. Prices at the processing and marketing levels are higher than at the production stage because value is added to yam gradually as yam move from initial stage of production to the market. Values that will reduce post harvest wastage, increase quality as well as the shelf life of yam produce

Constraints and Challenges Faced by Value Chain Actors

Many problems have been identified facing yam production but the most important challenges are identified below.

Table 5: Challenges Facing the Respondent Value Chain Actors

	PRODUCERS		PROCESSORS		MARKETING AGENTS	
PROBLEMS	**FREQUENCY**	**(%)**	**FREQUENCY**	**(%)**	**FREQUENCY**	**(%)**
Inadequate Capital	38	95.0	15	75.0	N/A	N/A
Unavailability of Improved Input	**31**	**77.5**	**N/A**	**N/A**	**N/A**	**N/A**
Inadequate Storage facilities	28	70.0	16	80.0	43	71.7
Inadequate Market Information	**32**	**80**	**15**	**75**	**49**	**81.7**
Inadequate Transport Facilities	27	67.5	14	70.0	44	73.3
Unfavourable Government Policy	**27**	**67.5**	**14**	**70**	**N/A**	**N/A**
Inadequate Record keeping	25	62.5	14	70.0	39	65.0
Unstable Supply	**N/A**	**N/A**	**N/A**	**N/A**	**40**	**66.7**
High Cost of Produce	N/A	N/A	16	80.0	40	68.4
High Competition among Marketers	**N/A**	**N/A**	**N/A**	**N/A**	**46**	**76.7**
Low Quality Produce	**N/A**	**N/A**	**N/A**	**N/A**	**31**	**51.7**
Unstable Demand	N/A	N/A	N/A	N/A	39	65.0

Source: Field survey, 2020. NA implies Not Applicable

Table 4.8 shows that the major constraints faced by producers in yam value chain include low capital formation, inadequate market information, unavailability of improved inputs, inadequate storage facilities, inadequate transport facilities, unfavorable government policy, inadequate record keeping constituting 95%, 80%, 77.5% , 70%, 67.5%, 67.5%, 62.5% of the respondents respectively. The result also revealed that for the processors shows that 75% of the respondents are faced with the problem of inadequate capital, high cost of produce (80%,), inadequate storage facilities (80%,), inadequate market information (75%), inadequate transport facilities (70%,), , unfavorable government policy (70%) as well as inadequate record keeping representing 70%

For the marketing agent respondents, the result shows the 66.7%, 68.4%, 71.7%, 81.7%, 73.3%, 76.7%, 51.7%, 65%, 65% are faced with the problem of: unstable supply, high cost of produce, inadequate storage facilities, inadequate market information, inadequate transport facilities, high competition among marketers, low quality produce, unstable demand and inadequate record keeping**.**

Summary, Conclusion and Recommendations

Summary

This study was carried out to investigate the economic impact of value chain on profitability of yam business in Baruten LGA in Kwara State. Primary data was used and analysed using descriptive statistics, and quantitative method.

The result showed that yam value chain actors were educated male and female youths. They were mostly small-scale players, The costs and returns analysis indicated that for each value chain actors the Benefit Cost ratio are 1.65; 1.11; and 1.14 respectively. Marketing margins differed among value chain

actors with yam marketers obtaining higher prices and profit margins per bag of yam, while the producers had the least.
The major constraints as perceived by the actors in yam value chain include: inadequate storage facilities, inadequate transport facilities as well as inadequate capital among others.

Conclusions

The finding of the study indicated that processors and traders had higher net income than the producers attributable to value addition along the value chain. The average net farm income realized by the producers is ₦26,773.34 while the net income gained by the processors and the marketing agent are ₦3,558,630 and ₦1,426,497 respectively. In the light of this, it is evident that value addition enhances net income of the players thereby constituting veritable means of improving the livelihood of the various actors in the chain.

Recommendations

Based on the above findings, the following recommendations and suggestion are proposed

i. Given the strategic importance of agricultural value chain, there is need for capacity-building among yam value chain participants to enhance yam value addition.
ii. Government should scale up the level of awareness by smallholder farmers on the various opportunities available in the value chain to enhance their inclusion in the value chain.
iii. On-farm infrastructure such as irrigation, post-harvest storage, processing facilities as well as rural road should be provided by the Government for improved value chain performance and market linkage
iv. Improved and high quality planting yam material should be made available to the producers to prevent post harvest losses of yam produce.
v. Regular training should be provided by agricultural extension agents to farmers on innovative production and marketing processes to enable them produce high quality product and benefit from high-value market,
vi. Improved access to affordable financing and other agricultural inputs by value chain actors should be provided to enhance their competitiveness in the value chain

REFERENCES

Anandajayasekeram, P. and BerhanuGebremedhin, (2009). Integrating innovation systems perspective and value chain analysis in agricultural research for development: implications and challenges. Improving Productivity and Market Success (IPMS) of Ethiopian farmers project working paper 16. ILRI (International Livestock Research Institute), Nairobi, Kenya.

Ayado S (2017). Discordant tunes over yam export policy in Nigeria. Article published in the Leadership Newspaper 19th june 2017

Elvira A. Zamora 2016 Value chain analysis; A brief review Asian Journal of Innovation and policy

FAO,2013. FAOSTAT DATABASE. (Online). Available at http://bit.ly/NmQz zif. (Accessed:6/17/2018

IITA, 2013. Healthy yam seed production, IITA publications. retrieved from IITA Website http://www.iita.org/publicatios

Kaplinsky, R and Morris, M. (2001).A manual for value chain research. Institute of Development Studies, Brighton. 212pp.

Mendoza, G., (1995). A premier on marketing channel and margins. Lyme Rimer Publishers Inc., USA.

Shepherd, A. (2014). Approaches to linking producers to markets" (PDF). FAO. Retrieved 25 February 2014.

Stamm, A. and C. von Drachenfels. (2011). Value chain development: Approaches and activities by Seven UN Agencies and Opportunities for Interagency Cooperation. International Labor Office, Geneva

Verter, N.and Becvarova, V.2014. Yam production as pillar of food security in Logo Local Gvt Area of Benue State, Nigeria. European Scientific Journal, 10 (31):27-42

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Comparative Analysis of Preference for Cooking Energies among Rural and Urban Households in Osun State

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Abstract

Introduction

Household cooking energy is a major part of the total energy utilized at home (Mainimo et al., 2022). It generally refers to the energy used in a household including animal dung, firewood, charcoal, kerosene, electric stoves, and Liquefied Petroleum Gas (LPG). In general, households frequently use more than one source of cooking energy. These have been categorized by Bolaji (2012) as follows: traditional (dung, agricultural residues, and firewood, intermediate (charcoal and kerosene), or modern sources (Liquefied Petroleum Gas (LPG), biogas, plant oils and, electricity).

Cooking in a household involves the use of solid fuel and non-solid fuel (Alphonsus *et al,* 2014). Solid fuels include fossil fuels (coal, peat) and biomass (wood, animal dungs, and agricultural products), while solid fuels consist of kerosene, electricity, liquefied natural gas such as ethanol gel, dimethyl ether, etc. The use of some solid fuels has been associated with indoor pollution and unsafe levels of toxic emission (Staton and Harding, 2011). Therefore, for effective prevention and intervention against indoor pollution from household fuel, it is important to identify suitable patterns of household cooking fuel for sustainable indoor air quality for man's survival in order to reduce diseases and child mortality in urban and rural areas.

The volume and type of energy use in both rural and urban households depend on many factors such as population size, lifestyle, economic status of the household, urbanization, type of residence, age of the occupants, and literacy level of the household (Nnaji et al., 2012). Although households require energy for various uses, cooking is one area that has received less attention from international and local communities (Kees and Feldmann, 2011).

Cooking could be a less energy-consuming activity but more than 2.6 billion people rely on traditional fuel and technologies to cook, shifting cooking fuel and technologies have significant potential to improve the sustainability of development and the welfare of individuals by addressing multiple problems, ranging from gender to health and the environment (Foell *et al*., 2011).

In Nigeria, a large population lives in rural areas, and firewood is the major source of energy for cooking and lighting (Uwaegbute, 2011), leading to the release of large amounts of health-damaging pollutants such as particulate matter, SO2, CO2, etc. into the air. Since women are primarily responsible for cooking especially in developing countries and their children often spend time with them while they are engaged, he cooking activities, women and young children are the most affected by indoor air pollutants (Banik, 2010). The International Agency for Research on Cancer (IARC, 2017) lists Household Air Pollution from the combustion of biomass as probably carcinogenic. Some prominent health effects

caused by solid fuel include acute respiratory infection in children below five years of age due to exposure to smoke, low birth weight, eye problems and chronic obstructive pulmonary disease.
Despite the abundant sources of renewable and non-renewable energy, Nigeria national energy supply is still largely dependent on fossil fuels and firewood (50.5 %), petroleum products (41.3%), and hydroelectricity (8.0 %) while solar, wind geothermal, coal and nuclear sources are largely ignored for the domestic energy needs. While fossil fuels constituted 94 % of exports from Nigeria in 2006, only a small fraction of this is available for domestic use, and about 40% of households are connected to the national electricity grid despite the epileptic nature of power supply from the national grid (Akpu, 2012). Hence, this study analyzed rural and urban household preferences for cooking energy in Osogbo, Osun State. The specific objectives were to identify the used and preferred cooking energy types among the rural and urban households in the study area, examine the determinants of preferred cooking energy types among the rural and urban households, and identify the constraints to the usage of the cooking energy types in the study area.

METHODOLOGY

The study was conducted in Osun State in southwestern Nigeria. The target population for consists of 119 respondents based on households drawn from the study area. A three-stage sampling procedure was employed in selecting the representative households. Stage one involved a random selection of two Agro-Ecological Zones (Osogbo and Ife-Ijesha) out of three (Osogbo and Ife-Ijesha and Iwo) in Osun State. In stage two, four rural towns (Dagbolu, Erin-Oke, Erin-Ijesha, and Iragbiji) and four urban cities (Ede, Ikirun, Ilesha, and Ilobu) were randomly selected. In stage three, forty-one households and seventy-eight households were proportionately selected in both rural and urban areas respectively. The difference in sample size in rural and urban areas was due to the higher numbers of households residing in urban areas compared to the rural areas within the study area. The total number of the sampled household for this study was gotten from the below sample size formula (n) which include a confidence level of 98% and marginal error of 9:

$$n = \frac{NC^2}{C^2+(N-1)e^2}$$

where n = sample size
N = number of households in the study area
C = Confidence level
e = marginal error

Table 1: Proportionate Sampling of Rural and Urban Households in Osun State.

Rural Area	No of Household Sampled	Urban Area	No of Household Sampled
Dagbolu	10	Ede	22
Iragbiji	12	Ikirun	24
Erin-Ijesha	9	Ilesha	16
Erin-Oke	10	Ilobu	16
TOTAL	**41**		**78**

Primary data were obtained with the aid of a semi-structured questionnaire and interview schedule. The primary data collected include; socio-economic characteristics of the household head and respondents used and preferred cooking energy types and constraints to the usage of cooking energy types in the study area.

Analytical Technique

Descriptive statistics such as frequencies and percentages were used to describe the socio-economic characteristics of the household head and respondents, used and preferred cooking energy types and constraints to the usage of each cooking energy type in the study area while multinomial logistic regression (MLR) was used to examine the determinants of preferred cooking energy types in rural and urban areas in the study area. MLR describes the behavior of consumers when they are faced with a variety of goods with a common consumption objective. MLR also assumes that the preference of a household's cooking energy is based on the maximization of the utility derived from this energy.

Multinomial Logistic Regression in its linear function is given as follows:

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \mu$$

Where y = Household cooking energy

X_1 = Sex of the household head

X_2 = Sex of the respondents

X_3 = Age of the household head (number)

X_4 = Age of the respondents (number)

X_5 = Marital status of the household head

X_6 = Household size

X_7 = Level of education

X_8 = Number of years spent in school (number)

X_9 = Primary occupation of the household head

X_{10} = Primary occupation of the respondent

X_{11} = Other occupation of the household head

X_{12} = Household monthly income (naira)

d_1 = Access to electricity

μ= Error term

RESULTS AND DISCUSSION

Table 2: Socio-Economic Characteristics of the Household Heads.

Socioeconomic characteristics of the respondents

Characteristics	**Rural**		**Urban**		
Sex of Household Head	Frequency	Percentage	Frequency	Percentage	Mean(SD)
Male	32	72	69	88.5	
Female	9	28	9	11.5	
Age of Household Head					
≤ 40	10	24.39	15	19.2	R=61.34(18.47)
41-60	11	26.83	32	39.7	U=42.85(12.56)
61-80	19	46.34	27	33.3	
81 and above	1	2.44	6	7.7	
Household Size					
1-10	31	77.5	48	60.3	
11-12	10	22.5	21	25.6	R=7.85(4.82)
21-30	0	0	8	10.3	U=5.65(3.49)
31-40	0	0	3	3.8	
Primary Occupation of Household Head					
Civil servant	12	29.3	26	33.3	
Self employed	28	70.7	51	65.4	
Unemployed	0	0	1	1.3	
Secondary Occupation					
Trading	16	39	46	59	
Farming	25	61	32	41	
Household Income					
≤ 30,000	23	55.0	24	30.8	
30,001-60,000	7	17.5	27	33.3	R=27,452.56(18.515.95)

60,001-90,000	11	27.5	18	21.8	U=49,862.25(31,256.23)
>90,000	0	0	11	14.1	
Access to Electricity					
Yes	8	19.5	63	80.8	
No	33	80.5	15	19.2	
No of days of supply					
0-2	11	26.82	23	29.48	
3-5	25	60.98	42	53.85	
6-7	5	12.20	13	16.67	
Total	**41**	**100**	**78**	**100**	

Source: *Field Survey* ***R=rural households; U= urban households***

The socio-economic characteristics of the respondents were separately tabulated in table 3 because the respondents were responsible for cooking and making cooking energy choices in both rural and urban households.

Table 3: Socioeconomic Characteristics of the Respondents.

Characteristics	**Rural**		**Urban**		
Sex of Respondent	Frequency	Percentage	Frequency	Percentage	Mean(SD)
Male	2	5	7	9	
Female	39	95	71	91	
Age of Respondent					
20-35	14	32.5	39	48.7	R=46.52(33.92)
36-50	11	27.5	27	33.3	U=38.34(30.07)
51-65	12	30.0	9	11.5	
60 and above	4	10.0	5	6.4	
Marital Status of HHH					
Single	1	2.4	4	5.1	
Married	33	80	61	78.2	
Separated	1	2.4	2	2.6	
Widowed	6	14.6	10	12.8	
Divorced	0	0	1	1.3	
Level of Education					
No formal education	18	43.9	5	6.4	
Primary education	15	36.6	13	16.7	
Secondary education	6	14.6	28	35.9	
Tertiary education	2	4.9	32	41.0	
Number of years spent in school					
1-8	14	35	17	20.5	
9-17	27	65	59	74.4	R=11.91(4.52)
18 and above	0	0	4	5.1	U=15.96(5.93)
Primary occupation of respondents					
Civil servant	4	9.8	18	23.1	
Self employed	35	85.4	59	75.6	
Unemployed	2	4.9	1	1.3	

Total	**41**	**100**	**78**	**100**

Source: *Field Survey* ***RA=rural areas; UA= urban areas***

The results in table 2 and 3 revealed that in both rural (RA) and urban areas (UA), 72% and 89% male respectively were the household head. Furthermore, in both RA and UA, cooking energy procurement was the responsibility of female rather than male. 95% and 91% of the sampled respondents in rural and urban areas respectively were female. The mean age of household heads was 61.34 and 42.85 years respectively in both RA and UA. The mean age for respondents was 46.52 and 38.34 years in both RA and UA respectively. This means that those responsible for cooking were still active. The result also showed that 80% and 78% of the household head were married in the RA and UA respectively. The mean household size was about 8 and 6 members respectively in both RA and UA. About 44% of the respondents have no formal education in the RA while 41.0% have tertiary education in the UA. This shows that the urban dwellers often have higher education than those in the rural households. This is probably a result of the establishment of tertiary institutions in the urban areas. The average number of years spent in school in both RA and UA was 11.91 and 15.96 years respectively. About 71% and 65% of the household heads were self-employed in RA and UA respectively and 85% and 76 % of the respondents were self-employed in RA and UA. The mean monthly income of household heads in both RA and UA was ₦27,452.56 and ₦49,862.25 respectively. About 81% of household heads in RA do not have access to electricity while 81% had access to electricity in the UA.

Preference for Cooking Energies

Table 4: Types of Household Energy Used for Cooking.

Cooking Energy Types	**Rural (N=41)**				**Urban (N=78)**			
	Used		Not used		Used		Not used	
	Freq	%	Freq	%	Freq	%	Freq	%
LPG	10	24.4	31	75.6	36	46.2	42	53.8
Kerosene stove	12	29.3	29	70.7	46	59.0	32	41.0
Solar	0	0	41	100	2	2.6	76	97.4
Firewood	30	73.2	11	26.8	41	52.6	37	47.4
Charcoal	21	51.2	20	48.8	36	46.2	42	53.8
Electric stove	15	36.6	26	63.4	34	43.6	44	56.4
Saw dust	0	0	41	100	0	0	78	100
Crop waste	5	12.2	36	87.6	9	11.5	69	88.5

Source: *Field Survey*, *2019.*

The results in table 4 showed that about 73% and 51% used firewood and charcoal respectively due to proximity and availability in the RA while 59% and 53% used kerosene stove and firewood respectively in the UA.

Table 5: **Preference for Cooking Energy Type.**

Cooking Energy Types	**Rural**		**Urban**	
	Frequency (N=41)	**Percentage**	**Frequency (N=78)**	**Percentage**
LPG	22	53.7	45	57.1
Kerosene stove	10	24.4	7	9.7
Solar	0	0	2	2.4
Firewood	1	2.4	3	3.9
Charcoal	2	4.9	2	2.4
Electric stove	6	14.6	19	23.8
Saw dust	0	0	0	0
Crop waste	0	0	0	0
Total	41	100	78	100

Source: *Field Survey*, *2019.*

Results in table 5 showed that about 54% and 24% preferred LPG and kerosene stove respectively in the RA because of their speed of cooking and ease of ignition while 57% and 24% preferred LPG, and electric stove respectively in the UA due to their speed of cooking, ease of use, and availability. Thus, increase in income and standard of living will increase preference for LPG usage among rural household relative to urban dwellers than other cooking energy types

Determinants of the Preferred Cooking Energy Types

Table 6: Result of the Multinomial Logit Regression Model for Rural Household.

Variables	LPG		Charcoal		Electric stove		Kerosene	
	Cof	p-value	Cof	P-value	Cof	p-value	Cof	Pvalue
Age of HHH	-0.070	0.764	0.098	1.000	0.233	0.999	2.338	0.996
Age of Resp.	0.281*	0.036	-0.006	1.000	-0.985	0.977	-4.805	0.990
Household Size	-0.105	0.573	-1.939	0.999	-0.364	1.000	5.292	0.995
Marital status	-17.744	0.999	-17.013	0.998	-64.161	0.998	-77.250	0.996
Primary occ. HHH	35.629	0.997	12.189	0.999	-3.398	1.000	75.420	0.997
Level of Edu	-18.939	0.996	-14.956	0.999	40.008	0.998	-198.2	0.994
HH Income	12.325	0.742	0.000	1.000	0.000	1.000	-0.001*	0.028
Sex of HHH	-20.55*	0.026	-5.954	1.000	-30.195	0.999	7.831	1.000
Sex of Resp.	0.000**	0.000	0.000	1.000	0.000	0.999	0.000	1.000
Pry Occ of Respondent	-16.51	0.418	-4.461	1.000	20.994	0.999	-65.558	0.996

Note: Reference category is firewood, Level of statistical significance are denoted as **,* for P<0.01 and P<0.05 respectively.

Table 7: Result of the Multinomial Logit Regression Model for Urban Household.

Variables	LPG		Kerosene		Charcoal		Electric stove	
	Cof	p-value	Cof	P value	Cof	P value	Cof	p-value
Age of HHH	-0.013	0.602	0.021	0.680	1.684	0.993	0.336	0.463
Age of Resp	-0.008	0.740	-0.135	0.336	-0.036	0.998	0..474	0.451
HH size	0.012	0.779	-0.462	0.126	-0.900	0.998	0.864*	0.036
Yrs Spent in Sch	-0.019*	0.036	0.475	0.244	-0.366	0.999	-0.320	0.723
Marital Status	-0.518	0.800	65.477	0.995	-2.322	1.000	-2.665	1.000
Pry Occ HHH	-19.19	0.700	51.393*	0.012	28.180	0.998	12.207	0.998
Sec Occ	-0.961	0.174	-6.966	0.095	11.131	0.998	5.200	0.524

Level of Edu	0.753	0.564	8.107	0.174	-33.903	0.997	-57.720	0.978
HH income	0.000	0.067	0.000	0.157	0.001	0.996	0.000*	0.029
Pry Occ	18.111**	0.000	-60.104	0.960	-9.699	0.999	12.207	0.998
Sex of HHH	-0.414	0.839	115.28	0.910	50.434	0.994	-21.161	0.997
Sex of Resp	0.388	0.718	17.554	0.080	15.582	0.999	41.878	0.988

Note: Reference category is firewood, Level of statistical significance is denoted as **,* for P<0.01 and P<0.05 respectively.

The results of the multinomial logit analysis in Table 7 for LPG, charcoal and electric stove and kerosene stove as compared to firewood. In the rural area, the estimated coefficient shows that the age of respondents has a positive and statistically significant (P<0.05) effect on LPG as a preferred cooking energy, indicating that as age of respondent increases, there is likelihood of household to use LPG relative to firewood because at old age, there won't be enough strength to fetch firewood in the forest. The result agreed with Goldenberg (2000) who reported that the use of firewood as source of heating and energy for cooking and lighting causes indoor air pollution and exposes families to air pollution levels as much as 50 times greater than World Health Organization guidelines for clean air, setting the stage for heart and lung disease.

Household income has positive and statistically significant coefficients (P<0.005) for kerosene stove indicating the influence of income on the use of kerosene. The result conformed with Adeyemi and Adereleye (2016) who implied that with everything else held constant, the respondent having higher income is more likely to switch over to modern fuel.

Sex of respondents has positive and statistically significant coefficients (P< 0.001) for LPG indicating an increase in the likelihood that firewood alternatives (e.g., LPG) would be used by household in the dwelling units. This is because most of the respondent prefers LPG to other cooking energy source due to its ease of use, little or no health issues and speed of cooking.

Urban

In urban households, the number of years spent in school has a negative and statistically significant coefficient for LPG (P<0.05). This negates the study of Obayelu et al., (2017) who reported that the more educated a respondent is, the more he/she switches from local cooking energy to a modernized form of energy. The primary occupation of the household head has a negative and statistically significant coefficient (P<0.001) for LPG. This implies that LPG will be used by households whose monthly income is high. By and large, there is a low tendency of using LPG if the income generated is low. Furthermore, the primary occupation of the respondent has a positive and statistically significant coefficient (P<0.001) for LPG. This implies that an increase in income generated by the respondent leads to the use of LPG. This conforms to the study of Adeyemi and Adereleye (2016) that respondent household whose spouse is employed in white-collar job is more likely to use fuel wood alternatives. This may be explained by the fact that women and bachelors are more involved with cooking fuel choice decisions in their households.

Household monthly income has a positive and statistically significant coefficient (P<0.005) for electric stoves. This implies that an increase in the level of income of the household will eventually lead to the use of an electric stove that is clean, convenient, and easy to use. This conformed to the study of Obayelu et al., (2017) who reported that respondents in UA used firewood alternatives because they see it to be more efficient and faster than firewood. The influence of income on the use of firewood alternatives may be attributed to improved socioeconomic status which drives the household upward on the energy ladder. An increase in income can make the household switch to direct current instead of prepaid meter

in order to maximize consumption of electric power supply so that electric stove can be used at its peak for cooking.

Household size has negative and statistically significant coefficient (P<0.005) for electric stove. This indicating that as household size increases there is less likelihood for the household to use electric stove relative to firewood. This conforms with the expectation that larger households will prefer to use firewood since it is comparatively cheaper when compared to sources such as electricity which at many times is not available in the study area. This agreed with Pundo and Fraser (2006) that larger households may have extra and free labour for firewood collection**.**

Table 8: Constraints of the Preferred Cooking Energy Types in the Rural Areas.

Rural						
Constraints	LPG	KS	FW	CC	ES	CW
	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)
High Cost	28(68.3)	12(29.3)	1(2.4)	5(12.2)	23(56.1)	-
Health Issue	-	-	28(68.3)	-	19(46.3)	-
Inaccessibility	27(65.8)	3(7.3)	2(4.9)	5(12.2)	17(41.5)	1(2.4)
Unavailability	25(61.0)	2(4.9)	3(7.3)	2(4.9)	11(26.8)	1(2.4)
Difficulty in use	14(34.15)	5(12.20)	8(19.51)	4(9.75)	15(36.59)	-
Amble of cooking	3(7.3)	-	2(4.9)	-	12(29.3)	-
Phobia and accident	22(53.7)	7(17.1)	12(29.3)	5(12.2)	26(63.4)	-
Highly Flammable	3(7.3)	1(2.4)	1(2.4)	3(7.3)	6(14.6)	3(7.3)

Source: *Field Survey, 2019*

Note: The figures in parentheses are percentages.

LPG =Liquefied Petroleum Gas, CC= Charcoal, ES= Electric Stove, KS= Kerosene Stove, FW=Firewood, S = Solar, CW= Crop Waste.

The results in Table 8 revealed that about 68% and 66% complained about the high cost, and proximity of LPG respectively while 29% complained about the high cost of using kerosene stoves, and 68% and 29% complained about the health issue of using firewood. About 12% complained about the high cost, proximity and phobia, and accident in using charcoal. 63% complained about phobia and accidents of using electric stoves in rural areas.

Table 9: Constraints of the Preferred Cooking Energy Types in the Urban Areas.

Urban							
Constraints	LPG FW	KS		CC	ES	S	CW
	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)
High Cost	15(19.2)	3(3.8)	-	7(9.0)	21(26.9)	2(2.7)	-
Health Issue	9(11.5)	12(15.4)	47(60.3)	13(16.7)	25(30.1)	-	-
Inaccessibility	6(7.7)	11(14.1)	2(2.6)	8(10.3)	12(15.4)	-	19(24.4)
Unavailability	5(6.4)	9(11.5)	12(15.4)	3(3.8)	13(16.7)	2(2.7)	21(26.9)
Difficulty in Use	6(7.69)	8(10.26)	13(16.67)	9(11.54)	6(7.69)	-	3(3.8)
Amble of Cooking	5(6.4)	2(2.6)	21(26.9)	1(1.3)	17(21.8)	-	-
Phobia and Accident	47(60.3)	12(15.4)	14(17.9)	5(6.4)	28(35.9)	-	-
Highly Flammable	2(2.6)	11(14.1)	13(16.7)	10(12.8)	6(7.7)	-	9(11.5)

Source: *Field Survey*

Note: The figures in parenthesis are percentages

LPG =Liquefied Petroleum Gas, CC= Charcoal, ES= Electric Stove, KS= Kerosene Stove, FW=Firewood, S= Solar, CW= Crop Waste.

Table 9 revealed that about 60% complained about phobia and accident of LPG, 15% complained about health issues and phobia and accident of kerosene stove, 60% complained about health issues of firewood, 17% and 36% complained about health issues and phobia and accident of charcoal and electric stove respectively while 27% complained about unavailability of crop waste.

Conclusion and Recommendations

The study concluded that about 73% and 51% of rural households made use of firewood and charcoal respectively while 59% and 53% of urban households used kerosene stoves, and firewood respectively. About 54% and 24% preferred using LPG and kerosene stoves respectively in the RA while 57% and 24% preferred using LPG, and electric stoves respectively in the UA.

Age, sex, and household income were the significant determinants of the use of LPG and kerosene stove in the rural areas while the number of years spent in school and primary occupation of the household head and respondents, household monthly income and household size were significant determinants for LPG in the urban areas.

Since an increase in income and standard of living will increase preference for LPG usage among rural household relative to urban dwellers than other cooking energy types. It is therefore recommended that engaging in multiple sources of income will increase income and standard of living which will further increase preference for LPG usage in order to ease the problem faced by cooking energy users in the study area price of LPG needs to be subsidized so that both rural and urban dwellers in the study area can afford and use it. There is the need to also educate both rural and urban dwellers on clean cooking energies using different types of waste.

References

Adeyemi, P.A. & Adereleye, A. (2016) *Determinants of Household Choice of Cooking Energy;* Ondo State, Nigeria.

Alphonsus, R.I., & Adesuwa, Q.A. (2014). Household Cooking Fuel Use among Residents of a Sub-Urban Community in Nigeria: Implications for Indoor Air Pollution. *Eurasian* J Med; 46: 203- 208.

Akpu V. (2012): Energy Future: The Role of Impact Assessment. IAIA 12 Conference Proceeding of the 32ndAnnual Meeting of the International Association for Impact Assessment, May 27 – June 1, 2012.

Banik, BK (2010). Female perceptions of health hazards associated with indoor air pollution in Bangladesh. *Int J Sociol Anthropol*. 2(9):206

Bolaji B. O. (2012): Effects of Unsustainable Use of Biomass Energy for Cooking and Strategies for their Reduction in Developing Countries. Developing Country Studies 2: 19 – 25.

Foell, W., Pachauri, S., Spreng, D. & Zerriffi, H. (2011). Household cooking fuels and technologies in developing economies. *Energy Policy*, 39 (12), 7487–7496.

Goldenberg, J (2000). *Rural Energy in Developing Countries*. In: World Energy Assessment: Energy and the Challenge of Sustainability. UNDP. NY.

IARC. (2017). Agents Classified by the IARC Monographs, Volumes 1–119. WHO

Kees, M., & Feldmann, L. (2011). The role of donor organizations in promoting energy efficient cook stoves. *Energy Policy* 39 (12): 7595– 7599

Mainimo E.N., Okello D.M., Mambo W, Mugonola B.,(2022).Drivers of household demand for cooking energy: A case of Central Uganda,Heliyon,8(3):1-7 https://doi.org/10.1016/j.heliyon.2022.e09118

Nnaji C. E, Uzoma C. C., & Chukwu J. O. (2012): Analysis of factors determining fuelwood use for cooking by rural households in Nsukka area of Enugu State, Nigeria Continental Journal of Environmental Sciences 6: 1 – 6.

Obayelu, A. E, Lawal, I. B., & Omotuyole I. A. (2017) *Comparative Analysis of Access, and Preferences of Rural and Urban Households for Cooking Energy*, *and the Determinants in Nigeria:* A Case of Ogun State. of Calabar Press, Calabar Nigeria: 92-101

Pundo, M. O & Fraser G. (2006) Multinomial Logit Analysis of Household Cooking Fuel Choice in Rural Kenya: The Case of Kisumu District*. Agrekon, Vol45, No1*

Staton, DM; & Harding, MH (2011). Health and environmental effects of cooking stove use in developing countries. 2000. Cited 22-11-2011.

Uwaegbute, AC (2011). *Food security in Nigeria:* Causes and consequences. In: Nwachukwu, I and Ekwe, K.C. (Eds.). Globalization and Rural Development in Nigeria. 74 -98.