POST-HARVEST LOSSES AND WELFARE OF YAM PRODUCERS IN UKUM LOCAL GOVERNMENT AREA, BENUE STATE, NIGERIA

Supported by tetfund TERTIARY EDUCATION TRUST FUND

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Received: January 21, 2021 **Accepted:** May 19, 2021

Abstract: Global efforts in the fight against hunger, improving food security and to raise farmers' income especially in the world's poorest countries has led to the prioritization of postharvest food losses. It is in the light of the foregoing, that this study seeks to evaluate post-harvest losses and its concomitant influence on welfare of Yam producers in Ukum LGA, Benue State, Nigeria. Using descriptive analysis, inferential statistics and Ordinary Least Squares as evaluation techniques, the study found out that inadequacy of storage facilities for farmers, insufficient pests and diseases control measures among others are the major constraints facing farmers in their efforts to control post-harvest losses. Empirical result equally revealed that post-harvest losses hurt the income of farmers and consequently their welfare. To this end, the study suggested that adequate training of farmers on post-harvest crop handling techniques as well as the provision of good storage facilities that has the capacity to help in preventing crop losses especially at the farm level.

Keywords: Food security, post-harvest losses, welfare, yam producers

JEL Classification: Q1, Q12, Q18

Introduction

Yam being a staple food is the second most important tropical root crop in West Africa after cassava. Besides the importance of Yam as a good source of food, it also plays a significant role in the socio-cultural lives of some Yam producing regions in many West African villages; wherefore Yam accords them, a festivity platform tagged New Yam Festival (Ansah *et al.*, 2018; Adejo, 2017). According to Zinash (2014) and Adejo (2017), Yamis grown widely throughout the tropics as well as in West and Central Africa, which accounts for about 94% of world production. Although Yam is produced throughout Africa, statistics shows that Nigeria is the world largest producer, accounting for over 70–76% of the world production (Adejo, 2017; Agbo *et al.*, 2016). For instance, Food and Agricultural Organization (FAO, 2010) reported that Nigeria produced 18.3 million tons of Yams from 1.5 million hectares, representing 73.8% of total Yam production in Africa.

In Nigeria, for instance, the state where Yam is mostly grown is in Benue State, especially among the Tiv people, more so that the size of the Yam farm or the tonnage of Yams produced becomes the social status of the farmer. Due to the high level and volume of Yam production, with other varieties of agricultural products in Benue State, She is tagged the Food Basket of the Nation. Again. Yamis produced in all the Local Governments Areas of the State. Nevertheless, report from BNARDA(1998) show that Ukum Local Government Area is the highest producer of Yam in the State, with Zaki-Biam International Yam Market rated as one of the biggest in Sub-Saharan Africa. Wherefore, Yam no doubt is an important staple food in Nigeria. The Yam tuber is prepared for consumption in a variety of ways including boiling, frying and baking. According to Verter & Becvarova (2014), not only is Yam an important staple food, but it has some ritual and socio-cultural significance attached to it. It is the food of choice at many ceremonies and festivities, as well as an indispensable commodity for bride price in many African Communities.

The nature of Yam with its inherent high economic value and the various forms to which, it can be consumed by man necessitates its production on a larger scale, as well as its utilization to solve food crisis amongst communities in Nigeria. To this connection, given current traditional practices in the production of Yams, financial gains for the product could be achieved through its direct sales than the procession of the product to flour. Thus, Agbo *et al.* (2016) reported that most farmers prefer to store their Yams after harvest. The methods of storage are rudimentary and hence vary from delayed harvesting, storage in simple piles or trenches and or storage in buildings, specially designed for that purpose. These traditional methods of storage tend to create huge post-harvest losses, with grave economic implications on the finances of both the farmers and Government. The post-harvest losses noticed in Yam and Cassava production has led Ansah *et al.* (2018) to champion advocacy in the mitigation of post-harvest losses of the product in Nigeria. This is substantiated by government led efforts in the establishment of programs and agencies mandated to seek novel ways of managing post-harvest losses, with the intent of adding value to these crops.

The Nigerian Stored Products Research Institute (NSPRI) as well as the Raw Materials Research and Development Council (RMRDC) are notable agencies to cite towards these efforts. Post-harvest loss reduction has also received international attention, as evidenced from the numerous international policy documents, of the Food and Agricultural Organization (FAO), the World Bank, World Health Organization (WHO), World Trade Organization and (WTO) and United Nations Children's Fund (UNICEF),which cut across nations, to ensure global food security, particularly in developing countries (Ani *et al.*, 2014). Despite the efforts, the success of these programs and initiatives are marginal as evidenced in the upward trajectory of food shortages and food prices. To this connection, Yam farmers in Benue State like others in Nigeriaare also faced with the problem of seasonal post-harvest losses. Among the major causes of Yamstorage losses as aptly captured by Adejo (2017), Ansah *et al.* (2018) include sprouting, transpiration, respiration, insect attack, rot due to mould and bacteria. These problems lead to the destruction of edible material and reduction in nutritional quality of Yam tuber. This in turn affects the farmers' income, welfare and precipitate poverty. It is on this premise that this study seeks to examine the extent of post-harvest losses and its concomitant effect on the welfare of Yam producers in Ukum Local Government Area of Benue State. Specifically, the study seeks to (i) identify the major causes militating against stemming the extent of post-harvest losses of the Yam producers in the study area. (ii) examine the profitability

effect of post-harvest losses on the household and the negative concomitant implication on the welfare of Yam producers in the study area.

Conceptual Clarification

Jhingan (2006) conceptualizes production as the transformation of raw materials into finished goods and services to satisfy human wants. Production is a process of combining various material and immaterial inputs to make something for consumption. In other words, the effort to contribute to an individual's utility leads to creation of a good or service. Economic well-being or consumer welfare as noted by Todaro (2000) portrays that welfare is created in a production process; meaning all economic activities directly or indirectly satisfy human needs in the production process, as such to measure economic well-being entails figuring out the extent, which an individual's needs are satisfied. Yam production on the other hand simply refers to all activities relating to planting, monitoring, harvesting, storage including processing of Yam (Adejo, 2017). The Yam tuber yield is dependent on the soil layer, the Yam specie, size of seed piece, size of heaps and environment (Zinash, 2014). Therefore, the Rockefeller Foundation (2015) contended that food loss occurs along all the phases of the food value chain in developing countries. In the submission for developing countries, they signal that the main causes of food loss are interlinked and complex, but the primary drivers include: inadequate extension services to build skills in handling, packaging, and storage, with the problematic issue of storage traced to inaccessible markets, poor on-farm and post-harvest storage. Agbo *et al.* (2016), Nweke (2017) while accounting for the reasons, why about 30 to 40% of agricultural produce, does not reach the consumer due to post-harvest loss, aptly amplifies this. They detailed the following associated factors as causes, which include; insect pests, poor logistics, fungal and bacterial diseases, poor management and inadequate storage facilities, as well as mechanical damage, serving as the inhibitors to accessibility of harvested crops by consumers.

Ansah *et al.* (2018) examined the key postharvest management practices and its effect on the welfare of Yam farmers and traders in selected towns of Northern Ghana region. The study used a random sample of a cross section of farmers and traders for data collection, and analysed the data with linear regression models. Results showed that farmers lose an average of 9.6% of stored Yam in 2-month period, while traders lose 3.3% of Yam stored in a month. This result show the positive effect of reduction of storage losses, which enhances traders' welfare outcome. To this end, the authors suggested thatimprovement be made on postharvest storage and its management practices among farmers and traders

Adejo (2017) investigated the post-harvest handling of Yam, while sampling 240 farmers in Kogi and Benue State, Nigeria. Findings revealed that about 78.7% of the respondents transported Yam from the farm to either at home or the markets. Analysis regarding the level of information needs, for storage showed that 50% of the Yam farmers were highly in need of information, on storage of tubers, in the study area. While the access of Yam farmers to improved, post-harvest management technologies showed that majority, i.e. 77.5% of the Yam farmers had access to improved transportation system, 14.28% exemplified access to a storage warehouse. The study recommended that farmers should have access to information on improved postharvest management. Such effective the practices would ensure better value addition to the product.

Agbo *et al.* (2016) who evaluated the harvest and post-harvest skills possessed by 270 Agricultural Education students, in Yam production in Colleges of Education in North Central Nigeria. The findings revealed that the students moderately possessed skills in harvesting, storage and marketing of Yam, which could put them in the right stead to teach Yam production on graduation.

Adisa *et al.* (2015) examined the factors influencing post-harvest losses of Yam farmers in Ekiti State, Nigeria, using multi-stage random sampling technique, where 200 respondents were selected from four Local Government Areas in the State. Data was analysed using simple descriptive statistics such as frequency, percentages and inferential statistic of the multiple regression form. The socio-economic traits of the respondents show that 56.8% were above 50 years and farming on small-scale of less than 5 hectares, with majority of them having no formal education. The study further revealed that farmers had a limited knowledge of post-harvest technologies in Yam production and their main reasons of post-harvest losses in the study area were attributable to poor storage, theft, poor technological knowledge, and Yam diseases. The regression result showed a significant relationship between sex, farm size, educational attainment, location and accessibility to post-harvest losses in Yam production. Recommendations include improved roads network to enhance easy accessibility, enlightenment campaign on unsophisticated post-harvest technologies to ensure ease of adaptation.

In examining, the effects of post-harvest losses on the welfare of 107 tomato farmers in Ogbomosho, who were selected through a multi-stage sampling procedure, Abimbola (2014) applied descriptive statistics, gross margin analysis and Ordinary Least Squares (OLS) regression model. The findings show that a more than half the respondents were married males with no formal education. The gross margin analysis revealed about 95.5% reduction in income of the household, given computation of with and without post-harvest losses. That is gross income declined from ₦72,905.80 to ₦3,229.45. This ensures farmers' need to be trained in modern post-harvest handling of tomato production, as well as adding value by establishing processing industries.

In Oyo State, where 160 tomato farmers were sampled in Surulere local government area. The intent was to examine how farmers, adapt to value addition technology, as well as the constraints towards reducing post-harvest losses, Akangbe *et al.* (2014) found out from the study that the causes of post-harvest losses of tomato were traced to poor transportation and storage, diseases, poor quality of seeds. The study, which highlighted all the post-harvest strategies of adding value to tomato production showed sun drying and peeled tomato preserves as the highest most used channel with trailed irradiation been the least utilized channel. Despite farmers' adoption of several preventive initiatives against post-harvest losses by tomato production, they were clouded with constraints such as inadequate technological knowledge about value addition, inadequate electricity supply, lack of cold storage facilities. In this light, the study recommended continuance of the preventive initiatives against post-harvest losses of tomato, which correlates with the farmers' level of education. It is therefore important that there should be an improved educational awareness on the part of tomato farmers in the study area to minimise post-harvest losses.

Olayemi *et al.* (2012) investigated the level and cause(s) of post-harvest losses of some selected produce in eight (8) local government areas of Osun State, using a sample size of 450 respondents. Results revealed that aside farmers utilizing traditional ways of food storage, they hardly connect with people to gain from the propagation of knowledge on novel and preventive approaches against post-harvest losses. Again, it was also observed generally that the percentage sold was more than the processed, stored and consumed at post-harvest stage. It was therefore, concluded that losses experienced

were generally on the high side and needed to be minimized by adapting novel approaches to stem the negative tide.

Theoretical Framework

This study has its theoretical foundation rooted in Cobb-Douglass production function, which was propounded in 1927 by Cobb and reaffirmed by Douglas in 1947. The Cobb-Douglas production is a unique functional form of the production function widely used to represent the technological relationship between the amounts of two or more inputs, particularly physical capital and labour; and the amount of output that can be produced by these inputs. A Cobb-Douglas production function is a standard production function, which is applied to describe how much input is required in a production process to attain a particular level of output. It is used commonly in both macro and microeconomic analysis of production relationship. Underpinning the above is the fact that enhanced Yam production will lead to expansion in Yam consumption, processing, sales and marketing activities. This will enhance an increase in income available to farmers and processors. In its most standard form for the production of a single good with two factors, the function is stated thus:

$$Q = AK^{\alpha} L^{\beta}\varepsilon:$$

Where: Q = total production; A= total factor productivity; K= capital input; ε= error term; α and β = are the output elasticities of capital and labour, respectively.

Thus, Cobb-Douglas production function only expresses the maximum level of production (Q) in terms of two variables, labour (L) and capital (K). However, in this work, the output of Yam is a function of more than two variables, as such all variables considered relevant are incorporatedto build the theoretical foundation of the work as envisaged in the production apparatus.

Materials and Methods

Survey research design was used for this study to elicit views of some selected Yam farmers among the numerous farmers in Ukum Local Government Area of Benue State, Nigeria. The local government is situated in the Northeast senatorial axis of Benue State. It shares boundaries eastward with Wukari Local Government Area in Taraba State. In the Southeast and South-West, Katsina-Ala and Logo Local Government Areas bound it respectively. It has a population of 216,938 (NPC, 2006) and a landmass of 1810.99 km^2 (BNARDA, 1998). The inhabitants of the local government are predominantly Tiv and are Yam farmers / producers. Other tribes domiciled in the area include Hausa, Ibo, Jukun, and Idoma who are mainly farmers, traders and a limited number of civil servants. Ukum LGA is made up of thirteen (13) council wards of Ateranyange, Azendeshi, Boikyo, Kendev, Kundav, Lumbur, Mbatian, Mbayenge, Mbazum, Tsaav, Tyuluv, Ugbaam, and UYam, respectively.

Study population and the sample size

This study considered all Yam producers in Ukum Local Government Area of Benue State as its population. However, due to lack of accurate knowledge about the exact population of farmers in the study area, via Cochran (1963) formula for sample size selection of unknown population, the sample size was determined. This formula is given as $n_0 = \frac{z^2 pq}{e^2}$;

Where n_0 = Sample size; Z= the abscissa of the normal curve in this case selected as 1.96 or at 95% confidence interval; p= the estimated proportion having the attribute in question. This is considered as 0.5 or 50% maximum variability; q=1-p, that is proportion of the population without the attribute in question; e=desired margin of error is considered at 5% or .05. Based on Cochran (1963) formula, 385 Yam producers were selected as the sample size.

Further, the Bowley (1926) proportional allocation formula given as $n_h = (N_h / N) * n$;Where n_h is the sample size for the stratum h;N_h =the population size for the stratum h; N= total population size; n= total sample size; was applied towards the selection of notable farmers per each of the 13 council wards of the local government. These respondents were selected through a random sampling technique, with similar socio-economic and cultural practices in Yam production. Thus, the council wards were the strata from which the sample of respondents were accessed.

Model specification

The Gross Margin Analysis: The gross margin analysis was used to estimate the profit made by the Yam farmers in Ukum LGA. The gross profit of a business is estimated as the difference between the total sales and the variable cost incurred. GM = TR – TVC; **Where:** GM = Gross Margin, TR = Total Revenue, TVC = Total Variable Cost. TR was obtained by multiplying the quantity of Yam sold by the average unit-selling price. TVC = Cost of all inputs (Pre-harvest and harvest labour wage, transportation costs and other input costs). The gross profit margin is obtained by dividing the gross profit by sales. The gross profit margin is given as: Gross Profit Margin = Sales –Variable Cost/Sales. Gross profit margin is particularly useful in evaluating the profitability of Yam production amongst the farmers in Ukum LGA. This is because many of the farmers' practice subsistence farming, which often involve a small amount of fixed capital. The Cause-effect results in examining the influence of post-harvest losses on respondents is scheduled through the Ordinary Least Square Model: The model is stated as follows:

$$y_j = b_0 + \sum_{k-1}^{4} a_k \; m_{k+} \sum_{j-5}^{12} a_j \; x_j + e \qquad (1)$$

Where αk and αj are coefficient vectors to be estimated; e represents a random error term; m are post-harvest storage practices, and x are control variables. The explanatory variables are fully presented in equation (2):

$$Y=\alpha+\beta_1M_1+\beta_2M_2+\beta_3M_3+\beta_4M_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\beta_9X_9 +\beta_{10}X_{10}+\beta_{11}X_{11}++\beta_{12}X_{12}+\varepsilon i \qquad (2)$$

Where: Y= Income per head (per capita income) measured by income earned from sale of Yams, divided by household size, X_1 = Post harvest losses measured by quantity of Yam tubers stored, less quantity of Yam tubers lost, multiplied by the quantity stored, X_2 = Heat Control, X_3 = Sorting, X_4 = Cleaning, X_5 = Marital Status (Married =1, otherwise = 0), X_6= Years of formal education, X_7 =Farming experience in years, X_8 = Farm size in hectares, X_9 = Access to credit (access = 1, if not 0), X_{10} = Savings (if saved 1, if not = 0), X_{11} = Market participation, X_{12} = Security (If adequate 1, if not 0), ε = error term. The market participation rate is defined as the ratio of the value of the total quantity of Yams sold to the price value of the total harvested Yams for the planting season. That is, value of Yams sold/value of total Yams harvested.

Results and Discussion

The result is discussed in terms of the socio-economic characteristics of the Yam farmers, the major post-harvest constraints by Yam farmers, gross margin analysis and the regression analysis explaining post-harvest losses and welfare of Yam farmers in Ukum LGA.

Sex: The result of Table 1 shows that there are more male farmers in Ukum LGA than their female counterparts. 61.5% of the sampled respondents were male farmers while only

38.5% were female. This development is well defined given that in the Nigerian traditional setting, women, children do not have farms independent of men. In these instances, women and children are regarded as part of the labour force on such farms.

Age: Majority of the respondents sampled comprising 57.7% were within the age bracket of 26-50 years. Those below this age are usually schoolchildren while those above are retirees or pensioners, these categories constitute the dependent population given the study.

Family size: further analysis on table 1 shows that 54.8% of the respondents in Ukum LGA had family size of 5-9 persons, while 29.8% of the respondents had a family size of 10 and above persons. Only 15.4% of the respondents had a family size of 1-4 people. This is an indication that majority of farmers in Ukum LGA had high dependency of above 5 people. This connotes low standard of living as average income earned per household becomes poor given the high number per household.

Educational Status: Table 1 report that majority of the farmers in Ukum LGA representing 38.6% and 30.7% had secondary and primary education respectively. While respondents with post-secondary qualifications and those with postgraduate qualifications, did record 9.6% each given the total sampled population. Respondents with no education constituted 11.5%. The foregoing signifies that the Yam farmers in Ukum LGA are mostly an enlightened population, which entails that there may not be serious difficulty in assimilating modern post-harvest techniques in the study area.

Table 1: Socio-economic characteristics of respondents

Variable		Frequency	Percentage
Sex	Male	237	61.5
	Female	148	38.5
	Total	**385**	**100**
Age	1-25	141	36.5
	26-50	222	57.7
	51-75	22	5.8
	Total	**385**	**100**
Family size	1- 4	59	15.4
	5- 9	211	54.8
	10 & Above	115	29.8
	Total	**385**	**100**
Education	No Education	44	11.5
	Primary	118	30.7
	Secondary	149	38.6
	NCE/HND/B.Sc.	37	9.6
	PG	37	9.6
	Total	**385**	**100**

Source: Field Survey, 2020

Table 2: Major causes of post-harvest losses of yam in Ukum LGA

Causes	Frequency	Percentage
Inadequate of Storage Facilities	118	30.7
Distance to the Farm	44	11.5
Poor Transport Network	44	11.5
Pests and Diseases	59	15.4
Insufficient Farm Capital	102	26.3
Low Government Support	18	4.6
Total	**385**	**100**

Source: Field Survey, 2020

Table 2 is a highlight of some major post-harvest constraints or obstacles reported by respondents in the study area. These constraints include the inadequate of storage facilities, long distance to market where harvested crops should be sold, poor transportation network, insufficient farm capital, pests and diseases and low government support.

The above challenges are major obstacles to farmers' maximization of profit from their productive activities in the study area. These findings further buttressed the works of Seid *et al*. (2013) and Basappa *et al*. (2007) who found inadequate storage facilities, inadequate transport facilities, pests and diseases to be significant factors contributing to post-harvest losses of maize and commercial horticultural crops respectively. Inadequate of storage facilities and insufficient farm capital were reported as the two major constraints faced by all the Yam farmers in the study area. As a result, farmers were usually forced to take their produce to the market, directly from the farm, to be sold and the money reinvested in other farming activities. Again, the inadequacy of storage facilities and farmers poor living condition, occasioned by insufficient capital to invest in other farming ventures, often results to an over-supply of produce, in the event of a bumper harvest, which leads to a glut in the market and consequently increase incidence of post-harvest losses. The long distance to market, coupled with the poor transport network, also serve as a major constraint to a majority of the farmers in the study area, which do incur higher transportation costs. Some farmers, because of their inability to pay the transportation costs, necessitate the giveaway of the produce at extremely lowfarm-gate prices. Other post-harvest constraint reported by Yam producers in the area, which is a common denominator to most farmers is low government support. There is no gainsaying the fact that the government has not given farmers the needed support, required to improve productivity in the country. Even instances where such support exists, especially in funding, it is either misappropriated or embezzled by government supervisors.

Table 3 presents the results of the gross margin analysis for evaluating the profitability of Yam production on welfare of Yam producers in Ukum Local Government Area of Benue State, Nigeria. The unit-selling price of a tuber of Yamwas used to value the post-harvest losses incurred. The computation of the between gross profit margin for post-harvest loss and without loss, which is N2,651,275 and N12,031,311, respectively. This translates to a scenario of 77.96% post-harvest loss suffered by Yam producers in the study area. This represent the monetary equivalence suffered on income reduction and welfare, attributable to post-harvest losses by Yam farmers in Ukum Local Government Area. In the same vein, the within percentage gross profit margin for without and with loss stood at about 74.9% and 39.7% respectively. It is instructive to state that the low percentage gross profit margin is a reflection of the fact that Yam producers in the study area retained a low percentage of each naira of sales, with little left over for other expenses and net profit.

Table 3: Gross profit margin analysis

Analysis	TVC (₦)	TR (₦)	GM (₦)	Average GM (₦) Per Household
Without Loss	4,027,853	16,059,164	12,031,311	31,250.16
With Loss	4,027,853	6,679,128	2,651,275	6,886.42

Source: Field Survey, 2020

Table 4: Ordinary Least Squares Regression output

Variable	Coefficient	Std. Error	t-statistic	P-value
C	29.28600	82.14236	3.565274	0.0004
Market Participation Rate	10.62702	51.59800	0.205958	0.8370
Farm size in hectare	99.57364	63.38539	-1.570924	0.1175
Marital status	74.70978	28.47274	0.262391	0.7932
Post-harvest losses	-18.73335	52.13563	-0.359320	0.7197
Heat control	-43.06499	76.92378	-0.559840	0.5761
Sorting	-36.44553	84.58681	-0.430865	0.6669
Cleaning	-22.65763	72.73742	-0.311499	0.7557
Years of formal education	17.65692	11.43703	1.543838	0.1239
Farmers expenditure	41.30677	49.74684	-0.830340	0.4071
Access to credit	-24.19773	54.51438	0.044388	0.9646
Savings	24.53023	66.56887	0.368494	0.7128
Security	-29.17172	34.41749	-0.847584	0.3975

R-squared (0.63); F-statistic (5.73738), Prob (F-statistic (0.002389); DW stat (2.02)

Source: Author's computation from E-views 9

The result on Table 4 showed an R^2 value of about 63% explaining the total variations in the model, leaving an unexplained 37% of variations, captured by the stochastic error term. Further, the probability value of the F-statistic at 5% level of significance substantiates this finding, as well as tell the story about the joint importance of all the predictors utilized for the study. In other words, though individual insignificance exist for each of the predictors, but the effect of their joint significance, lay credence to explaining at least the economic relationship between the dependent and independent variables. The Durbin Watson Statistic of 2.02, which is within the acceptable threshold established by econometric theory, explains the absence of autocorrelation. This means that the overall model is significant and useful for decision-making. One of the essential determinants of the welfare of Yam producers in the study area is the Market Participation Rate (MPR). Table 4 revealed a positive relationship between MPR and per-capita income among Yam producers in Ukum LGA. Succinctly put, a unit increase in market participation leads to 11 naira rise in per capitaincome and hence welfare of Yam farmers in the study area. This implies that farmers with high market participation rate fare better in terms of welfare, than those with lower participation rate.

In the same vein, the farm size in hectare is positively related to the farmers' per capita income, as a unit rise in farm size of farmers result to about 100 naira percapita income increase and hence improvement in the welfare of farmers. The positive association between farm size in hectare and per-capita income implies that the larger the size of the farmland, the higher the output, the better per capita income and consequently, improved welfare for Yam farmers. Marital status had a positive relationship with the income of Yamfarmers in the study area. This implies that married couples earned more income from their farming activities than singles. This is expected as children helping on the farm, have the potential of increasing income, which enhances welfare when compared with farms owned by singles. Statistically put, a one unit increase in the number of married couples in farming activities resulted to approximately 74 naira increase in farmers' per capita income and hence their welfare.

The post-harvest losses predictor appeared negative to farmers' income and welfare. Empirical evidence showed that a unit rise in post-harvest losses resulted to about 18 naira per capita income losses to farmers. It is acknowledged from the study that post-harvest losses impacts per-capita income negatively as such setting up a decline of farmers' welfare. The large expanse of land on which Yam was cultivated in this area, which although increased productivity, also increased the chances of losses due to inadequate or poor storage facilities, not to mention the inadequacy of processing techniques. This gives rise to post-harvest losses and reduced welfare among the farmers. Also, the negative relationship between heat control and per-capita income of the household implies that the poor storing facilities, leaves the Yam producers with no better option than resorting to traditional storage methods in open spaces, which precipitates the excessive heat and compounds the adverse effect on the crops. Similarly, it was revealed that the farmers' access to credit appeared with a negative sign to Yam farmers' per capita income. This is true and a vindication of the predicament farmer's face in their quest to access agricultural credit to improve their farming activities. Another striking revelation from Table 4 is the inverse relationship between farmers' income and security. The negative relationship between this variable and the dependent variable is indicative of the high level of insecurity farmers in Ukum Local Government Area are confronted with. The alarming insecurity in the study area had in no small measure impacted negatively on the income of Yam farmers and their overall welfare. The high rate of insecurity in the study area which, include kidnapping and communal clashes has had serious negative implication on Yam farmers, more so that Ukum Local Government Area is known to be one of the largest Yam production centres in Nigeria.

Diagnostics

The Ordinary Least Squares estimates for the model, the results were subjected to various econometric tests. These include tests for heteroscedasticity, serial correlation, normality and stability. The econometric tools employed included Breusch-Pagan-Godfrey, Breusch-Godfrey Serial Correlation LM Test, Jarque-Bera, Specification tests (Ramsey RESET test) and CUSUM tests, respectively. The diagnostic estimates are as summarized in Table 5.

Table 5: Residual diagnostic tests

Type of Tests	P-Value
Breusch-Godfrey Serial Correlation LM Test	0.7815
Heteroskedasticity Test using Breusch-Pagan-Godfrey	0.8868
Ramsey RESET Specification Test	0.7480
CUSUM Stability Test	0.05 Sig.

Source: Author's extract from E-views 9.0

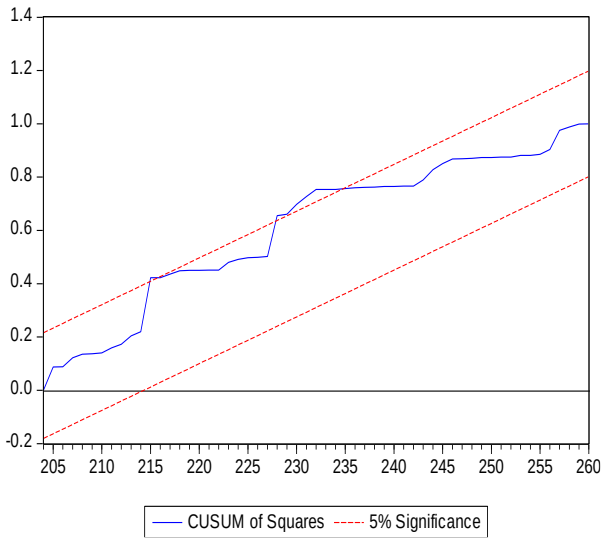

Fig. 1: CUSUM test for model stability

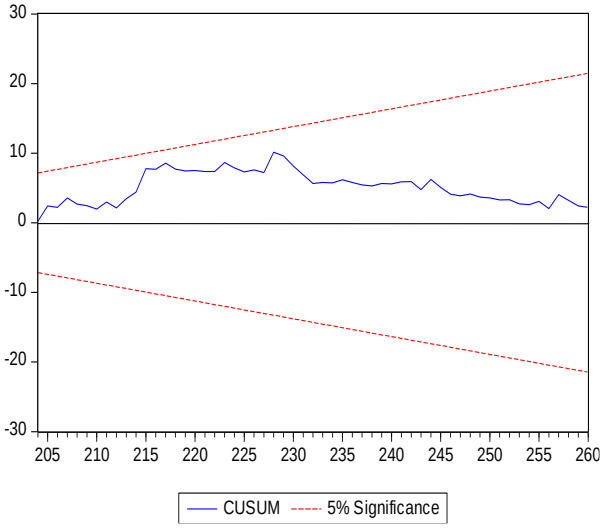

Fig. 2: CUSUMQ test for model stability

From the foregoing, it was revealed that the model estimates were largely correct. This is attested to by the insignificant probability values of the various diagnostic measurements. The model's residuals were free from presence of Heteroskedasticity threats, not fraught with severe threat of Multicollinearity and properly specified or not mis-specified. The stability of the model is evidenced from the results of the stability test using CUSUM/CUSUMQ test as indicated in the diagram in Figs. 1 and 2. The result of the stability test indicates that the model is stable, given that both the CUSUM and CUSUMQ lines are bounded within the 5% level of significance.

Conclusion and Recommendations

Efforts in the fight against hunger as well as enhancing farmers' income and improving food security especially in the world's poorest countries has given priority to the issue of food losses. It is in the light of the foregoing, that this study was carried out to evaluate post-harvest losses and welfare of Yam producers in Ukum LGA, Benue State, Nigeria. The study adopted descriptive and Ordinary Least Squares Regression approach to answer questions posed by the post-harvest losses study in Ukum LGA.

Findings from the study revealed a positive relationship between market participation rate (MPR) and per capita income among Yam producers in the study area. This implies that farmers with high market participation rate fare better in terms of welfare than those with lower participation rate. In the same vein, the coefficient of farm size in hectare was positively related to the farmers' per capita income and hence their welfare in the area. The positive association between farm size in hectare and per-capita income implied that the larger the size of the farmland, the higher the output, per capita income and consequently improved welfare for Yam farmers. On the other hand, the coefficient of post-harvest losses appeared negatively inclined to farmers' income and welfare. It is acknowledged from the study that post-harvest losses influenced per-capita income negatively, as such setting up a decline of farmers' welfare. The study thus concluded that post-harvest losses caused by inadequacy of storage facilities for farmers; insufficient pests and diseases control measures among others are the major constraints facing farmers in their efforts to control post-harvest losses and therefore hurt the income of farmers and consequently their welfare. The study therefore recommended that: adequate training of farmers on post-harvest crop handling techniques as well as the provision of good storage facilities could help prevent crop losses especially at the farm level; improvement of linkage roads and creation of efficient and effective haulage system could assist curb post-harvest losses; investment in modern postharvest processing technologies and establishment of processing industries is a welcome development; quick and easier access to agricultural credit by farmers to assist them purchase pesticides and herbicides that could reduce food losses both during planting and after harvesting of their crops should be at the front burner; adequate security measures need to be provided to curb the menace and its negative implication on farming activities within the area of study.

Conflict of Interest

The authors declare that there is no conflict of interest related to this work.

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