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FOOD SECURITY STATUS OF WOMEN RICE FARMERS IN SHIRORO LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA

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Abstract

The study assessed the food security status of women rice farmers in Shiroro Local Government Area, Niger State. The study was based on a multi-stage sampling procedure used in selecting 120 women rice farmers in the study area. Information pertaining the farmers' socio-economic characteristics, production activities, household expenditure and food security coping strategy were elicited using questionnaire/scheduled interview. Data for the study were analysed using descriptive statistics (frequency counts, percentages, range and mean), food security index, farm budgeting techniques and logit. The findings of the study revealed that an average proportion (53.3%) of the women had no formal education, were married (78.3%) with mean age of 36years and average household size of 5 persons. The cost and return analysis showed that the total revenue from rice production was ₦412,567.92 per hectare, while the gross margin and net farm income per hectare were ₦338,803.8 and ₦255,358.67 respectively. Food security index revealed that 62% of the respondents were food secure and this was influenced by education (β = -0.08, P<0.05), household size (β= -0.86, P<0.01), experience (β = -0.09, P<0.05) and access to credit (β = -1.50, P<0.05). The study therefore concluded that most of the women rice farmers were food secure. Thus, to ensure food security in the study area, the study recommends that financial institutions as well as cooperatives should make it easy for women to access loans to boost their production and enhance their food security status. In addition, policies geared towards reducing the birth rate should be enacted to control household sizes.

Keywords: Rice, Food security, Gender, Income, Nigeria

Introduction

Food security has become an issue of global concern because food is a necessity of life and its vital role at the household level is obvious since it is a basic means of sustenance (Burchi and Muro, 2012). According to Abdulrahman *et al.* (2017), adequate intake of quality food is very necessary for a healthy and productive life. Hence, a threat to sufficient food production is a threat to human survival [Food and Agriculture Organization (FAO), 2005)] Food insecurity concern may be due to either inadequate physical availability of food supplies, poor access among the population or inadequate utilization of food (Habicht *et al.*, 2004).

Studies have shown that the challenge of food insecurity is greater in sub-Saharan Africa (SSA) where the income per capita is low (FAO, 2010; Shala and Stacey, 2012 and Thome *et al.*, 2019). In 2019, 35.3% of SSA's population were food insecure and the number of food insecure persons is expected to increase by 22.5% in 2029 notwithstanding the improvements.

Nigeria is blessed with rich human and natural resources that can feed its populace and export the surpluses to other countries if properly harnessed. Yet, it is experiencing persistent food crisis both in terms of quantity and quality (Otaha, 2013). Food insecurity is one of the top most developmental problem in Nigeria Oke (2015), the level of food insecurity has continued to rise steadily since 1986 to about 41% in 2004 (Sanusi, *et al.*, 2006) and as at 2019, the Global Food Security Index ranked Nigeria as the 96th food insecure country out of the 113 countries examined even though Nigeria's agricultural sector was the most vibrant non-oil sector contributing significantly to the country's economy [Human and Environmental Development Agenda (HEDA), 2019]. Rural farmers usually have access to regular food supply during harvest season as their income becomes relatively sufficient to purchase food products whose prices may have reduced because of excess supply which may not be the case during the dry season implying that they may have access to food, but the access may not be secured (Ikelegbe and Edokpa, 2013). Although, there may be a high level of food production at the national level, it does not guarantee household food security and this may be due to unfair distribution of resources, variation in production function, and motives for productivity (Oke, 2015). That is why even if the production increase through time food insecurity, malnutrition and hunger remains a serious problem in the world.

Globally, rice provides over 19% human per capita energy as it is a staple food to more than 50% of people (KPMG, 2019). Rice is one of the major staple foods in Nigeria, consumed across all geo-political zones and socio-economic classes in Nigeria (KPMG, 2019). It is an essential cash crop mainly for small scale producers, who account for 80 percent of total production but only 20 percent of consumption. Nigeria earning from local rice production has been on the increase from 2.40 billion dollars (5.3 million metric tonnes) in 2017 and 2.48 billion dollars (608 metric tonnes) in 2018 KPMG,2019). Rice is one of the crops considered under the federal government of Nigeria's Agricultural Transformation Agenda (ATA) to boost food security given its growing importance and prominent role among staple food crops in Nigeria. The country has a history of indigenous rice production and high demand (Johnson *et al.*, 2013).

Women constitute a large part of agricultural workers in much of the developing world (FAO, 2012). Approximately 500 million women depend on agriculture as their means of survival (FAO,2012). However, women in the developing countries including Nigeria have limited access to critical resources and services (Amina, 2006). More than 50% of the agricultural activities are performed by women, producing about 60-70% of the food in Africa (Gawaya, 2008). In Nigeria, women constitute about 37% of the agricultural work force with 32% in the North, and 51% in the South (Amparo *et al.*, 2017). Women have become more vulnerable to food insecurity because they are more susceptible to the effects of climate change and they lack access to productive resources, markets and sources of financing thus inhibiting the full potential of women ensuring food security (Asian Development Bank (ADB), 2013). Food insecurity is higher among women who are poorer, less educated, unemployed, and sometimes marginalized (CARE Food and Water Systems, 2020)). Meanwhile the food insecurity of women affects not only the women concerned, it

also has serious repercussions for their households and the next generation because the poor nutrition of a mother during pregnancy and the child during its first 2 years of life has lifelong consequences for the child's physical and mental development (Alderman *et al.*, 2006). Research have shown that if women are given similar access to resources and inputs as men, they could have 9-30% higher yields than men and this can reduce the number of people malnourished by 12-17% (Moock, 2006; FAO, 2012; Alderman *et al.*, 2013; Saito, 2014). Therefore, an understanding of the relative status and role of women is essential to comprehend the strategies women utilize to promote food security. Thus, the objectives of the study were to; estimate the cost and returns to rice production, examine the food security status of the women rice farmers, and determine the factors influencing the food security status of the women rice farmers in the study area.

Methodology

Area of Study:

Shiroro Local Government Area is in Niger State, Nigeria. It lies between latitude 8^0-10^0N and longitude 3^0-8^0N. It has a land mass of 5171.926km^2 with a population density of 66.02 (Kmsq.). Shiroro has a projected population of 340,425 out of which about 169,046 are women (Niger State Bureau of Statistics (NSBS, 2017). Shiroro LGA has an average annual temperature of 26.26^{0C} and annual rainfall ranging between 1100mm and 1600mm. Shiroro LGA is considered the food basket of the district because most of its population is engaged in peasant farming.

Sampling Procedure:

The study was based on a multi-stage sampling procedure. The first stage involved the purposive selection of the two districts (Kuta and Galkogo) in Shiroro Local Government Area Niger State. This is because most of the farmers in the area cultivated rice due to the good rainfall pattern experienced (DEVASS AGRO CONSULTANTS, 2018). In the second stage, one community (Pina) and two communities (Galadimakogo and Gussoro) were purposively selected from Kuta and Galkogo respectively because of their high involvement in rice farming (Ibrahim *et al.*, 2009). In the third stage, a total of 120 respondents were randomly selected (from the communities using Yamane formula based on the list of registered women rice farmers in each community as shown in Table 1. The Yamane formulae is specified as follows according to Dika *et al.*, (2018):

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

Where:
n = targeted number of respondents
N = sampling frame
e = Precision level (0.05)

Method of Data Collection:
The study data was collected using structured questionnaire. The questionnaire was used to elicit information on the women rice farmers' socio-economic characteristics such age, marital status, educational status and farm size, market accessibility, different farming systems adopted, food consumption pattern and constraint faced by the women rice farmers in the study area.

Analytical Techniques:
Descriptive statistics: Descriptive statistics such as mean, frequency distribution, percentages and standard deviation were used to describe the socio-economic characteristics of the women rice farmers and the challenges faced by women rice farmers in the study area.
Food Security Index (FSI):
The FSI was used to assess the food security status of the women rice farmers. The women rice farmers were classified into food secure and food insecure using food security index following Omonona and Agoi (2017) and specified as Equation 1.

$$F_i = \frac{per\ capita\ food\ expenditure\ for\ the\ ith\ woman\ rice\ farmer}{\frac{2}{3}\ of\ the\ mean\ per\ capita\ food\ expenditure\ for\ all\ women\ rice\ farmers} \qquad (1)$$

Where:
F_i = Food Security Index
$F_i \geq 1$ = Food secure i^{th} woman rice farmer, and
$F_i \leq 1$ = Food Insecure i^{th} woman rice farmer.

A food secure woman rice farmer is one whose per capita monthly food expenditure is above or equal to two- third of the mean per capita. A food insecure woman rice farmer is that whose per capita food expenditure is below two third of the mean monthly per capita food expenditure.

Farm Budgeting Model:
The farm budget model was used to estimate costs, returns and net farm income of the women rice farmers.

Budgetary technique was used to estimate the costs and returns as well as the Net Farm Income (NFI) associated with rice farming from the sampled women rice farmers. The NFI is a measure of the profit of rice farming, and it is expressed as:

$$NFI = GFI - TC \qquad (2)$$

Where:
GFI = is the Gross Farm Income, which is the total value of farm outputs including those sold, consumed at home and/or given out.
TC = is the Total Cost of production, including the cost of all the variable and fixed inputs employed in production.

Logit Model:
Logit Model was used to determine the effect of rice production on the household food security status of the respondent, and it is expressed as Equation 3:

$$\ln\left[{}^{p_i}/_{(1-p_1)}\right] = Y = \beta_0 + \Sigma\beta_i X_i + e \quad (3)$$

Y is the dependent variable, representing the food security status of respondents (1= food secure, 0= food insecure), X is a vector of independent variables namely:

X_1 = Age of the respondent (years), X_2= Education (years), X_3 = Household size (Number of persons). X_4 = Marital Status (Married 1 otherwise 0), X_5 = Farming experience (years), X_6 = Net Farm Income (₦), X_7 = Income from other sources (₦), X_8= access to credit (Yes = 1, No = 0) (₦), X_9= Distance from home to farm(Km), X_{10}= Number of extension visits, X_{11}= Membership of association (yes= 1 and 0 otherwise) X_{12}= Goal of rice production(1= food for family and 0, otherwise).
β is a vector of unknown coefficient and e is an independently distributed error term assumed to be normal with zero mean and constant variance.

Results and Discussions

Socio-economic characteristics of respondents:
The main tenet of this study is to assess the food security status of women rice farmers in the study area and the result in Table 2 shows that most (52.4%) of the women rice farmers were aged between 31and 40 years with mean age of 36years. This finding corroborates with the findings of Ecosystems Development Organization (EDO, 2003), Kolo (2004) and Tijani *et al.* (2010), Bwala and John (2018) who reported that most rice farmers were aged between 26 and 48 years in Nigeria, Niger State, Borno State and Zone 1 of Niger State respectively. Majority (78.3%) of the women were married with average household size of 6 persons. The large household size may be of advantage to the household in terms of labour supply especially when there is a scarcity of labour. However, it may be a disadvantage when children and young adults of school age are prevented from going to school because they need to carry out some farming activities which may be detrimental to the household on the long run. In addition, large household implies more mouths to feed and therefore the need for higher income to meet up with the household consumption demand and vice versa. Table 2 also shows that an average (53.3%) female rice farmer lacks formal education, and this may limit their access to information and adoption of technology. Education can influence their ability to adopt new technology which can enhance rice output because modern technology requires the use of manuals in most cases for proper understanding of their operations.

Furthermore, the lack of formal education further proves the assertion of early marriage in the study area. The results also bring to light the need for proper sensitization of farmers on ways to eradicate food insecurity since they may lack the knowledge because of their lack of formal education. This finding is in consonance with the studies of Akinbile (2007), Ayoola *et al.* (2011), Oladimeji and Abdusalam (2013). Profit maximization was the main goal of farming in the study area as indicated by 55% of the women rice

farmers. However, 42.5% of the respondents reported that they were involved in farming to produce food for their families (Table 2). This is to say that women rice farmers in the study area are on the right track of reducing food insecurity since the achievement of profit maximization will translate into higher income for the households. Again, Table 2 showed that 80% of the rice farmers had 3 extension visits during the production cycle while 95% of the respondents belonged to one cooperative or the other. Three times visits may not be sufficient since a large percentage of the rice farmers had no formal education. However, membership of cooperative could enhance productivity since members can learn from their peers and also have access to one information or the other. Table 2 also showed that majority (68.3%) of the women rice farmers have not had no access to loan. This is an indication that they depend on their personal savings and loans from family and friends. Hence, there is a possibility that they produce on a small scale which can limit their goal of profit maximization.

Cost and Returns to Rice Production:

Table 3 shows that total of ₦412,567.92 was realized from rice production. However, 87.24% of the revenue was realized from the sales of paddy rice while 2.31% and 10.45% of the revenue was from the sales of rice husk and shafts respectively. Also, the total variable cost was ₦73,764.08 and fertilizer contributed about ₦51,293.33 which is about 69% of the total variable cost. associated with rice farming in Ekiti and Ogun States in Southwest Nigeria.

This is in line with Afolami *et al.* (2012) who also reported that fertilizer application was the highest variable cost. The net farm income per hectare of rice production in the study area was ₦255,358.66 as shown in Table 3. This is an indication that rice production in the study area was a profitable venture. However, net farm income in relation to food security in the study area implies that an average woman rice farmer has about ₦670 per day to purchase food and non- food items. Since the woman has an average household of 6 persons, it then implies that ₦670 per day may not be sufficient to make the woman food secure because a woman's purchasing power may not only be used to buy food and other basic assets for herself and her family, but also to pay for the inputs used in food production.

Food security status and food coping strategies:

Figure 1 revealed that majority (61.7%) of the women rice farmers were food secure expending above ₦17,963.38 per month on food consumption, while only 38.3% were food insecure. To achieve food security, majority (98.3%) of the women rice farmers purchased food from the market and this is mostly done on credit as reported by 90% of the rice farmers (Figure 2). In addition, 89% of the respondents reported that they do not sell their farm produce, while 84.2% of the respondents reduce the number of meals taken per day. It is worthy of note that some (40%) of the women rice farmers engage in other jobs to increase the household income. However, they do not work in urban centre as 89.2% of the women reported that they do not work in urban centres. This further buttress the findings reported in Table 3 which revealed that net farm income from rice production alone is not sufficient to make the women rice farmers food secure.

Determinants of food security status of women rice farmers in the study area:
The result of the logit regression is shown in Table 4. The chi – squared statistic of 33.91 was significant ($P<0.01$) indicating that the model was well fitted. Education (β = -0.08, $P<0.05$), household size (β= -0.86, $P<0.01$) and experience (β = -0.09, $P<0.05$) had negative and significant effect on the food security status of the women rice farmers while access to credit (β = 1.50, $P<0.05$) had positive influence on food security.

The negative effect of education on food security of the respondents implies that an increase in the number of years of education will lead to a decrease in the likelihood of the women rice farmers who are food secure by 2%. This could imply that specific programmes such as extension services in agriculture may be more effective at increasing the women rice farmers food availability and access (World Food Programme (WFP, 2006); Muro and Burchi (2007). However, this finding disagrees with the findings of Mukudi (2003) who found a positive relationship between household food security and education in Africa, but it agrees with Muro and Burchi (2007) who reported that primary education is a key determinant of food insecurity in the rural areas of low-income countries.

The coefficient of household size was negative and significant. This is an indication that the larger the number of persons in a household, the higher the likelihood of the household been food insecure. In order words, increase in the number of persons in a household by 1 will reduce the likelihood of the household being food secure by 15%. This is so, because more people in the household could result to a higher level of dependence and the need for more income to be able to meet up with the household expenditures. This is in line with Ibok *et al.* (2014); Oyetunde-Usman and Olagunju (2019) and Agidew and Singh (2018) who also reported that household size had negative effect on household food security in Nigeria and Ethiopia.

The negative coefficient and significance of rice farming experience is an indication that higher level of rice farming experience reduces the likelihood of the household being food secure. Experience enhances specialization but it may hinder adoption of technology. The women rice farmers may be used to doing things in their own way and this can translate into refusal to adopt new technologies which can enhance their efficiency and level of output. Thus, they may not be maximizing their output, and this can cause a decrease in their income and further translate into food insecurity.

In addition, the results showed that a percentage increase in access to credit will lead to an increase in the likelihood of the women rice farmers being food secure by 26%. Therefore, farmers' access to credit enables them to expand production and it can also serve as a safety net against food insecurity. This finding corroborates the studies of Kuwornu *et al.* (2013) and Jabo *et al.* (2017) who found that access to credit improved the food security status of households in Ghana and Nigeria.

Conclusion and Recommendations

Based on the results obtained from this study, it can be concluded that rice farming enterprise by women in the study area was profitable and most (62%) of the women rice farmers were food secure and this was influenced by education, household size, experience and access to credit. Thus, in order to ensure the food

security of the women rice farmers in the study area, the study recommends that financial institutions well as cooperatives should make it easy for women to access loans so as to boost their production a enhance the food security of their households. In addition, policies geared towards reducing the birth r should be enacted so as to control the nation's population which will in turn reduce the household size the women rice farmers.

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Table 1: Sample distribution of women rice farmers

LGA	District	Community	Sampling frame	Sampling size
Shiroro	Kuta	Pina	52	39
	Galkogo	Galadimakogo	46	34
		Gussoro	62	47
Total	2	3	160	120

Source: Survey data, 2019

Table 2: Distribution of respondents by their socioeconomic characteristics

Description	Frequency	Percentage (%)	Mean
Age			
21-30	28	23.4	36
31-40	63	52.4	
41-50	29	24.2	
46-50			
Marital status			
Single	12	10.0	
Married	94	78.3	
Divorce	9	7.5	
Separated	5	4.2	
Household size			
1-3	2	1.7	6
4-6	91	75.8	
7-9	27	22.5	
Formal Education			
Yes	56	46.7	10
No	64	53.3	
Main goal for rice farming			
Produce food for family	51	42.5	
Profit maximization	66	55.0	
Other goals	3	2.5	
No. of extension visits			
1.00	7	5.8	
2.00	14	11.7	
3.00	96	80.0	
4.00	3	2.5	
Cooperative organization			
Yes	114	95.0	
No	6	5.0	
Access to credit			
Yes	38	31.7	
No	82	68.3	

Source: Survey data, 2019.

Table 3: Cost and returns to rice production in the study area

Variables	Revenue/Cost (₦ /ha)	Percentage
Rice Output		
Paddy rice	359,927.50	87.24
Rice shaft(grass)	43,101.67	10.45
Rice husk	9,538.75	2.31
Total Revenue	**412,567.92**	**100.00**
Variable Input		
Labour	8,128.75	11.02
Transportation	725.33	0.98
Fertilizer(kg)	51,293.33	69.54
Rice seed(kg)	6,085.00	8.25
Insecticides(L)	2606.67	3.53
Herbicides(L)	4,925.00	6.68
Total Variable Cost	**73,764.08**	**100.00**
Gross margin	**338, 803.83**	
Fixed Inputs		
Cost of Land	8,128.75	9.74
Plough	11,1666.67	13.38
Harrow	5,292.67	6.34
Cutlass	3,435.00	4.12
Hoe	4,852.50	5.82
Wheelbarrow	5,693.33	6.82
Tractor	11,025.00	13.21
Rake	1,453.33	1.74
Storage facilities	5,758.33	6.90
Knapsack sprayer	12,866.67	15.42
Planter	7183.33	8.61
Bags	6,590.58	7.90
Total Fixed Cost	**83,445.17**	
Net Farm Income	**255,358.66**	

Source: Field survey, 2019

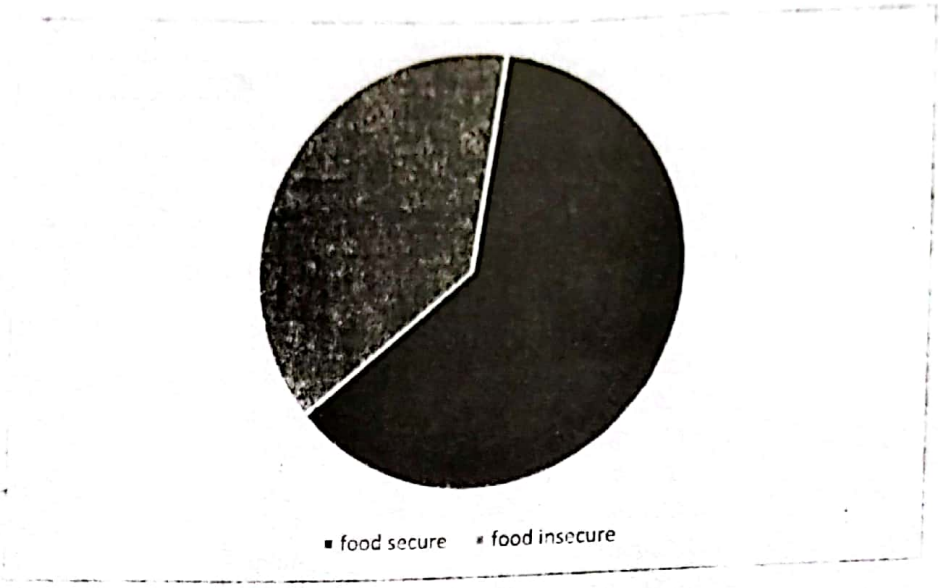

Figure. 1: Food security status in the study area.
Source: Field survey, 2019

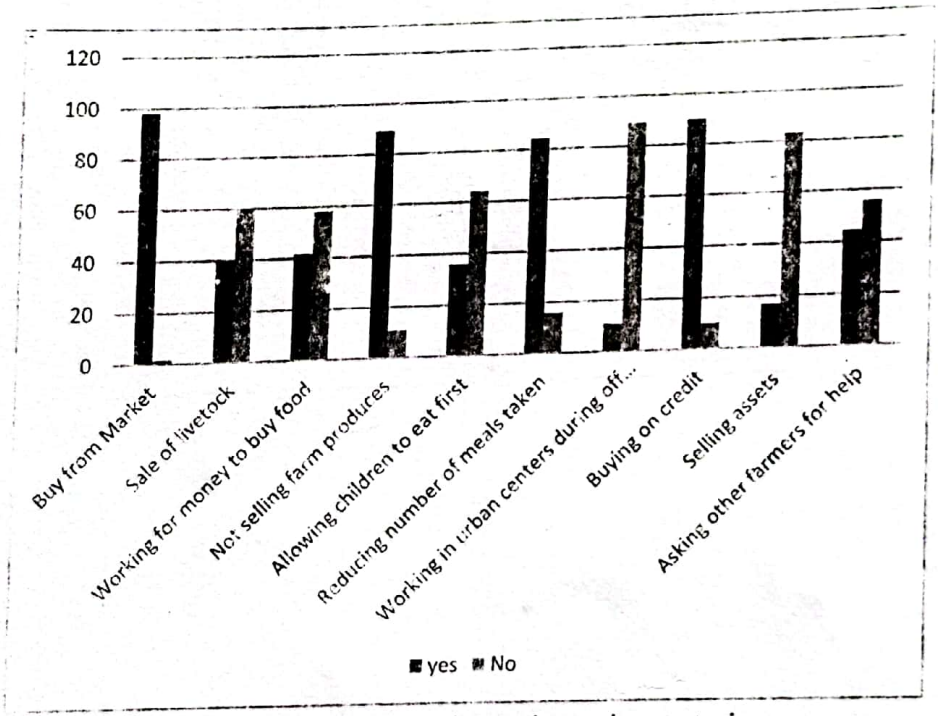

Figure 2: Women rice farmers food insecurity coping strategies
Source: Field survey, 2019

Table 4: Determinants of food security status of women rice farmers in the study area

Variables	Coefficient		Z-value	Marginal effect
Age	0.01	0.04	0.17	0.00
Education	-0.08*	0.05	-1.67	-0.02
Household size	-0.86***	0.24	-3.57	-0.15
Marital Status	0.85	0.71	1.21	0.15
Experience	-0.09*	0.05	-1.68	-0.02
NFI	-3.72e-06	2.68E-06	-1.39	0.00
Income from other sources	3.59e-06	9.78E-06	0.37	0.00
Access to Credit	1.50**	0.60	2.50	0.26
Distance from home to farm	0.23	0.35	0.66	0.06
Number of extension visits	0.25	0.42	0.59	0.04
Membership of cooperative	0.41	1.16	0.35	0.07
Goal of farming	-0.18	0.47	-0.38	-0.03
Constant	5.29**	2.43	2.17	
LR $chi^2(12)$	33.91			
Prob > chi^2	0.0007			
Pseudo R^2	0.2111			

***, **, *implies significance at 0.01, 0.05 and 0.1 probability levels respectively

Source: Field survey, 2019

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ANALYSIS OF MARKET INTEGRATION OF MAIZE IN RURAL AND URBAN MARKETS OF OYO STATE, NIGERIA

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Abstract

The study analyzed market integration of maize in the rural and urban markets of Oyo State, Nigeria. The specific objectives were to: determine the market integration of maize price series, ascertain the market that causes integration and identify the direction of causality in the rural and urban markets of Oyo State, Nigeria. Average monthly price series of maize spanning from January 2008 to December 2018 were collected and analyzed using Augmented Dicky Fuller test to test for stationarity, Johansen co-integration test to test for co-integration, Index of Market Concentration (IMC) to determine market integration as well as the Granger causality test to find out the market that causes integration. The result of ADF test showed that the price series were non-stationary at levels but became stationary after first differencing and the co-integration test revealed the presence of co-integration between the rural and urban market price of maize. The Index of Market Concentration was less than one ($p \leq 0.05$) which implies the existence of short-run market integration between rural and urban markets in the study area. Also, the result of Granger causality shows both uni-directional and bi-directional causalities between rural and urban markets in the study area. The study concludes that there were both short and long run market integration between rural and urban markets with uni-directional and bi-directional causalities between the stated markets in the study area and therefore recommended that, government should establish market information centres and awareness programmes on mass media to facilitate efficient information flow among maize producers and consumers in the state.

Keywords: Integration, Market, Maize, Oyo, Price, Stationarity.

Introduction

In a developing economy like Nigeria, the dynamics of the exchange of information and its effect on the pricing processes are not well understood. The cropping pattern is no longer dictated by what the producers need for personal consumption but what is responsive to the market in terms of prices received by the farmers (Sadiq *et al.*, 2017). According to Abdulhameed and Onuk (2016), market integration is the co-movement of prices and the smooth transmission of price signals and information across spatially separated markets. Several researchers have dealt on food crop price transmission and market integration issues in

Nigeria. In separated markets, when there is significant price difference between homogenous goods, such that the differences exceeded the transfer cost; the arbitrage activities will be activated. The arbitrageur purchases commodities from lower-price markets and resell in higher-price markets. This is a situation where spatial markets are not integrated but on the other hand, two markets are integrated when there is a significant long-run relationship between prices of homogenous goods due to the smooth transmission of price signals and information across the two markets (Ani *et al.*, 2017). Market integration could be perfect if price changes in one market are fully and instantaneously reflected in the alternative markets.

Hence, understanding the direction and magnitude of the price transmission of maize between the rural and urban markets in Oyo State will provide indispensable input to policy makers to formulate workable policies for the agricultural sector in the state. It will also, promote the achievement of the food self-sufficiency goal and help in minimization of the poverty menace among the citizens in the state and the nation at large. Therefore, such information can help government at all tiers to decide the extent to which price transmission can be considered as efficient across different geo-political zones in their domains (Ani *et al.*, 2017).

Maize (*Zea mays*) is one of the major staple foods, whose prices are highly unstable between seasons in the Western part of Nigeria. Consumers pay different amounts for the same product in different markets separated by few kilometres. According to Ani *et al.*, 2017, price instability of agricultural commodity would be considered a normal phenomenon if it does not significantly differ from one market to another. On the contrary, if products prices are significantly different among markets it will distort resources flow, which might have adverse effect on the food security goal of the federal government.

In recent years, research works on agricultural price transmission, such as Ani *et al.*, (2017), Sadiq *et. al.*, (2017), Ibrahim *et al.*, (2016), Marco and Chuma, (2015), Ojo *et al.*, (2015), Akpan *et. al.*, (2014) among others has gathered considerable attention. Interest in this topic unquestionably increased after the so-called food crisis of 2007-2008 in which international agricultural markets were shocked by increased volatility, which is a rapid rise and fall of the "price bubbles" as well as a possible change in the long-term downward trend of agricultural prices. The boom and subsequent decrease in food prices that took place around 2008 raised numerous questions about the impact of such variations on populations' welfare and on the economic sector which directly concerns the agricultural sector (Mkpado *et al.*, 2018). Therefore, if governments are to take adequate measures to ensure food security, they need to have good knowledge of the functioning of their markets. This means that among other things, it is important to know the state of price transmission along the marketing chain within the country and between international and domestic markets (Sadiq *et al.*, 2017). Based on the above, this study provides answers to the following research questions: What is the level of price relationship between integrated markets in the study area? Which market causes the movement of prices, and in what direction?

Objectives of the Study:

The aim of this study is to analyze the market integration of maize in the rural and urban markets of Oyo State, Nigeria. The specific objectives are:

1. To determine the market integration of maize price series in the rural and urban markets of Oyo State
2. To find out the market that causes integration and determine the direction of causality in the study area.

Empirical Review:

Several studies about price transmission and market integration have been conducted by various researchers in Nigeria. Some of the major studies include: Bako *et al.*, (2021) who conducted a study on price dynamics of local and imported rice in Lagos State Nigeria, using unit root test, Granger causality test and index of market concentration (IMC); revealed that all the price series became stationary after 1st differencing with an order of integration of I(1), implying that the prices of both local and imported rice in rural and urban markets were trending upwards in an irregular pattern. Mpkado *et al.*, (2018) studied price transmission and market integration of rural and urban rice market in Nigeria. Primary and secondary data were collected and analyzed using co-integration analysis, market integration function and descriptive statistics. The result showed that price series were integrated but the level of integration was low. Ohwo and Adeyemi (2018) conducted their study on price transmission and market integration of sawn wood in Delta State Nigeria and the results revealed that prices of sawn wood were not integrated. Ani *et al.*, (2017) studied market integration of retail prices of soyabeans in Benue and Enugu States. The results indicated that retail prices of soyabean in Benue State did not granger cause the retail prices in Enugu State. Marwa *et al.*, (2017) investigated market integration of agricultural products at both producer and consumer levels and showed that prices of agricultural products were integrated at both levels with bi-directional causalities between producer and consumer prices. Oladapo and Momoh analyzed food price differences and market integration in Oyo State and revealed that prices of food in Oyo State were not stationary at their various levels but became stationary at first difference with the existence of co-integration among the price series in the study area.

Methodology

The Study Area:

The study was conducted in Oyo State, Nigeria. It is in the South-Western part of Nigeria and lies between latitude 7^0 and 9.3^0N and longitude 2^0 and 4^0E. The state is made up of 33 Local Government Areas with a total population of 5,591,585 which was projected to be about 7,594,071 in 2020 at 2.5% growth rate according to the National Bureau of Statistics (NBS), (2016). The Oyo State rural markets are representing different communities and villages in the rural areas, while the urban markets are representing different towns and cities in the urban areas. The major ethnic group mainly comprises of the *Oyos*, the *Oke-Oguns*, the *Ibadans* and the *Ibarapas*, all belonging to the Yoruba family. Both annual and perennial crops are grown in the region, and this includes but not limited to maize, cassava, yam, oranges, cocoa, tobacco, cashew, and sugar cane.

Methods of Data Collection and Analytical Techniques:

Secondary data such as average monthly prices of maize spanning from January 2008 to December 2018 were used for this study. The data was collected from the National Bureau of Statistics and the Oyo State Agricultural Development Programme. The study applied series of statistical and econometric techniques

to analyze the relationship between rural and urban market price of maize in Oyo State, Nigeria. The tests include Augmented Dickey Fuller (ADF) test, Johansen Co-integration test, Index of Market Concentration (IMC) as well as Granger causality test.

Augmented Dickey Fuller (ADF) Unit Root Test: As first step in the analysis involving time-series data, the investigation of the presence of unit root in the data is very important because it helps to ensure that the variables used for the analysis do not result in spurious regression. The ADF unit root test was carried out on the data to test for the stationarity of each time series data set. The test also enables the determination of the order of integration of the series, which is the number of times a series must be differenced for it to become stationary. The ADF unit root test is represented in equations 1 and 2.

$$\Delta P_{Bt} = \beta_0 + \beta_t P_{Bt-1} + \sum C_j \Delta P_{Bt-1} + \varepsilon_i \quad 1$$

$$\Delta P_{At} = \gamma_0 + \gamma_t P_{At-i} + \sum d_j \Delta P_{At-1} + \varepsilon_i \quad 2$$

Where Δ = first difference operator and ε_t= stochastic error term that follows the classical assumptions. The decision rule is that, if the value of the ADF statistic is less than the critical value at a specified significance level then the series (P_t) is said to be non-stationary and vice versa.

Index of Market Concentration (IMC): The index of market concentration presented in equation 3 was used to measure the price relationship between integrated markets.

$$P_t = \beta_0 \beta_1 P_{t-1} + \beta_2 (R_t - R_{t-1}) + \beta_3 R_{t-1} + \varepsilon_t \quad 3$$

Where: R_t = urban, P_t= rural price, R_{t-1} = lagged price for urban markets, R_t-R_{t-1} = difference between urban price and its lag, $\in_t$ = error term or unexplained term, β_0= constant price, β_1 = coefficient of rural lagged price, β_2 = coefficient of $R_t - R_{t-1}$ and β_3 = coefficient of urban lagged price.

$$IMC = \beta 1/\beta 3 \quad 4$$

Where $0 \leq IMC \leq \infty$

IMC < 1 implies high short-run market integration, IMC > 1 implies low short-run market integration, IMC = ∞implies no market integration, and IMC = 1 implies high or short-run market integration (Patrick *et al.*, 2016).

Johansen Co-integration Test: The next logical step was to test for co-integration using Johansen co-integration techniques (Trace and Eigen-value Test). It was used to test the hypothesis:

H_0: The time series variables are not co integrated (r=0)

As stated in equation 5, if two series are individually stationary at same order, the theories of Johansen and Juselius (1990) and Juselius (2006) can be used to estimate the long run co-integrating vector from a Vector Autoregression (VAR) model of the form:

$$\Delta_{pt} = \propto + \sum_{i=1}^{k-1} \tau_i \Delta P_{t-1} + \pi P_{t-1} + \mu_t \quad 5$$

Where: P_t is a (n x 1) vector containing the price series at time (t), Δ is the first difference operator. Γ_i and Π are (m x n) matrix of parameters on the i^{th} and k^{th} lag of $p_t, \tau_i = (\sum_{i=1}^{k} A)\text{-}I_g$, $\pi_i = (\sum_{i=1}^{k} AI)\text{-}I_g$, I_g is the identity matrix of dimension g, α is constant term, μ_t is (n x 1) white noise vector. Throughout, p is restricted to be (at most) integrated of order one, denoted by I(1), where I(j) variable requires j^{th} differencing to make it stationary.

Granger Causality Test: If a pair of series is co-integrated, then there must be Granger-causalities in at least one direction, which reflects the direction of influence between series (in this case, price) (Ojo *et al.*, 2015). Theoretically, if the current or lagged terms of a time-series variable, as in equation 6, determine another time-series variable, as in equation 7 then there exists a Granger-causality relationship between equations 6 and 7 in which equation 7 is Granger caused by equation 6:

$$\Delta P_{Bt} = \theta_{11}\Delta P_{Bt-1} + \ldots + \theta_{1n}\Delta P_{Bt-n} + \theta_{21}\Delta P_{At-1} + \theta_{2n}\Delta P_{At-n} - \gamma_1(P_{Bt-1} - \alpha P_{At-1} - \delta) + \varepsilon_{1t} \quad 6$$

$$\Delta P_{Bt} = \theta_{31}\Delta P_{Bt-1} + \ldots + \theta_{3n}\Delta P_{Bt-n} + \theta_{41}\Delta P_{At-1} + \theta_{4n}\Delta P_{At-n} - \gamma_2(P_{Bt-1} - \alpha P_{At-1} - \delta) + \varepsilon_{2t} \quad 7$$

The following two assumptions, as in (Equations 8 and 9) must be tested using the above two models as stated in (equations 6 and 7) to determine the Granger causality relationship between prices.

$\theta_{21} = \Delta = \theta_{2n} = \Delta = \gamma_1 = 0$ (No causality from P_{Bt} to P_{At}) 8

$\theta_{41} = \Delta = \theta_{4n} = \Delta = \gamma_2 = 0$ (No causality from P_{Bt} to P_{At}) 9

The causality test procedures offer a framework for the assessment of which market (rural or urban) cause the integration and in which direction is the movement (Ojo *et al.*, 2015).

Results and Discussion

Summary Statistics of Variables used for Analysis:

The descriptive statistics of the price series used in the empirical models for investigation in this study are presented in Table 1. The results showed that the average price of dry maize was ₦68.43/kg and ₦105.00/kg in the rural and urban markets respectively while the minimum and maximum values were ₦64.59/kg and ₦175.00/kg and ₦50.96/kg and ₦90.92/kg for rural and urban prices respectively. The findings also revealed that, there was a significant deviation between the rural and urban price of maize in the study area as indicated by the standard deviation of ₦31.46/kg and ₦14.42/kg for rural and urban markets respectively. In addition, the coefficient of variation in price of maize in the rural and urban markets was 98.90% and 20.70% respectively, which showed that, the rural price of maize exhibited higher variations compared to the urban price.

Time Series Properties of Maize Price Series in Oyo State:

As first step in the analysis involving the use of time series data, the stationarity of the variables is required. The properties of the time series data were tested using Augmented Dickey Fuller (ADF) test to determine the stationarity of the price series under consideration as presented in Table 2. The ADF test shows that the maize market price series were non-stationary at levels but became stationary after first differencing with order of integration 1, That is, I (1). The results as presented shows that only the market price series of *Aarada* was significant at the 0.05 probability level ($P < 0.05$), while other markets price series namely *Bodija, Sabo, Omi – Adio, Iluju* and *Ilora* were all significant at the 0.01 probability level ($P < 0.01$). This implies that the market price series for the analysis were all stationary at first difference, leading to the acceptance of the null hypothesis of non-stationarity of the market price series at levels in the study area. This finding supports the findings of Oladapo and Momoh (2017) that examined food price differences and market integration in Oyo State, Nigeria and reported non stationarity of food price series at their respective levels, but only became stationary at first difference.

Johansen Co-integration Test for Maize Markets in Oyo State:

The results of Johansen co-integration test for maize markets in Oyo State presented in Table 3 shows a trace statistic of 320.54 which is greater than the critical value of 94.15 at 5% level of significance ($P < 0.05$) and a max statistic of 134.31, which is also greater than the critical value of 39.37 at 5% level of significance. The result shows that there was at least one co-integration equation among the market price series. Therefore, based on the decision rule, the null hypothesis of no co-integration among the maize market series was rejected. This implies that there is a long run relationship among the maize market price series in the st udy area and the variables in the model are co-integrated. Ojo *et al.*, (2015) also reported the existence of co-integration at 5% significant level for rice market price series in Niger State thereby implying the presence of long run relationship among the variables.

Index of Market Concentration (IMC) for Maize Markets in Oyo State:

To determine the market integration between rural and urban maize markets in Oyo State, the Index of Market Concentration (IMC) was used, and the results obtained are presented in Tables 4. The result of Index of Market Concentration (IMC) shows the IMC values of 0.8300 for maize in the study area. This result is less than unity ($IMC < 1$) and statistically significant at 5% level of significance, which implies the existence of high short-run market integration between rural and urban markets for maize in Oyo State and thereby indicated the presence of perfect price transmission mechanism in the short-run between rural and urban markets of maize in Oyo State, Nigeria. This is a strong indication that price changes in the rural markets of maize do cause immediate change in the prices of maize in the urban markets. This result is in concordance with the assertion of Akpan *et al.*, (2014) in their study on monthly price analysis of cassava derivatives in rural and urban markets of Akwa-Ibom State reported that there was high short-run market integration between rural and urban prices of cassava products in the study area.

Granger causality test on maize markets in Oyo State:

The results of granger causality tests for maize price series as presented in Table 5 shows that the F-statistics for the listed market pairs in Oyo State were statistically significant at 1% level of significance and as such, the null hypotheses of no granger causality between the stated markets pairs was rejected. The results also

show that, there were uni-directional causalities between the market pairs of *Bodija–Aarada* and *Bodija–Ilora*, while the market pairs of *Bodija–Iluju, Aarada–Iluju, Aarada–Ilora* and *Iluju-Ilora* shows a bi-directional causality. The implication of the uni-directional causalities between two markets is that, a change in price in the former market in each pair granger causes the price formation in the latter market, whereas the price change in the latter market is not fed back by the price change in the former market in each pair, while the bi-directional causalities implies that the former market in each pair granger caused the price formation in the latter market which in turn provides the feedback to the former market as well. This result further substantiates the strong co-movement of the price of maize in the rural and urban markets and strong evidence of market integration in Oyo State. Ohwo and Adeyemi (2018) investigated price transmission and market integration of sawn wood in Delta State, Nigeria and reported bi-directional causalities between the rural and urban markets within State.

Conclusion and Recommendations

The study analyzed the dynamics of market integration of maize in the rural and urban markets of Oyo State, Nigeria and concludes that there were both short and long run market integration between rural and urban markets with uni-directional and bi-directional causalities between the stated markets in the study area. Based on the research findings, the study therefore, recommended that government should establish market information centers and awareness programmes on mass media to facilitate efficient information flow among maize producers and consumers in Oyo State.

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Table 1: Descriptive statistics of maize price series used in the study.

Parameters	Maize Price Series (₦/Kg)	
	Rural Market	Urban Market
Mean	68.429	105.002
Minimum	64.590	50.960
Maximum	175.000	90.920
Standard Deviation	31.459	14.422
Coefficient of Variation	0.989	0.207
Skewness	0.907	0.492
Kurtosis	3.595	1.943

Source: Data Analysis, 2020.

Table 2: Results of augmented Dickey Fuller (ADF) unit root test

Market price series	Level	1st Difference	Order of Integration
Bodija	-2.661	-4.486***	I (1)
	(0.081)	(0.005)	
Aarada	-2.646	-3.360**	I (1)
	(0.040)	(0.034)	
Sabo	-2.761	-4.636***	I (1)
	(0.064)	(0.005)	
Omi-Adio	-2.509	-5.622***	I (1)
	(0.113)	(0.000)	
Iluju	2.411	-4.142***	I (1)
	(0.138)	(0.000)	
Ilora	-2.308	-4.929***	I (1)
	(0.169)	(0.000)	

Source: Data Analysis, 2020.

- ***and** implies 1% and 5% level of significance respectively.
- Figures in parentheses are probability values.

Table 3: Johansen co-integration rank test for maize market

Hypothesized No. of CE(s)	Trace Statistics	Critical Value (5%)	Max Statistics	Critical Value (5%)
r = 0*	320.54	94.15	134.31	39.37
r = 1	186.24	68.52	91.11	33.46
r = 2	95.13	47.21	32.94	27.07
r = 3	62.19	29.68	31.13	20.97
r = 4	30.06	15.41	22.29	14.07
r = 5	7.76	3.76	7.76	3.76

Source: Data Analysis, 2020
Denotes rejection of null hypothesis at 5% significant level.

Table 4: Results of index of market concentration (IMC) for maize

Markets	β_1	β_2	β_3	**IMC**
Maize	0.0836	0.1050	0.1006	0.8300
	(2.26) **	(2.23) **	(2.10) **	

Source: Data Analysis, 2020.

Note: *** and ** implies significant at 1% and 5% level of significance respectively.
Figures in parenthesis are t-values.

Table 5: Pair-wise Granger causality test on maize markets in Oyo State

Null Hypothesis	F-Statistics	P-Value	Direction of Causality
Bodija → Aarada	8.2725***	0.0003	
Aarada → Bodija	1.4135	0.2625	Uni-directional
Bodija → Iluju	5.0495***	0.0048	
Iluju → Bodija	6.1743***	0.0017	Bi-directional
Bodija → Ilora	2.6549	0.0602	
Ilora → Bodija	11.536***	0.0000	Uni-directional
Aarada → Iluju	2.1452	0.1092	
Iluju → Aarada	15.414***	0.0000	Bi-directional
Aarada → Ilora	5.2521***	0.0040	
Ilora → Aarada	49.265***	0.0000	Bi-directional
Iluju → Ilora	19.353***	0.0000	
Ilora → Iluju	71.277***	0.0000	Bi-directional

Source: Data Analysis, 2020
→: indicates direction of causality,
*** and** means significant at 1% and 5% level of significance respectively.