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Research Article

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Analysis of Spatial and Seasonal Price Variation on Palm Oil Markets in Bayelsa State, Nigeria

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ABSTRACT

The study analyzed spatial and seasonal price variation in palm oil markets in Bayelsa State using multistage sampling procedure to obtain data from 300 palm oil marketers with the use of a well-constructed questionnaire and the data was analyzed with descriptive statistics, multiple linear regression and binary logistic regression. The study revealed that palm oil marketing was dominated by the females (70%) with average education, well experienced and married with a moderate family size. Findings from the study revealed that mean price of palm oil in the urban market was N32500/25 litres in the off season and N20500/25 litres the peak season while in the rural markets; it was N27125/25 litres in the off season and N17625/25 litres in the peak season. The study further revealed a significant ($p < 0.05$) spatial price variation in the off season and an insignificant ($p > 0.05$) spatial price variation in the peak season. The result also revealed a significant ($p < 0.05$) seasonal price variation both at the urban and rural markets with a mean difference of N12000 at the urban markets and a mean difference of N9500 at the rural market. Regression result from the study identified cost of production, cost of transportation, storage cost, rate of sales, market levies, rent fee and market information as factors that influences spatial price variation. It also identified supply, demand, weather, flood, seasonal supply of fresh fruit bunch, cost of purchase, cost of storage and political instability as factors that influences seasonal price variation in palm oil marketing. The study also revealed price variation has a significant ($p < 0.05$) effect on the demand for palm oil. It is recommended that marketers should provide warehouses to buy and store palm oil during the season of massive production to resell during the season of little or no production in order to maximize profit.

Keywords: Spatial, seasonal, variations, markets, analysis

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INTRODUCTION

Palm oil is very important in the Nigeria economy with regard to its role as a source of farm income and food requirement. It provides direct and indirect employment for a million of people, and also contributes about 70% of the country's national consumption requirement of vegetable oils (Nzeka, 2014). Palm oil is everywhere, because it is extremely versatile and has diverse functions and qualities which make it frequently used. It is semi solid in room temperature and at such keeps spreads spreadable; it gives products longer shelf life because it is resistant to oxidation; it gives fried products

a crunchy and crispy texture since its stable at high temperatures; it also doesn't alter the look and smell of food products as a result of its colourless and odourless characteristics. Its properties make it fascinating for crop growers and stallholders who rely basically on the regular/smooth income from palm oil, and also palm oil unlike most agricultural products is both storable and relatively homogeneous (Jeffrey and Andrew, 2009). In the 60's, Nigeria was the world leader producer and exporter of palm oil. However, Nigeria lost its dominant position in the international trade after 1980s and became

the third largest producer (Food and Agricultural Organization Statistics (FAOSTAT), 2012). As regards to palm oil production in Africa, however, Nigeria's production is estimated at 55% of the African output (Monitoring African Food and Agricultural Policies (MAFAP), 2013). Although, palm oil production has been rising since 1990, the output is still not enough to match the local consumption because the national demand has grown faster than the domestic supply. Production deficit was about 150,000 tons per annum (Partnership Initiative in the Niger Delta (PIND), 2011). Consequently, Nigeria imports palm oil to meet local demand. However, Nigeria has the capacity to increase its production through the application of improved processing techniques and better marketing (MAFAP, 2013). In 2013, imports stood within the vicinity of 518 thousand metric tons. However, Nigeria's export of palm oil into the world market accounted for a small and unimportant portion of the world export of palm oil (Henry et al., 2016). This is as a result of the lack of production surplus and quality which make Nigerian palm oil not competitive in the global market. Similarly, there was no incentive to export the commodity (Journal of Agricultural and Development (JAD), 2012). The Nigeria oil palm belt states are; Edo, Delta, Bayelsa, Cross River, Akwalbom, Osun, Ebonyi, Ekiti, Rivers, Enugu and Imo (Business Day.ng, 2013). In Nigeria, marketing of palm oil takes place in stalls, local or periodic markets centers, homes and road sides (Nwauwa, 2012). These can be both wholesale and retail types in both rural and urban centers, and palm oil is mainly the only means of livelihood for both its producers and marketers.

It was highlighted by the Central Bank of Nigeria (CBN, 2011) that major agricultural commodities in Nigeria have price variations and the domestic retail prices of seven out of the fourteen food items they studied moved upward as compared to their levels in 2010 (CBN, 2011). The price increase in these commodities was attributed largely to seasonal factors, coupled with the distribution constraints and hoarding attitudes of middlemen (CBN, 2011; Solomon et al., 2013).

In recent years, price variation has been a major concern for those responsible for economic policy because of its influence on the dynamics of economic activity, inflation, and balance of payments (Hassanzoy et al., 2016). Seasonal fluctuation is a major feature of agricultural products supply. Seasonal variation is regularly recurring pattern which is completed within every twelve months (Sahu, 2018). Seasonal price variability is the change in price level over time and seasons and has been a major problem in the agricultural sector especially palm oil industry in Nigeria (Barmon and Chaudhury, 2012).

In general, prices for agricultural products are unstable compared to non-agricultural products. This price instability is directly linked to the biological nature of

agricultural production; which suffers from climate instability, and has put the lives of many under threat resulting from food insecurity (Ogisi and Begho, 2023).

Spatial price analysis is considered as the smooth transmission of price signals and information across spatially separated markets (Ghanforr et al., 2009; Achoja and Gbigbi, 2019). Due to the bulkiness and seasonality of agricultural products with their production and consumption point been spatially dispersed, spatial price analysis is considered necessary (Enimu et al., 2017).

Price variation is a common experience in palm oil marketing as prices of palm oil do vary seasonally and spatially (prices of agricultural products do vary from month to month and even from day to day, and also differ between various grades of a product and between alternative markets). The relationship between price stability and price information in the performance of product market cannot be overemphasized, hence the research.

Objectives of the study

The broad objective of this study was to analyze spatial and seasonal price variation in palm oil markets in Bayelsa State.

Specifically, the study sought to:

1. Examine price differentials between palm oil markets.
2. Determine seasonal price fluctuations in palm oil marketing
3. Factors that influence price variation between different palm oil markets.
4. Determine factors that influence seasonal price variation in palm oil marketing.
5. Determine effects of price variation and other variables on the demand for palm oil.

MATERIALS AND METHODS

Study area

The study was done in Bayelsa State. Bayelsa state is situated in the Southern region of Nigeria, and spans across 21,100 square kilometres with Yenagoa as its capital. Bayelsa State is geographically located within Latitude 04° 15' North, 05° 23' South and longitude 05 ° 22' West and 06° 45' East. It shares boundaries with Delta State on the North, Rivers State on the East and the Atlantic Ocean on the West and South. The area lies almost entirely below sea level with a maze of meandering creeks and mangrove swamps. Bayelsa State consists of eight local government areas.

Data collection, sampling procedure and method of data analysis

Multistage sampling procedure was used to collect data from 300 palm oil marketers in the study area. The first stage involved a purposive selection of three local government areas in Bayelsa State for a proper sampling of the rural and urban markets. The second stage also involved a purposive selection of urban markets and rural markets from each of the selected local government areas making a total of 12 markets and the third stage was a random selection of 25 marketers from each of the selected markets. A well-constructed questionnaire was used to obtain data for the research and the data collected were analyzed with descriptive statistics, multiple linear regression and binary logistics regression.

Model specification

Factors influencing spatial price variations

The implicit form of the model is shown below:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, \dots, X_n + U) \dots\dots\dots 1$$

The explicit form is expressed as follows:

$$Y = b_0 + b_1X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6X_6 + \dots\dots\dots X_n + U) \dots\dots\dots 2$$

Where;

Y = price variation (~~NY~~), X_1 = cost of production (~~NY~~), X_2 = rate of sales (~~NY~~), X_3 = market levies (~~NY~~), X_4 = market information, X_5 = cost of transportation (~~NY~~), X_6 = cost of storage (~~NY~~), b_1 - b_6 = coefficients of explanatory variables, U = stochastic term

Factors influencing seasonal price variation

The implicit form of the models is shown below:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, \dots, X_n + U) \dots\dots\dots 1$$

The explicit form is expressed as follows:

$$Y = b_0 + b_1X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6X_6 + b_7 X_7 + b_8 X_8 + b_9 X_9 + b_{10} X_{10} + \dots\dots\dots X_n + U) \dots\dots\dots 2$$

Where;

Y = price variation (~~NY~~), X_1 = weather, X_2 = cost of production (~~NY~~), X_3 = storage cost (~~NY~~), X_4 = quantity supplied (25 litres), X_5 = cost of transportation (~~NY~~), X_6 = cost of purchase (~~NY~~), X_7 = demand (liters), X_8 = seasonal

supply of FFB (tons), X_9 = flood, X_{10} = political instability, b_1 - b_{10} = coefficients of explanatory variables, U = stochastic term

Effect of price variation and other variables on the demand of palm oil

The explicit form is expressed as follows:

$$Y = [P/1-P] = Z = b_0 + b_1X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + \dots\dots\dots X_n + U)$$

Where;

Y = dependent variable (measured in binary form)

X_1 = price (~~NY~~)

X_2 = marketing experience (years)

X_3 = marital status

X_4 = household size (number)

X_5 = household income (~~NY~~)

b_1 - b_5 = coefficients of explanatory variables

RESULTS AND DISCUSSION

Spatial price variation between urban and rural palm oil markets

Table 1 presents the prices of palm oil in the urban and rural markets. The result in (Table 1) revealed that prices of palm oil do vary significantly between urban and rural markets during the off season and it further reveals that there is also a price difference between urban markets as well as between rural markets, it also revealed that prices of palm oil do vary but not by so much between urban and rural markets during the peak season. This price difference between markets is attributed to the cost of transportation, rent fees, market levies and rate of sales.

Factors Influencing Spatial Price Variation between Urban and Rural Palm Oil Markets

Table 2 presents the results of a regression analysis aimed at examining the factors influencing spatial price fluctuations in Bayelsa State. The R-squared value of 0.580 indicates that approximately 58% of the fluctuations in spatial prices can be explained by the independent variables included in the model. The Adjusted R- squared value of 0.570 suggests that 57% of the fluctuation in spatial market prices is explained by the variables that are truly contributing to the model's performance. The F-ratio of 57.616 is statistically significant at $p < 0.05$ level. A significant F-ratio suggests that at least one of the independent variables in the model is contributing significantly to explaining the variation in the dependent variable.

Table 1: Spatial price variation between urban and rural palm oil markets (off season) and Spatial price variation between urban and rural palm oil markets (off season).

Market	Rural	Urban	year	Rural	Urban
Market 1	28000	32000	Market 1	18000	22000
Market 2	25000	30000	Market 2	17000	19000
Market 3	28000	33000	Market 3	18000	21000
Market 4	27500	35000	Market 4	17500	20000
Mean	27125	32500	mean	17625	20500

Source: computation from field survey data, 2024.

Table 2: Regression analysis of factors that influence spatial price variation between urban and rural markets.

Variable	B	Std. Error	Beta	T	Sig.
(Constant)	26130.559	1025.255		25.487	0.000
cost of production	3673.219	893.018	0.330	3.300	0.002
rate of sales	2920.111	941.413	0.251	3.102	0.002
cost of storage	1806.078	629.829	0.161	2.868	0.010
market levies	3606.436	783.974	0.276	4.600	0.000
market information	3243.768	747.465	0.240	4.340	0.003
store rent fee	3561.831	843.943	0.200	4.220	0.000

Source: computation from field survey data, 2024.

Model summary

R squared = 0.580

Adjusted R squared= 0.570

Durbin Watson= 0.594

F - stat = 57.616, sig = 0.000

Cost of production

The p value of 0.000 (at $p < 0.05$ level of significance) indicates that cost of production has a significant influence on the price differential between markets that are spatially dispersed. This shows that the different patterns of production in the rural and urban setting determine the price of its product based on the different techniques of production. According to Nwibo and Udo (2014), spatiality exists because of cost of production amongst other factors.

Cost of transportation

The cost of transportation is significant with a p value of 0.000 at $p < 0.05$ level of significance. Marketers both at the urban and rural area affirm that transportation cost is a major cause of spatial price fluctuation. This is as a result of the distance from production site to marketing site since majority of the production site in the study area are located at the rural location. Terwase (2012) also acknowledged transportation cost as a major cause of spatial price variation because of the distance from point of production (which is mostly the rural areas) to the urban markets.

Cost of storage

P value of 0.010 suggests that storage cost is also a significant cause of spatial price variation at $p < 0.05$ level

of significance. This is because more money is spent on storage at the urban markets than the rural markets where majority of the marketers use their homes as store houses. Accordingly, Nwibo and Udo, (2014) also identified storage cost (90%) as major cause of spatial price variation.

Rate of sales

The rate of sales at p value of 0.002 indicates that rate of sales has a significant influence on the variation of prices between the urban markets and rural markets. This is because of its population difference and usage. In the urban market demand for palm oil is always higher because of its usage and high population rate. In view of this, Achoja and Gbigbi (2019) also identified rate of sales (patronage) as a major cause of spatial price variation.

Market levies

The p value of 0.000 indicates that market levies is considered a significant cause of spatial price variation between the urban and rural markets. This implies that urban markets market levies are higher at the urban markets than the rural markets since the urban markets tend to pay more for levies than the rural areas. Nnaji et al. (2019) also identified market levies as a cause of spatial price variation.

Market information

The p value of 0.003 reflects the recognition among marketers that market information is equally a significant cause of price difference between the urban and rural markets. Nuga (2020) also identified marketing information as a factor that influences of spatial price variation. According to Nwauwa et al., (2016), two lag periods were identified between the spatially separated markets indicating that it takes about 1-2 months for price information to be disseminated across the markets.

Rent fees

The p value of 3.2 also suggests that store rent fee is a significant cause of spatial price variation between the urban and rural markets because rent fee is always higher at the urban markets than the rural markets where only little or no amount is paid for store rent as opposed to the urban markets.

Factors influencing seasonal price variation in palm oil marketing

Table 3 presents the results of a regression analysis aimed at examining the factors influencing seasonal price fluctuation in Bayelsa State. The R-squared value of 0.601 indicates that approximately 60% of the fluctuations in seasonal palm oil prices can be explained by the independent variables included in the model. The adjusted R-squared value of 0.587 suggests that about 58% of the fluctuation in palm oil prices between spatially separated markets is explained by the variables that are truly contributing to the model's performance. The F-ratio of 43.504 is statistically significant at $p < 0.05$ level. A significant F-ratio suggests that at least one of the independent variable in the model is contributing significantly to explaining the variation in the dependent variable. Therefore, the null hypothesis which states that there is no significant seasonal price difference in palm oil marketing in Bayelsa state is hereby rejected.

From the regression analysis, supply, demand, political instability, weather, cost of purchase, cost of production, Seasonal supply of FFB and flood were identified as significant causes of seasonal price variation with a $p < 0.05$ while transportation was insignificant at $p > 0.051$.

Supply

The p value of 0.004 indicates that supply of palm oil has a significant effect on seasonal price variation in palm oil marketing at $p < 0.05$ level of significance. Indicating that the seasonal supply of palm oil is a major cause of seasonal price variation as two seasons were identified in the study area; the peak season (season of full production) and the off season (season of little or no

production due to extreme weather conditions). Adewale et al (2023), analyzed the seasonal price variation of palm oil in Nigeria and from their findings it was concluded that palm oil prices are greatly influence by the forces of demand and supply, confirming the result of this study.

Demand

With a p value of 0.004 (at $p < 0.05$ level of significance), demand for palm oil is identified as a significant cause of seasonal price variation. This corresponds with Enimu et al., (2017) research on the causes of seasonal price variation in palm oil markets where it was concluded that prices do rise in response to fall in production or increases in demand.

Political instability

The p value of 0.004 (at $p < 0.05$ level of significance), shows that political instability and government policies are major causes of seasonal price fluctuations. Prices of palm oil tend to increase with unfavorable government policies and relatively decrease with favourable government policies. Sanaullah et al., (2015) acknowledged the role of the government as a key factor in adjusting seasonal price fluctuations.

Weather

The p value of 0.000 indicates that weather has a significant influence on seasonal price variation of palm oil at $p < 0.05$ level of significance. This is because during the peak season supply is surplus as production is in its best state due to favorable weather conditions thus resulting to fall in prices as supply exceeds demand while in the off season the prices get relatively high as supply falls. This result is in line with the result of Oktarina et al. (2021) on "the effect of climate change to palm oil prices dynamics" where, it was observed that the climate change in terms of fluctuating rainfall causes unfavourable palm oil price level that aggravates smallholder welfare. Furthermore, Ogisi et al. (2023) highlighted temperature and rainfall as the most significant climate variables that influence production.

Cost of production

The p value of 0.004 (at $p < 0.05$ level of significance), reflects the effect of production cost on seasonal prices. Prices tend to increase with increase in cost of production while it relatively gets lower in response to fall in production cost.

Table 3: Regression analysis of factors that influences seasonal price variation in palm oil marketing.

Variable	B	S.E	Beta	T	Sig.
(Constant)	23861.755	1267.988		18.819	.000
Supply	2640.504	896.862	0.148	2.994	0.004
Demand	1595.280	1045.868	0.143	1.525	0.040
political instability	2646.941	952.426	0.233	2.728	0.004
seasonal weather	4015.528	966.048	0.346	4.157	0.000
cost of production	1646.941	893.639	0.147	2.843	0.004
cost of purchase	3379.708	780.274	0.259	4.331	0.000
Transportation cost	1387.142	638.907	0.124	2.171	0.031
cost of storage	1675.556	854.283	0.127	1.961	0.050
Seasonal supply of FFB	3247.269	750.595	0.240	4.326	0.000
Flooding	5088.695	1749.023	0.452	2.909	0.004

Source: computation from field survey data, 2024.

Model summary

R squared = 0.601

Adjusted R squared= 0.587

Durbin Watson= 0.611

F – Stat= 43.504, sig@0.000

Cost of purchase

The p value of 0.000 (at $p < 0.05$ level of significance) indicates that the cost of purchase has a significant influence on seasonal price fluctuation. This implies that when goods are purchased at a lower price, they'll be sold at favourable prices but when purchased at a high price, they'll be sold at a relatively high price. And this is as a result of palm oil production seasons; season of massive production and season of little or no production. Enimu et al. (2017) also identified high cost of purchase as major cause of seasonal price fluctuations.

Cost of transportation

The p-value of 0.051 shows that transportation cost is not a significant cause of seasonal price variation as the fluctuation in seasons barely affects the cost of transportation within the year/period.

Cost of storage

A p-value of 0.031 suggests a significant influence of storage cost on seasonal palm oil price variations. As regards this, Lonut et al., (2022) did a research and the third degree polynomial regression equation revealed a fluctuating price pattern indicating that prices tend to be high in the initial months of the year when supply decreases. However, during the harvest period, prices decrease due to increased supply in the market while in the last months of the year, prices reached their highest point due to the additional expenses incurred in storing the production.

Seasonal supply of FFB

Seasonal supply of fresh fruit bunch (FFB) is significant with a p value of 0.000 at $p < 0.05$ level of significance,

indicating that supply of palm fruit is a major cause of seasonal price fluctuation because fluctuating rainfall brings about difficulty in accessing palm fruits which further results to unfavourable palm oil price levels. Augustina (2011) also identified supply of palm fruit as a major cause of seasonal price fluctuation. According to the research the processing of palm oil is continuous or done throughout the year but the supply of palm fruits in general is seasonal.

Flood

Flood is a major cause of seasonal price fluctuation in palm oil prices with a significant p value of 0.004 indicating that flood has been a major cause of seasonal price fluctuation as it affects the production of palm oil during the flood season leading to high palm oil prices. This result is in line with the suggestions of Achoja and Gbigbi, (2019) on flood hazards directly leading to a fall in food availability leading to increase in food prices as demand for such products increases with respect to fall in supply.

Conclusion

From the study, it was concluded that there was a significant price difference between the urban and rural palm oil markets. There was also a significant seasonal price fluctuation between the off season and peak season. The study also concluded that the price difference between the urban and rural markets were higher during the off season than the peak season, indicating that seasonality of production has a significant effect on the price determination of palm oil leading to an increase or decrease in the demand for palm oil as a result of increase or decrease in supply. This finding is attributed to the fact that palm oil is massively produced and supplied at the peak season as increase in supply

leads to a fall in price. Furthermore, the study revealed that the unsteady and unpredictable market price changes makes it difficult for some marketers to purchase more goods during the season of high prices because of the swift and unplanned increase in price thus reducing their purchasing power. The study also identified market levies, transportation, rent fee, rate of sales as the major causes of price spatiality in the palm oil market while supply, demand, flood, weather, supply of fresh fruit bunch and political instability were identified as the major causes of seasonal price fluctuations. It was concluded that fluctuating prices of palm oil, income of the marketers, marketing experience, and the educational level of the marketers pose a significant effect on the demand for palm oil. The study established that for effective and efficient palm oil marketing, the issues of spatial and seasonal price variations are cardinal parameters that should be managed. The study affirmed that the socio-economic characteristics of the palm oil marketers are key determinants of profitability and market demand. The study showed that price control mechanism and regulations are need for price stabilization. Palm oil marketers should provide warehouses to buy and store palm oil during the peak season where there is massive production and excess supply in the market and resell during the off season in order to maximize profit. Massive production should be encouraged during the peak season in order to maintain active supply during the off season.

Recommendations

Based on the foregoing, the following recommendations were made:

1. Marketers should provide warehouses to buy and store palm oil during the peak season where there is massive production and excess supply in the market and resell during the off season where supply is low because of little or no production to maximize profit
2. Palm oil buyers should be trained on palm oil seasonal trend patterns so that they will be able to adjust to changing patterns and prices since palm oil production and supply follows a seasonal trend pattern. This will help make well-informed decisions about when to buy and sell the product.
3. The standard of rural road networks should be improved
4. Massive production during the peak season should be encouraged in order to maintain active supply during the off-season.

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