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Analysis on the Impact of Petroleum Price and Transportation Fare on the Prices of Goods and Services in Kaduna State

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Abstract

In this study, the data on the prices of Premium Motor Spirit (PMS), transportation and some selected goods were analyzed in order to understand how transportation fare and PMS price impacts the food industry. This can help to identify areas of improvement and optimization, leading to more efficient and sustainable practices. The data for this research was sourced from Kaduna State Bureau of Statistics. Three years (2020,2021 and 2022) prices of PMS, transportation and some selected commodities (rice, guinea corn and yam) were analyzed using correlation and regression analysis to determine the linear dependency and linear correlations between the variables. It was observed that the prices of petroleum influences transportation costs and high transportation costs impact commodity prices. Hence, recommended that the government should provide mass transit buses at subsidize costs, improve transportation infrastructures, establish farmers co-operatives, among others.

Keywords: Kaduna, petroleum motor spirit, transportation, commodity, KDBS.

1.0 Introduction

Kaduna State is in north-central Nigeria. The area includes the traditional emirate and chiefdoms. Kaduna was substantially reduced in size when its northern half became Katsina state in 1987. Kaduna is bordered by the States of Zamfara, Katsina, and Kano to the north; Bauchi and Plateau to the east; Nasarawa to the south; and Niger to the west. Abuja Federal Capital Territory also borders Kaduna State to the southwest.

Kaduna State produces cotton and peanuts (groundnuts) for export. Other cash crops include shea nuts, ginger, peppers, and vegetables grown in the riverine floodplains, brown sugar processed locally from sugarcane, onions and soybeans.

Tobacco is a major cash crop around Zaria (where cigarettes are made) and sorghum is utilized by a brewery in Kaduna town. Sorghum and millet are staple foods. Cattle, chickens, guinea fowl, and sheep are raised, and hides and skins are tanned for export.

Kaduna, the state capital is the Nigeria's largest textile-manufacturing Centre and has other major industries as well, including an oil refinery. Another industrial Centre which is Zaria, processes tobacco and cotton seed and manufactures textiles, bicycles, and printed matter. Traditional crafts, especially cotton weaving and dyeing (with locally grown indigo), leather processing, raffia weaving, and pottery designing (notably among the Gbagyi), also retain considerable economic importance. Tin mining continues near Kafanchan on the western edge of the Jos Plateau, and tantalite is also found there.

Kaduna, Zaria and Kafanchan are major railway centers in the state, with lines from Lagos and Port Harcourt (south) serving both towns, and lines running to Kaura Namoda, Jos, and Nguru (north and east). The main highway network serves Kaduna and Zaria. Kaduna has an area of 17, 781 square mile (46,053 square km), (NPopC, 2006).

For the purpose of this research, the following food items are selected: Rice, Guinea corn and yam. This is because they are the most produced and consumed staple food and cash crops in Kaduna State.

Transport, also known as transportation or logistics, refers to the movement of people, goods, and services from one location to another. It plays a crucial role in modern societies, enabling the efficient exchange of resources, facilitating economic activities, and connecting people and businesses across various regions.Transportation systems can be classified into different modes, each serving specific purposes and offering distinct advantages. These include; Road, rail, maritime, air, pipeline transports, among others. For this project, road transport is considered as it is the sole transport system patronized by farmers in Kaduna State.

Road transport plays a vital role in the food industry, as it ensures the timely delivery of perishable goods to markets and consumers. It also connects farmers, producers, and distributors to supply chains, making food accessible to a broader population.

Analyzing transportation data related to the food items and PMS (Premium Motor Spirit) usage can provide valuable insights into the supply chain efficiency, food safety, and sustainability practices. Understanding how transportation impacts the food industry can help identify areas for improvement and optimization, leading to more efficient and sustainable practices.

The data for this research is sourced from Kaduna State Bureau of Statistics. The Kaduna State Bureau of Statistics (KDBS) is saddled with the responsibility of collecting official statistics in the State, which also involved collection of PMS pump prices, Transport fares from local governments to state headquarters and Commodities prices across the twenty-three (23) LGAs by the field officers.

Transportation plays a pivotal role in facilitating the movement of goods, services, and passengers, effectively connecting different locations. The transport system's efficiency and cost-effectiveness significantly influence the availability and pricing of commodities (Anderson, 1980). Diverse forms of transportation such as land, oceanic, and animal transportation contribute to this process (Ajibodye & Afolaya, 2009).

Volpe, Roeger & Leibtag (2013) conducted a study investigating the impact of fuel prices on wholesale produce prices via transportation costs. Their research centered on marketing costs for various commodities, revealing a substantial correlation between transportation costs and wholesale prices. Factors like distance between markets and sources, transportation methods, and import timings affected this correlation. Overall, escalating fuel prices were found to drive up wholesale produce prices.

Kleon (2018) surveyed the influence of transportation costs on consumer retail goods, specifically in Garriki market, Enugu South L.G.A. Their study emphasized that production costs have a more pronounced impact on agricultural goods retailers compared to manufacturers. It was suggested that sourcing goods from a single origin could mitigate transportation costs.

Roehner (2013) conducted a theoretical study exploring the role of transportation costs in commodity markets. Using a stochastic model, the study assessed variables such as trade volume, price volatility, and spatial price differentials. The findings supported the model's validity and underscored the importance of limiting

distances between cities or connecting them to sea ports to curb price volatility.

Jacoby (2000) analyzed the distributional effects of rural roads in Nepal, highlighting the benefits of improved road access to markets. The study revealed that enhancing road connectivity could significantly benefit poorer households. Consequently, transportation infrastructure was identified as a crucial factor in facilitating economic growth and equitable distribution.

Delsalle (2002) investigated the effects of fuel price changes on the transport sector and its emissions through simulations with TREMOVE. The study analyzed how varying fuel prices impacted transport behavior and emissions. The findings demonstrated the intricate relationship between fuel prices, transportation choices, and environmental outcomes, shedding light on the complexities of fuel price policies on the transport sector.

According to Ajibodye & Afolaya(2009), Kleon (2018) and Roehner (2013) cause of high transport fare include factors such as bad roads, illegal collections by highway patrol teams, price fluctuations in motor spare parts, and high fuel prices. Additionally, the effects of transportation costs on consumable goods prices encompass delayed supplies due to bad roads, increased prices due to cost transfers, and scarcity of commercial vehicles causing commodity scarcity.

These studies addressed either causes or effects of PMS prices transportation costs on commodity prices. In our study we intend to model and understand the impact the price of petroleum and transportation fare have on consumable commodity prices in Kaduna state. Hence it is aimed to study and examines the driving force and nexus between PMS prices and transportation fare as determining factors for commodity price.

2.0 MATERIALS AND METODS

This generally talks about the methods and tools used in this study. The discussion centered on methods of data collection and tools of analysis. This ensures better understanding of the methodology for the purpose of reliability, integrity and accuracy of reporting.

2.1 Methods data collection

Kaduna State Bureau of Statistics (KDBS) field officers did the process of Data

collection across the twenty-three (23) LGAs in the State supported by supervisors who monitored the exercise. This is also complimented by online monitoring during submission.

GIS checking team from KDBS also checked the location by tracking the geographical information of the Data sent from the field.

The exercise was conducted in some selected fuel station across the 23-LGAs in the State. A simple random sampling of two (2) fuel station per LGA was selected for the research. A total of forty six (46) fuel stations were visited across the State.

The price statistics Data was collected using android phone through ODK-collect application.The average of all the prices is then computed for each LGA and then the average for the State is also computed.KDBS team validates the Data by embarking on Data cleaning process of the recorded prices.Also the Bureau has field staffs whose responsibility is to collect prices of goods and services (which is called price statistics) and that ensure the data integrity.The Bureau also monitors the change in price across the State to ascertain whether it's increasing or decreasing base on month-on-month and year-on-year change. The data was rescaled and standardized for the purpose of normality. This is for ease of uniformity and analysis.

For the analysis tool, descriptive statistics was used to determine the measure of central location of the observations. Multiple regression and correlations were used to determine the dependency and linear relationship between the variables. R and python were used for the analysis.

3.0 Analysis and Discussion

The selected commodities are rice, guinea corn and yam. These commodities were chosen because they are mostly consumed foods across all the 23 LGAs in the state.The variables; petroleum price, transportation fare and the commodities (goods and services) are recorded for the period of three years (2020, 2021 and 2022). The analyses were conducted against each of the commodity versus the petroleum price and transport fare. Distance in kilometers was not considered with respect to the transportation cost because, in Kaduna state the transport fare is not a function of distance in kilometer but a function of inaccessibility due bad roads and availability of vehicles flying in a particular road.

3.1 Test for Normality

The data wasnormalize across the three variables. The figures below shows the density plots for the three years under study. The density plot portrays a graphical representation that shows the distribution of the data as a smooth curve. It helps us understand the shape of the data distribution and identify patterns or concentrations in the data. It can givesvisual indications of normality.

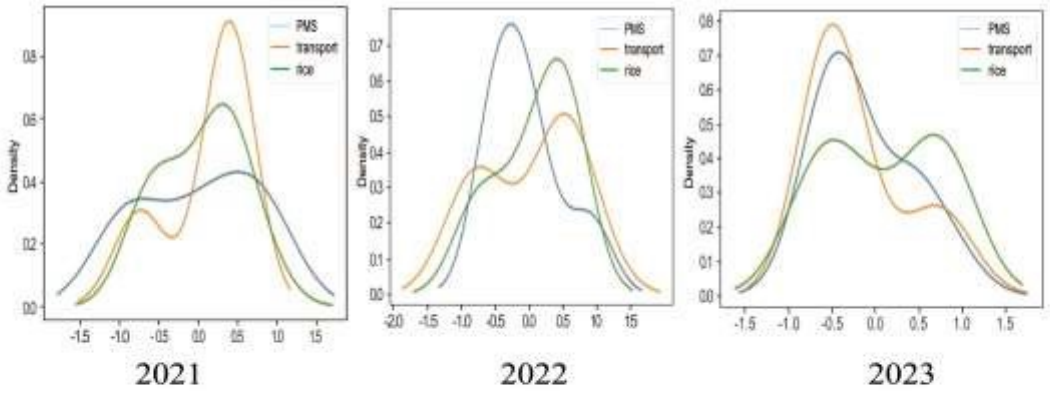

Fig 1: Density plot for the price of rice

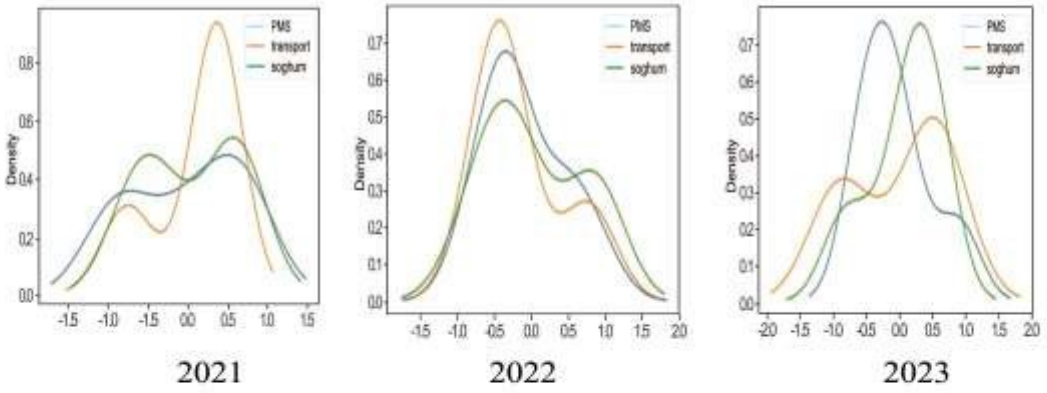

Fig 2: Density plot for the price of Guinea Corn

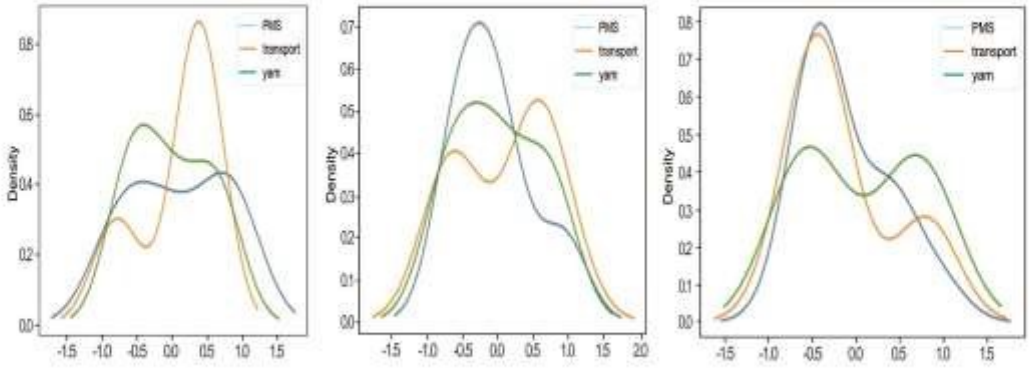

Fig 3: Density plot for the price of Yam

3.2 Data Analysis

Here we present the analysis of each commodity with respect to petroleum price and transportation fare. This segregation will reveal the impact of each commodity to the petroleum price and transportation fare. In each case the price of the commodity is regarded as the dependent variable while price of petroleum and transportation fare as independent variables.

3.2.1 Analysison the Price of Rice

Table 1 presents and summarizes the regression and correlation analysis of rice for the periods under study.

Table 1: Regression and Correlation Analysis Table forthe price of Rice

	Correlation		Slope				Standard
year	PMS	Transport	PMS	Transport	R-square	P-value	Error
2020	0.42	0.79	0.2553	0.7689	0.7584	0.0017	0.2836
2021	0.08	-0.29	0.0435	-0.2295	0.0871	0.6637	0.5929
2022	-0.4	-0.13	-0.5179	0.0478	0.1652	0.4438	0.6603

In the year 2020, the correlation coefficient between rice and PMS is 0.42, indicating a moderate positive correlation. The correlation between rice and transport is 0.79, indicating a strong positive correlation. Both PMS and transport show a positive relationship with rice prices in 2020. Therefore, the determining factor for the cost of rice is attributed more to transport fare. This is also explained by the slope and R-square value. For example, for every one-unit increase in PMS, rice prices

are expected to increase by approximately 0.2553 units. For every one-unit increase in transport, rice prices are expected to increase by approximately 0.7689 units. And the R-Square value of 0.7584 suggests that approximately 75.84% of the variance in rice prices can be explained by the linear relationship with PMS and transport, indicating a strong correlation. Furthermore, the p-value of 0.0017 ($p < 0.05$) provides strong evidence against the null hypothesis of equality, indicating that the correlation between rice and the combined effect of PMS and transport is statistically significant. And finally, the standard error of the estimate is 0.2836, suggesting that the model's predictions are relatively close to the actual data points, indicating a good fit.

Overall, Table 1 shows that the relationship between rice prices and the combined effect of PMS and transport changes over the years. In 2020, there was a strong positive correlation and statistically significant relationship. In 2021 and 2022, the correlations weaken significantly, with weaker relationships and non-significant p-values. This suggests that the impact of PMS and transport on rice prices becomes less pronounced in 2021 and 2022 compared to 2020. This may be due to lock-down period of COVID-19 pandemic during 2020.

3.2.2 Analysis on the Price ofGuinea Corn

Table 2 below summarizes the regression and correlation analysis of guinea corn for the periods under study.

Table 2: Regression and Correlation Analysis Table forthe price of guinea corn

	Correlation		Slope				Standard
Year	PMS	Transport	PMS	Transport	R-square	P-value	Error
2020	0.62	0.47	0.5085	0.8274	0.8920	0.00004	0.2148
2021	-0.02	-0.05	-0.0244	-0.0405	0.0034	0.9848	0.5803
2022	-0.14	-0.04	-0.1672	0.0019	0.0194	0.9155	0.7174

The correlation coefficient between guinea corn and PMS is 0.62, indicating a positive correlation. The correlation between guinea corn and transport is 0.47,

indicating a fair positive correlation. Both PMS and transport showed positive relationships with guinea corn in 2020. The slope shows for every one-unit increase in PMS, guinea corn is expected to increase by approximately 0.5085 units. For every one-unit increase in transport, guinea corn is expected to increase by approximately 0.8274 units. The R-Square value of 0.8920 indicates that approximately 89.20% of the variation in guinea corn can be explained by the linear relationship with PMS and transport, suggesting a strong relationship. The p-value of 0.00004 ($P < 0.05$) is very small, providing strong evidence against the null hypothesis of equality, indicating that the linear relationship between guinea corn and the combined effect of PMS and transport is statistically significant. The standard error of the estimate is 0.2148, suggesting that the model's predictions are relatively close to the actual data points, indicating a good fit.

Overall, the table shows in 2020, there was a strong positive correlation and statistically significant relationship. However, in 2021 and 2022, the correlations weaken significantly, with very weak relationships and non-significant p-values. Although, the result clearly demonstrated that transportation has been a major driving force in determining the price of guinea corn.

3.2.3 Analysis on the Price of yam

The Table 3 demonstrates the summaries for regression and correlation for yam. Yam is one of most popularly consume crops in Kaduna state.

Table 3: Regression and Correlation Analysis Table for the price of yam

	Correlation		Slope				
Year	PMS	Transport	PMS	Transport	R-square	P-value	Standard Error
2020	-0.57	0.53	-0.6197	0.7634	0.8342	0.0003	0.2480
2021	0.26	-0.64	0.2027	-0.5559	0.4489	0.0684	0.4855
2022	-0.24	0.04	-0.3832	-0.1636	0.0751	0.7039	0.7169

The correlation coefficient between the price of yam and PMS price is -0.57, indicating a negative correlation, implies inverse relationship. However, the correlation between yam and transport fare is 0.53, indicating positive correlation.

The slope shows for every one-unit increase in PMS price, price of yam decreases by approximately 0.6197 units. Furthermore, for every one-unit increase in transport fare, price of yam increases by approximately 0.7634 units. The R-Square value of 0.8342 indicates that approximately 83.42% of the variance in the price of yam can be explained by the linear relationship with PMS and transport, suggesting a strong relationship. The p-value of 0.0003 ($p < 0.05$) is very small, providing strong evidence against the null hypothesis of equality, indicating that the correlation between the price of yam and the combined effect of PMS price and transport fare is statistically significant. The standard error of the estimate is 0.2480, suggesting that the model's predictions are relatively close to the actual data points, indicating a good fit.

In overall, In 2020, there was a strong negative correlation and statistically significant relationship. In 2021 and 2022, the correlations weaken significantly, with weaker relationships and non-significant p-values. This suggests that the impact of PMS and transport on yam prices becomes less pronounced in 2021 and 2022 compared to 2020.

4.0 Conclusion

In synthesizing these research contributions, it becomes evident that the prices of petroleum impacts transportation costs and high transportation costs impact commodity prices. In addition to the price of PMS, poor road infrastructure and scarcity of commercial vehicles also influenced transport fare hence caused high costs on consumable goods prices.

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