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Industrial Demand Analysis for Millet in Kaduna and Kano States of Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors OOA, AFL and YAA jointly conduct the field survey, code, summarize and analyze data collected. Authors OOA, AFL and YAA jointly write and correct the article report. All authors read and approved the final manuscript.

Original Research Article

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ABSTRACT

This study examined industrial demand analysis for millet in Kaduna and Kano States of Nigeria. The Primary data used for the investigation were obtained using structured questionnaires administered to 31 firms. Descriptive statistics; demand function and grafted polynomials model were used for the analysis of data. The results showed that price of millet, price of substitute maize, price of substitute sorghum and income derived were significant factors influencing quantities of millet demanded by industries at 1% probability level. The grafted polynomial model used for forecasting demand of millet in tonnes for Kaduna and Kano States showed an increase in industrial quantities demanded for a forecast period of 2006 to 2015. It is recommended that industrial demand of millet should be conducted for all States of the Federation, so that annual consumption can be estimated.

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1. INTRODUCTION

Millet (*Pennisetum glaucum*) constitutes the main staple diet in Western Africa [1]. Millet is potentially attractive raw materials for feed, food and industries [2,3]. Millet indirectly contributes to receipts from livestock sales much more than which is observed from direct sales [4,5] reported that adequately processed sorghum and millet grain may be 95% as efficient as maize. [6] recommended that sorghum and millet be processed by grinding, pelleting or rolling for diets of beef and diary or calves in order to be used efficiently. [7] reported that at an equal protein levels, pear millet was equal to sorghum with respect to weight gains and feed efficiency in chicks. [8,9] carried out extensive studies on the selection of sorghum and millet grain for malting, his findings shows that selection of sorghum and millet grain for malting was dependent on the genetic factor and seasonal factor. Millet starches generally exhibited higher gelatinization temperature, higher water binding capacity and slow in enzymatic hydrolysis than wheat or rice starches [10]. ICRISAT develop suitable recipe for non- wheat bread using 70% maize, sorghum, or millet flour and 30% cassava starch. Other ingredients are added at the following percentage of total weight, 20% yeast; 1.5% salt, 1% fat; 0.2% fungal amylase and 80% water [11, 12] reported that the future of composite flour in the baking industry in Nigeria is quite promising. The success of this product however will largely depend on the government policy in favour of concerned research and agro-industries in that sector, in addition making fund and other necessities available for research to solve impending problems relative to palatability, appearance and shelf life of those composite flour based products could further enhance their acceptable among the consumers [11]. The use of millet, maize and sorghum as raw materials in the agro-allied industries gained importance especially with import substitution prevalent in the brewing industry, starch and pharmaceutical companies [10]. Utilization of millet; sorghum and maize by commercial industries to produce breakfast cereals, baby food, baked good, beverage and starch products is increasing, providing more diverse market for farmers [10]. In West Africa Nigeria is a pioneer in the industrial utilization of millet, sorghum and maize [13]. A total utilization of millet use in the manufacturing and food industries would increase cash flow to the farmers and thereby constitute an incentive to increase production [2]. Millet can be malted and used for the production of traditional Africa beer or in a mixture with precooked or extruded cereals for weaning food [14]. Starch properties of millet and sorghum hybrids and high-yielding varieties and those of maize are suitable for industrial starch production [15,16] emphasized the need to investigate and analyzed the food grain industrial demand. An understanding of the role of agro- processing industries is important for designing appropriate policies for developing the sector. [17] investigated the determinants of the changing pattern of cereal used in West Africa and concluded that the patter is demand driven. This study intends to provide answers to the following research questions:-

(i) Which firms utilize millet, their location and years of existence in the study area?
(ii) What is the quantity of millet demanded by these firms?
(iii) What are the factors influencing industrial demand of millet in the study area?
(iv) What will be the demand function for millet by these industries in the study area?
(v) What will be the forecast of industrial millet demanded per annum by the industries in the study area?

The broad objective is to evaluate industrial demand analysis for millet in Kaduna and Kano States of Nigeria. The specific objectives are to:

(i) Identify firms utilizing millet, their location and years of existence in the study area;
(ii) Estimate quantity of millet used by the firms;
(iii) Identify the factors influencing the industrial demand for millet in the study area;
(iv) Estimate the demand function for millet by these industries in the study area;
(v) Forecast for ten (10) years the industrial demand for millet per annum to be the industries in the study area.

The study hypotheses are stated thus:-

(Null Hypothesis) Ho: There are no significance differences between quantities of millet demanded by Industries in the Study Area.
(Alternative Hypothesis) Ha/H_1: There are significant differences between quantities of millet demanded by Industries in the Study Area.

2. METHODOLOGY

This study was conducted in Kaduna and Kano States of Nigeria. Kaduna state is located between Latitudes 9ºN and 12ºN and Longitudes 6ºE of the prime meridian. It shares common borders with Abuja in the South-East and six other states namely, Katsina, Kano, Zamfara, in the North-North Nasarawa, Plateau in the North-East, Niger in the North-West. The climate varies from North Guinea Savanna in the North and Southern Guinea Savannah in the South. The State has a population of 6,066,562 people according to 2006 census [18]. Kano state is located between Latitudes 10ºN and Longitudes 8ºE and 9ºE of the prime median. Kano State lies with Savanna except the southern part where Guinea Savanna predominates. The population of the State on the basis of a census conducted in 2006 was out at 9,383,682 people [18]. The purposive sampling was used to select Kaduna and Kano States. The primary data used for this study were obtained using structured questionnaire. A total number of 31 identified firms were used to achieve objective 1.

2.1 Descriptive Statistics

such as percentage frequency- distribution tables, arithmetic means and coefficient of variation were used to group and summarize the data obtained from the field, the coefficient of variation is expressed as:-

$$CV = \frac{S}{\bar{X}} \times 100$$

Where, CV = Coefficient of Variation, S = Standard Deviation, $\bar{X}$ = Arithmetic Mean

2.2 Demand Function Analysis

In implicit form, the demand function for millet can be expressed as:-

$$Q = F(X_1, X_2, X_3, X_4, X_5, X_6, X_7, e_t)$$

Where Q = Total millet demanded (tonnes); X_1 = Price of millet (₦/tonnes); X_2 = Price of substitute, maize (₦/tonnes); X_3 =Price of substitute, sorghum (₦/tonnes); X_4 = Price of millet last year (₦/tonnes); X_5 =Colour/Variation of millet (White, 1;0, Otherwise); X_6 =Total

imported/Processed millet (tonnes); X_7 = Income derived per annum (₦);e_t = Error term. The explicit forms of these functions are as follows:

$Q = a + bX_1 + cX_2 + dX_3 + eX_4 + fX_5 + gX_6 + hX_7 + e_t$(Linear)
$Q = a + b\log X_1 + c\log X_2 + d\log X_3 + e\log X_4 + f\log X_5 + g\log X_6 + h\log X_7 + e_t$(Semi-Log)
$\text{Log}Q = a + b\log X_1 + c\log X_2 + d\log X_3 + e\log X_4 + f\log X_5 + g\log X_6 + h\log X_7 + e_t$(Double-Log)

2.3 Grafted Polynomial or Spline Function

These models are also referred to as grafted relationship or grafted function or Spline function segment of polynomial can be used to forecast time series [19]. These segmented curves are restricted to be continuous derivation at a joint. For quadratic-linear function, the mean function can be represented as.

$$Y_t = \alpha_2 + \beta_2 t + \lambda dt$$

$$d_t = \begin{cases} (K-t)^2 \; for \; t < K \\ 0 \; for \; t > K \end{cases}$$

Y_t =Estimate forecast in the year (t) for millet; K = Joint point; α_2, β_2, λ = Structural parameters; t =Time factors in years.

2.4 Description of Explanatory Variables

Table 8 shows the expected signs or apriori expectations of explanatory variables included in the model. It is expected that price of millet should have negative relationship with quantity of millet demanded in current year because increase in price leads to decrease in quantity demanded of a commodity. Increase in price of millet could lead to increase in quantities demanded of substitute maize and sorghum and vise-versa as reflected with positive and negative relationships. Price of millet last year if favourable could lead to increase in quantity of millet demanded by industries the following year and vice-versa as reflected in apriori signs indicated in Table 8. Income derived by industries if increase could lead to increase in millet demanded by industries.

3. RESULTS AND DISCUSSION

3.1 Variability in Industrial Quantity Demanded and Price of Millet in Kaduna and Kano States of Nigeria

Table 1 shows that the industrial quantity demanded and price of millet seems to be stable based on coefficient of variation 26.36 and 6.41 percent respectively.

3.2 Types, Location and Year of Existence of Firm

The type and location of firm using millet were confined to the grouping of various firms into three related industries and their locations in the two states of the study. Table 2 reveals that 71.19% of the firms in the sample were into livestock feed production. Most of these firms produced chick mash, broiler starter, broiler finisher, layer mash; about 10% of the firms were in beverages, while the remaining 16% were in food and confectionary. Table 3

indicates that 83% of the firms were located in Kaduna. About 16% were located in Kano State. Table 4 showed that few firms 6% were in existence for about 30 years ago. This study was in agreement with [20] who reported in his study on characteristics of industrial end users of agricultural raw material that majority of firms in Nigeria has post independent origin.

3.3 Demand Function Analysis for Millet

Table 5 shows that The Coefficients of Multiple Determinations R^2 value of 0.79 revealed that 79.0% of the quantity of millet demanded by the industries was explained by the explanatory variables included in the model. The study as further shown in Table 5 observed that all the regression coefficients of the independent variables had a positive relationship with quantity of millet demanded by the industries. Three (3) equations were fitted to the demand function, linear, semi-log and double-log functional forms. Based on the statistical and economic criteria like the R^2- value, significance of F-value, level of significance of variables included in the model and conformity with apriori or an expected sign, the linear equation was chosen as the lead equation. As observed in Table 5, One unit increase in price of millet in the current year leads to 0.105 increases in industrial quantities of millet demanded, this even though may be contrary to apriori or expected signs as indicated in Table 8 may or could be due to high expectations by industries in this area for further increase in price of millet in that current year. Also, one unit increase in price of substitute, maize leads to 0.818 increase in industrial quantities of millet demanded, this is in line with expected or apriori signs in Table 8, because a unit increase in price of substitute would leads to a unit increase in demand of millet based on economic principle. The price of millet; price of substitute maize, price of substitute sorghum, and income derived were significant at 1% level of probability. The F-value of 20.38 was significant at 1%, which is an indication that variables in the model were significantly responsible for the variation in the quantity demanded of millet by the industries. The structural coefficients of total quantity of millet demanded by industries were presented in Table 6. The estimate of the coefficients of X_1, X_3 $F \quad -Value$ were significant at 1% probability level for millet. This study agrees with [21] who reported in his study using grafted polynomial function to forecast maize production trend in Nigeria that the intercept, coefficients of X_1, and X_2 were significant at 1% probability level. The estimates of the grafted function were utilized to obtain expost forecast of total quantity of millet demanded by the industries in Kano and Kaduna States of Nigeria. The study as shown in Table 7 indicates expost forecast of millet in tonnes for Kaduna and Kano States of Nigeria. As observed in Table 7, there is gradual and steady increase in quantities of millet demanded by industries in the study area within the period and this is expected to increase further outside the forecast period.

Table 1. Variation in industrial quantity demanded and price of millet in Kaduna and Kano states of Nigeria

Estimates	Quantity Demanded (Tonnes)	Price (₦/Tonnes)
Maximum	4,500.00	42,000.00
Minimum	16.00	37,000.00
Average	1,857.33	40,000.00
Standard Deviation	2,346.94	2598.07
Coefficient of Variation (%)	26.36	6.41

Source: Field Survey, 2007

Table 2. Types and number of firms using millet

Industries	Number of Firms	Percentage of Total
Livestock Feed	23	71.19
Beverage	03	09.68
Food and Confectionary	05	16.13
Total	**31**	**100.00**

Source: Field Survey, 2007

Table 3. Location and number of various firms in each state

Location	Livestock	Food and Confectionary	Beverages	Total No of Firms in Each State	% of Firms in Each State
Kaduna State	20	03	03	26	83.87
Kano State	03	02	-	05	16.13

Source: Field Survey, 2007

Table 4. Years of existence of firm in Kaduna and Kano states

Years of Existence	Number of Firms	Percentage of Total Firm
0 – 10	21	67.74
11 – 20	05	16.13
21 – 30	03	9.68
31 – 40	01	3.23
Greater than 40	01	3.23
Total	**31**	**100.00**

Source: Field Survey, 2007

Table 5. Estimate demand function for millet in Kaduna and Kano states of Nigeria

Variable	Regression Coefficient	Standard Error	t-Value	Level of Significance
Constant	-24053.30	6056.95	3.971	0.01
X_1(Price of Millet)	0.105	0.019	5.547	0.01
X_2(Price of Substitute, Maize)	0.818	0.111	7.366	0.01
X_3(Price of Substitute, Sorghum)	1299.00	0.387	3.359	0.01
X_4(Price of Millet Last Year)	-0.388	0.254	1.528	NS
X_5(Colour/Variety of Millet)	0.009	0.125	0.072	NS
X_7 (Income Derived)	0.49	0.136	3.59	0.01
$R^2 = 0.79$				
$F = 20.38^{***}$				

*Source: Field Survey, 2007, ***- Significant at 1% Probability Level*

Table 6. Estimate of the structural parameters of the total quantities of millet demanded by industries (grafted functions)

Variables	Grafted Functions		
	Coefficient	t-Value	Level of Significance
Intercept	6797.686	8.732	0.01
X_1	681.598	11.914	0.01
X_2	-6.227	0.362	NS
X_3	88.319	5.109	0.01
$d.f = 15$			
$F - Value$	100.097***		
R^2	0.959		

*Source: Field Survey, 2007, ***- Significant at 1% Probability Level*

Table 7. Expost Forecast of Millet (Tonnes) In Kaduna and Kano States of Nigeria

Year	Industrial Quantity Demanded (tonnes)
2006	13589.09
2007	13632.63
2008	13663.73
2009	13682.37
2010	13688.51
2011	13682.27
2012	13663.53
2013	13725.98
2014	13966.87
2015	14383.51

Source: Field Survey, 2007

Table 8. Apriori expectations (expected signs) of explanatory variables included in the model

Explanatory Variables	Expected Signs
Price of Millet (X_1)	$-$
Price of Substitute Maize (X_2)	$\pm$
Price of Substitute Sorghum (X_3)	$\pm$
Price of Millet Last Year (X_4)	$\pm$
Colour/Variation of Millet (X_5)	$\pm$
Income Derived (X_7)	$+$

4. CONCLUSION AND RECOMMENDATION

The industrial demand for millet is greatly influenced by income, price of millet, price of substitute maize, and price of substitute, sorghum. Linear demand function was used to examine the impact of these independent variables on the industrial demand for millet. Based on the findings the following recommendations are made, Research institutes should develop varieties by incorporating colour attributes to the breeding process and qualities (colour) that could encourage industrial demand of millet. Since this study covered two (2) States of the Federation, there is the need to identify all the agro-industries using millet and other agricultural produce as raw materials in all States of the Federation. Identifying the industries

will help in determining their annual consumption of these produce. This will further help in aggregate estimation of the country consumption of these produce and finally help in food formulation policies of the country.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Debrah SK. Soghum in Western Africa. in: Byth DE (ed).Sorghum and Millet commodity and research environment, Patancheru, A.P 502324 India, ICRISAT. 1993;17-37.
2. Hallgren L, Raxen FPB and Munck L . Industrial utilization of whole crop sorghum for good and industries. in: Gomez MI, House I, R Rooney DAV, (eds). Utilization of sorghum and millet Patencheru, A.P P502324 India, ICRISAT. 1992;121-130.
3. Kumar K. Pearl millet in West Africa. in: Byth DE, (ed) sorghum and millet commodity and research environments. Patancheru, A.P 502324 India, ICRISAT, Rome Italy. 1993;1-5.
4. Smith AJ. Rations for laying hens in Southern Africa Rhodesia, Poultry Journal. 1987;64:1-2.
5. Jancic S, Crnojeciv Z, Pesut MJ, Cosic J. Effect of structure and plans of ration and ration during pregnancy on productivity of sows. Agronomist Glamik. 1975;37:335-350.
6. Hale OM. Performance of swine-fed grain sorghum and beagle 82 triticale diets. in: Proceedings of the Georgia nutrition conferences for the feeds industry, University of Georgia USA. 1984;53-61.
7. Stanford PE. Comparison of feeding broiler strain chicks' yellow endosperm sorghum grain and corn as sources of energy. Poultry Sciences. 1972;51:18-56.
8. Daiber KH. The selection of sorghum for malting. The sorghum beer unit of the CSIR special report BB 118 Pretoria, South Africa; National Food Research Institute; 1978.
9. Daiber KH. Quality of sorghum for malting. The sorghum beer unit of the CSIR special report BB13. Pretoria, South Africa; National Food Research Institute; 1980.
10. IITA. International Institute of Tropical Agriculture, Ibadan, Oyo State, Nigeria, Report; 1996.
11. Olatunji O, Koleoso OA, Oniwinde AB. Recent experiences on the milling of sorghum, millet and maize for making non-wheat bread, cake and sausage in Nigeria. in: Gomez MI; House LR; Rooney LW and Dendy DAV (eds). Utilization of sorghum and millet. 1992;83-88.
12. Chindo PS, Ahmed B, Macauver OJ. Tranfer of the utilization of sorghum composite flour for bread and confectionaries to end-users in Kaduna state of Nigeria. in: Alintemo I, Sedgo J, (eds). Towards sustainable sorghum production, utilization and commercialization in West Africa, Patancheru, A P502324 India, ICRISAT. 2001;226–231.
13. Baidu-Forson J, Ajayi O. Industrial utilization of sorghum in Nigeria implication of evidence and distributive impact for research in: Menyonga et al. (ed). Regional workshop on processing and industrial utilization of sorghum and related cereals in Africa. The coordination of sorghum and related cereal in Africa. The coordination office OAU/STRC-SAFGRAD. Semi-arid food fain research and development. 1995;7-18.

14. Reichert RD. Sorghum dry milling. in: Sorghum in the eighties proceeding of the international symposium on sorghum. Patancheru, A. P 502324 India ICRISAT. 1982;547-563.
15. Subrahmanian V, Jambunatha R. Laboratory procedure for evaluating grain and good quality of sorghum and pearl millet, Gomez MI; House LR; Rooney LW and Dendy DAV, (eds). in: Utilization of sorghum and millet, Patancheru A.P 502324, India, ICRISAT. 1992;143-150.
16. Kormawa PM, Aiyedun E. Food demand structures and market studies for IITA mandate crops in the drier savanna of Nigeria. Proceedings of a methodology and stakeholders workshop, September, Kaduna. 1999;110.
17. Delgado CL, Reardon T. Cereal consumption shifts and policy changes in developing countries. General trend and case studies from the Western Africa Semi-Arid Tropics. in: Proceedings of the international sorghum and miller CRSP conference, Texas, USA, Int. Sormil Publication No92, Lincoln Nebraska, USA University of Nebraska. 1991;27-39.
18. FOS. Federal office of statistics. National Agricultural Sample Survey. 1994;45-48.
19. Phillip DOA. Grafted polynomial as forecasting functions application to cotton production in Nigeria. Savannah Journal. 1999;11(1):103-108.
20. Omole DA, Ukeje E, Yekini TK. Characteristics of industrial end users of agricultural raw materials. in: Ajakaiye DO, Akande SO, (eds). A characteristic of industrial demand for major agricultural commodities in Nigeria. 1999;34-59.
21. Rahman SA. The use of a grafted polynomial functions in forecasting maize production trend in Nigeria. Savannah Journal of Biological Sciences. 2001;1:69-72.

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