COMPARATIVE ANALYSIS OF DEMAND FOR FROZEN AND FRESH FISH IN NIGER STATE, NIGERIA: THE CASE OF MACKEREL AND CATFISH

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Abstract

Despite government efforts at improving the consumption of locally produced goods (fish), many marketers still prefer the sale of imported fish. The study is aimed at conducting a comparative analysis of the determinants of frozen and fresh fish, the costs and returns and, the determinants of net income of the marketers in Niger State. The study employed multi-stage sampling technique while descriptive statistics, multiple regression and gross margin techniques were employed. Analysis of the determinants of demand for mackerel land catfish showed that price elasticity of demand was inelastic while the income elasticity of demand showed that fresh and frozen fish were normal goods. The cross elasticity of demand of fish for chicken and turkey revealed that fish and chicken were substitutes while fish and turkey were complements. The costs and returns analysis of catfish revealed that total variable cost (TVC) was 93.3% in which the cost of feed had the highest share of 70.2%. The total cost was ₦20653.10/month while the net income was ₦28589.80/month. Unlike catfishmarketing, cost of labour had the highest TV Cat 18.2% while the total revenue was ₦35162.9/month. The net income of ₦27994.70/month implied that catfish and mackerel marketing were profitable ventures in the area. The main determinants of net income of mackerel marketing included cost of transportation ($P < 0.10$), age ($P < 0.10$), capital input ($P < 0.05$) and utility ($P < 0.01$). Based on the results, given the total cost outlays of both mackerel and catfish marketing in the area, it is easier to start up frozen fish marketing than fresh fish marketing though there was no appreciable difference between the demand and elasticities of catfish and mackerel in the area.
Keywords: Demand, Elasticity, Income, Price.

1. Introduction

Nigeria is the largest fish market in sub –Saharan Africa with a population of more than 150million people. In 2014, the contribution of Agriculture to GDP was 20.24% while fisheries contributed 0.48% to the Agriculture GDP (FCWC, 2016). Crop production accounted for about 85 percent of agricultural activities, with livestock and poultry accounting for 10 percent, and fisheries and forestry, 5 percent, with domestic food products such as corn, sorghum, tubers, and seafood(fish) being the traditional food stuffs consumed by the majority of the population (Rondon & Nzeka, 2010). Fish is an integral part of the diet of an average Nigerian because it is low in omega-6 fatty acids (commonly found in red meat) but high in omega-3 fatty acids. It supplies the body with protein needed for the growth and repair of worn out tissues as well as provision of essential nutrients required for the proper functioning of the body system. Moreover, it provides a range of health benefits due to the presence of the omega-3 fatty

acids. These benefits include the regulation of blood clotting and vessel constriction; prenatal and postnatal neurological development; reduction in tissue inflammation; alleviation of the symptoms of rheumatoid arthritis; reduction in depression, halting of mental decline in older people and, may play a beneficial role in cardiac arrhythmia (irregular heartbeat) (EDF, 2017).Of all the other sources of animal protein such as chevon, pork, mutton, beef and chicken, fish is unique in that it is more affordable and is void of cultural and religion barriers.

Catfishes of the family *Claridae* comprise the most commonly cultivated fishes in Nigeria. It is eaten by most tribes, resistant to harsh environmental conditions, commands good price, tasty and can be kept alive for days during marketing. It is interesting to know that more than 80 percent of cultured fish in Nigeria is catfish, mainly *Clarias spp., Heterobranchus spp.* and their hybrids. Unfortunately, the required quantity and quality of fish seed have never always been available. For instance, in 2013, the production output of *Clarias gariepinus*was over 253,898 MT per year and at a total value of US$800 (Anetekhai, 2013; Adewumi, 2011). In addition, the total production and supply of fingerlings was 55 million which is far less than about 500 million fingerlings per annum needed to satisfy the immediate needs of the market (Atanda, 2007). Moreover, in 2014 the total fish demand for Nigeria was 3.32 million MT while the domestic fish production from Aquaculture, Artisanal and Industrial fisheries was 1.123 million MT (FCWC, 2016). Therefore, the fish demand-supply gap of over two million MT per annum necessitated the large volumes of frozen fish imports to meet local demand.

Frozen seafood is the cheapest form of animal protein in Nigeria and consumption has been increasing. The country is a potential market for approximately 2.5 million MT of fish valued about $3 billion (Rondon & Nzeka, 2010). It was further reported that Atlantic mackerel, horse mackerel, herring and croakers are the major species imported into the country with Netherlands, China, Chile an d U.S being the major suppliers of frozen seafood to Nigeria.The market for frozen fish, especially mackerel of the family of *Scombridae*, herring and croaker, is large and is mostly sourced from the EU, South America, and some African countries and, Nigeria is expected to continue to import these foods due to inadequate local food production in order to reliably provides an alternative supply of fish to meet the rising demand (Rondon & Nzeka, 2010).

Marketing of fish could be regarded as the performance of all business activities involved in the flow of fish from the point of production (fisherman or fish farmer) to the final consumer (Akanni & Akinleye, 2004; Olukosi, Isitor & Moses, 2007). Fish could be sold in various forms ranging from smoked, iced, fresh, canned, and dried fish. The demand for fish is rising seriously with the speedy increase in the population to about 150 millions and sincecatfish farming has been the major focus of recent investment into aquaculture production especially by the private investors and that some fish dealers and marketers also specialize in certain species of fish import especially, mackerel, it is pertinent therefore to conduct a comparative study on demand for mackerel and catfish so as to know the consumers' preferences and the factors that influence the choice of either or both of breeds taking into cognizance the diversity embedded in the marketing of each of them.

2. Methodology

2.1. Study Area

This study was carried out in Niger State, Nigeria with Latitude 8°22'Nand 11°30'N and longitude 3°30'N and 7°20'E. It has the largest land mass of 74,244 square kilometres and shares an international boundary with the Republic of Benin and Zamfara to the North, Kebbi to the north-west, Kogi to the south, Kwara to the south-west, and Kaduna and FCT to the north-west. It has a projected population of 5,056,647 people in 2015 at 2.5% growth rate (NPC, 2006). The State has an annual seasonal variation of rainy season which occurs between April and October and, dry season between November and March. The average rainfall distribution is 1000mm-1500mm annually. In addition, it has a total of 25 Local Government Arears (LGAs)and is blessed with a fertile land which aided the growth of some major crops such as yam, maize, cowpea, rice and ground nut. Agriculture has been the major occupation of the people with few of them engaged in white collar jobs (GIS, 2013).

2.2. Sampling Techniques

A multi-stage sampling procedure was used to select the marketers in the study area. The first stage involved the random selection of three LGAs in the State. The second stage involved random selection of three markets from each of the selected LGAs, *that is,* Bosso LGA (Ultra-modern market, Tunga market and Mobil fish market), Bida LGA (Sokotako market, New market and Old market), Chanchaga LGA (Chanchaga market, Tungagoro market and Shango market). Finally, the third stage involved the selection of 5 fresh fish marketers and 7 frozen fish marketers from each of the markets making a total of one hundred and eight marketers in all. The unequal selection emanated from the fact that frozen fish has larger market than fresh fish market.

2.3. Method of Data Collection

Primary data were used for the study through well-structured questionnaire and interview schedule to elicit information on factors that influenced demand, input costs and value of output as well as factors that influenced the net income of the marketers.

2.4. Analytical Techniques

These were achieved using descriptive statistics such as frequencies, percentages, multiple regression and gross margin analytical techniques. Ordinary Least Square technique (OLS) regression was employed in estimating the determinants of frozen and fresh fish demand and net income from frozen/fresh fish marketing in the area.

The multiple regression model for the determinants of demand was implicitly stated as:

$$Y = f(X_1, X_2, X_3 X_4, X_5, \mu_i) \quad (1)$$

Where,

Y = Quantity of frozen (Mackerel)/fresh fish (Catfish) demanded (kg),
X_1 = Retail price of fish (₦)
X_2 = Monthly disposable income (₦)
X_3= Retail price of chicken (₦)
X_4 = Retail price of turkey (₦)
X_5= Retail price for egg (Crate)
μ_i = Error term

The model for the determinants of net income of the marketers was depicted in equation 2 as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \mu_i \quad (2)$$

Where,

Y= Net income from fish marketing (₦)
X_1= Cost of purchase (₦/kg)
X_2= Cost of transportation (₦/kg)
X_3= Cost of labour (₦/kg)
X_4 = Depreciation of capital input (₦)
X5= Utility (Electricity bill and taxes) (₦)
X_6= Level of education (Year)
X_7= Age (Year)
X_8= Household size (No.)
μ_i = Error term

The above model was estimated using four different functional forms namely, linear, power, semi-log and exponential.

The Budgetary technique and profitability ratios were used to determine the profitability embedded in the marketing of frozen and fresh fish in the study area.

This was computed as follows:

Gross Margin (GM) = GI – TVC *(3)*

that a 1 percent increase in the disposable income of the consumers and retail price of chicken led to 0.76 and 6.20 units increase in the quantity of fresh fish demanded in the area. This finding agrees with Dauda, Ojoko and Fawole (2016) in a study conducted on the economic analysis of frozen fish demand in Katsina Metropolis, Katsina State, Nigeria who reported that price of fish, consumer's income, household size, educational status and species of fish were important factors influencing demand for frozen fish in Katsina State. The analysis also showed that the price elasticity of demand of -1.893 was inelastic demand while the income elasticity of 0.342 showed that mackerel was also a necessity in the area. The cross elasticity of demand of mackerel for chicken and turkey of 2.791 and -1.284, respectively, revealed that mackerel and chicken were substitutes while mackerel and turkey were complements. Mackerel and turkey could be complementary commodities during festive periods and special celebrations such as naming, wedding, burial, graduation and birthday ceremonies as well as religious festivities such as Easter, Christmas and *Eid el-kabir*. The finding is also in agreement with Dauda *et al.* (2016) who reported that the own price elasticity of 0.78, indicated that demand for frozen fish was inelastic while the income elasticity of 0.11 implied that frozen fish is a necessity in the area. The report further showed that the cross price elasticities for chicken and beef of -0.076 and -0.63, respectively implied that frozen fish and chicken and beef were complimentary goods in the area.

Table 2. Determinants of Demand for Mackerel in the Study Area

Variables	Coef. Frozen	t-value	Elasticity
Retail price (X_1)	-420.717	-3.81***	-1.893
Disposable Income (X_2)	76.027	2.44**	0.342
Retail price of chicken (X_3)	620.445	2.21**	2.791
Retail price of turkey (X_4)	-285.426	-2.04**	-1.284
Retail price of egg (X_5)	-92.111	-0.12^{NS}	
R^2	0.43		
F- Ratio	8.95***		

Source: Field Survey, 2017.

The overall results (Pooled) also with semilog functional form as the lead equation (Table 2) showed the coefficient of determination, R^2 of 0.406 and F-ratio of 13.93, respectively. The analysis also showed that the price elasticity of demand was -2.240. This was an indication that fish demand in the area was inelastic while the income elasticity of 0.390 showed that fish was a necessity in the area. The cross elasticity of demand of fish for chicken and turkey of 1.436 and -1.349, respectively still confirmed the earlier result that fish and chicken were close substitutes while fish and turkey were complements.

3.2. Profitability of Fish Marketing

Result in Table 3showed the costs and returns analysis of catfish and mackerel marketing in the study area. The analysis of the catfish marketing revealed that total variable cost (TVC) was 93.3% (*that is,* ₦19281.40/month) of the total cost. Cost of feed had the highest share of the TVC of 70.2% (₦14496.00/month) which was followed by cost of labour (9.2%) and cost of transportation (3.8%) at ₦1893.00/month and ₦789.30/month, respectively. The least TVC was the cost of charcoal/firewood at ₦46.40/month. This was only needed for the processing of fish for better storability. The total cost was ₦20653.10/month while the total revenue was ₦49242.90/month. The net income of ₦28589.80/month showed that catfish marketing was a profitable enterprise in the study area. The result is in consonance with that of Adebayo and Daramola (2013) in a study on economic analysis of catfish production in Ibadan metropolis and reported that catfish was profitable in the area.In another development, Osarenren and Ojor (2014) in a study on marketing analysis of smoke-dried fish in Etsako East Local Government Area of Edo State, Nigeria reported that smoke fish marketing was a profitable venture with a net profit ₦19,800 per marketer in the study area.

Where:
TVC = Total Variable Cost.
Therefore,

$$Net\ Income\ (NI) = GM - TFC \quad (4)$$

Where:
NI = Net Income,
TFC = Total Fixed Cost

3. Results and Discussions

3.1. Determinants of Demand for Fish in the Study Area

In the analysis of the determinants of demand for fish in the area (see Table 1), four functional forms namely, linear, power, semi-log and exponential functions were used. Semi-log function was chosen as the 'lead' equation because it had the highest number of significant variables and R^2.

The power functional form of the ordinary least square regression model revealed that catfish had coefficient of determination (R^2) value of 0.73 which means that 73% of the variations in the demand for catfish marketing was explained by the included explanatory variables. The F-ratio of 19.99 showed that the whole model was significant at $P < 0.01$. Retail price (X_1) was negative but significant at $P < 0.01$ which showed that a 1 percent increase in retail price led to a 3.33 percent decrease in the quantity of fresh fish demanded and vice versa, whereas the disposable income (X_2) of positive with $P < 0.01$implied that a 1 percent increase in the disposable income of the consumers led to 0.44 percent increase in the quantity of fresh fish demanded in the area.

Table 1. Determinants of Demand for Catfish in the Study Area

Variables	Coefficient	t-value	Elasticity
Retail price (X_1)	-3.331	-7.91***	-1.33
Disposable Income (X_2)	0.439	4.16***	0.44
Retail price of chicken (X_3)	0.075	0.11^{NS}	
Retail price of turkey (X_4)	-0.490	-0.85^{NS}	
Retail price of egg (X_5)	1.164	0.33^{NS}	
R^2	0.73		
F- Ratio	19.19***		

Source: Field Survey, 2017.

The elasticity analysis showed that the price elasticity of demand of -1.33 implied that the demand for catfish was inelastic in the area. This showed that a one percent change in price led to a less than one percent change in quantity demanded of catfish fish, *ceteris paribus*. This agreed with the *a priori* expectation that most agricultural commodities are inelastic in nature. This have great implications on the total revenue of the marketers, *that is,* marketers of catfish in the area would enjoy increase in their total revenues which could improve the scope of their business and eventual improvement in their living standard. Moreover, the income elasticity of demand was 0.44 which showed that a percentage change in income led to less than proportionate change in quantity of catfish demanded. This implied that catfish was a necessity in the area. Income elasticity of demand is useful in assisting the marketers to make better investment decisions, especially the type of income earners to be targeted as well as an indicator of future consumption pattern of the consumers.

The result of determinants of demand for mackerel (see Table 2) in the area was not appreciably different from that of catfish. For instance, semi log functional form was chosen as the lead equation with R^2 of 0.43, which showed that 43% of the quantity demanded of mackerel was explained by the included explanatory variables. The F-ratio of 8.95 showed that the whole model was significant at $P < 0.01$. Retail price of mackerel (X_1) and retail price of turkey (X_4) were negative but significant at $P < 0.01$ and $P < 0.05$, respectively which showed that a 1 percent increase in retail price of both mackerel and turkey led to a 4.21 and 2.85 units decrease in the quantity of mackerel demanded and vice versa, whereas the disposable income (X_2) and retail price of chicken (X_3) of positive with $P < 0.05$ implied

Table 3. Determinants of Demand for Clarias and Mackerel (Pooled) in the Study Area

Variables	Coefficient (Pooled)	t-value	Elasticity
Retail price (X_1)	-386.19	-5.48***	-2.240
Disposable Income (X_2)	67.16	3.62***	0.390
Retail price of chicken (X_3)	247.58	1.70*	1.436
Retail price of turkey (X_4)	-232.52	-2.51**	-1.349
Retail price of egg (X_5)	-130.23	-0.26	
R^2	0.41		
F- Ratio	13.39***		

Source: Field Survey, 2017.

Table 4 further revealed the result of analysis of mackerel marketing in the area. Unlike catfishmarketing, cost of feed was zero because the fish sold were lifeless. Therefore, the highest variable cost was that of labour at ₦1307.00/month (18.2%) which was followed closely by cost of transportation and electricity at ₦688.00/month and ₦463.00/month, respectively. Water was only needed for cleaning and therefore was the least cost at 0.1%. The TVC was just about half of the TC as compared with fresh fish of 93.3%. The total revenue was ₦35162.9/month, gross margin was ₦31646.20/month while the net income was ₦27994.70/month which implied that mackerel marketing was equally a profitable venture in the area.

Table 4. Costs and Returns Analysis of Fish Marketing in the Study Area

Items	Clarias (₦/Month)	%	Mackerel (₦/Month)	%	Pooled (₦/Month)	%
Variable Items						
Newspaper	0.00	0	223	3.1	223	0.8
Leather Bag	249.00	1.2	271	3.8	520	1.9
Feed	14496.00	70.2	0	0	14496	52.1
Water (keg)	433.20	2.1	6.5	0.1	439.6	1.6
Charcoal/firewood	46.40	0.2	130	1.8	176.4	0.6
electricity/generator	719.00	3.5	463	6.5	1182	4.2
Cost of storage	648.00	3.1	426.9	6	1074.9	3.9
Transportation	789.30	3.8	688	9.6	1477.3	5.3
Cost of labor	1893.00	9.2	1307	18.2	3200	11.5
Total variable cost	**19273.90**	**93.4**	**3515.4**	**49.1**	**22789.2**	**81.9**
Fixed Items						
Tax	40	0.2	150.7	2.1	190.7	0.7
Depreciation (Freezer, coolers, table, chair, bowls, oven)	1330.5	6.4	3510.9	49	4841.4	17.5
Total fixed cost	**1370.5**	**6.6**	**3661.6**	**51.1**	**5032.1**	**18.2**
Total cost	20644.40	100.00	7177.00	100.20	27821.30	100.10
Total revenue	**49242.9**		**35162.9**		**84405.9**	
Gross margin	**29961.5**		**31646.2**		**61616.6**	
Net income	**28589.8**		**27994.7**		**56584.6**	

Source: Field Survey, 2017.

The overall analysis revealed that given the total cost outlays of both mackerel and catfish marketing in the area, it is easier to start up frozen fish marketing than fresh fish marketing. The pooled result

showed that the total variable cost was ₦22789.2/month (81.9%) while the TC was ₦27821.30/monthwith net income of ₦56584.60/month. This result is consistent with the findings of Ashaolu (2006) who observed that fish farming was a profitable business in the area, In addition, Runfu, Adepuju, Salau and Adebiyi (2009) in a study on the determinants of yield performance in small scale fish farming in Alimosho Local Government Area of Lagos State reported that fish farming in the study area was profitable.

3.3. Determinants of Net Income of Marketers

Table 5 showed the result of the analysis of the determinants of the net income of the fish marketers in the study area. Based on *a priori* economic and statistical criteria for selecting the 'lead' equation, linear equations were chosen for both mackerel and pooled data, respectively. Since the F-ratio for all the functional forms for the determinants of catfish marketing was insignificant, the regression result was not discussed. Therefore, analysis of the determinants of net income of mackerel marketers revealed that the coefficient of variation (R^2) of 0.51 implied that 51% of the variations in the income of the marketers were explained by the included explanatory variables. More so, the F-value (7.30) was significant at $P < 0.01$ and implied that the whole model was significant. The Table (see table 5) further revealed that cost of transportation (X_2), age (X_7) and capital input (Depreciation) (X_4) were negative but significant at $P < 0.10$, $P < 0.10$ and $P < 0.05$. This implied that an increase in any of these variables reduced the income of the marketers, *that is,* the higher the cost, the lower the net income of the marketers. As marketers grow in age, their efficiency reduces thereby reducing the net income of the marketers. However, utility (X_5) was positive and significant at $P < 0.01$ which implied that the more the utility, the more the net income of the marketers. This could occur when marketers relied more on electricity as the main power source for frozen fish (mackerel) preservation rather than generator as alternative power supply which is extremely expensive to maintain. Furthermore, the Table showed that the pooled result indicated an R^2 of 0.33 which implied that 33% of the variations in the net income of the marketers were explained by the included explanatory variables while the F-ratio was 5.98 and significant at $P < 0.01$, which implied that the whole model was significant.

Table 5. Determinants of Net Income of Fish Marketers in the Study Area

Variables	Frozen fish	T-value	Pooled	T-value
Purchase cost (X_1)	0.43189	0.06	1.5748	0.51
Transportation(X_2)	-24.88338	-1.96*	-9.4995	-1.35
Labour cost(X_3)	16.36316	1.41	10.7073	1.47
Capital input (X_4)	-19.81375	-2.28**	-18.1182	-2.58**
Utility (X_5)	47.38579	4.32***	25.9544	3.99***
Education(X_6)	5914.652	0.94	5359.111	1.06
Age(X_7)	-4897.565	-1.75*	-6063.104	-2.68***
Household Size(X_8)	15225.70	1.50	20514.08	2.52**
R^2	0.51		0.33	
F Ratio	7.30***		5.98***	

≤ 1.00 = 1%, 1.01-5.00 = 5%, 5.01-10.00 = 10%.
***= significant at 1% probability, **= significant at 5% probability, *= significant at 10% probability, NS= not significant
Source: Data Analysis (2016).

In addition, it was discovered that four out of the eight included explanatory variables were significant, *that is,* capital input (Depreciation) (X_4) and age (X_7) were negative but significant at $P < 0.05$ and $P < 0.01$, respectively. However, utility (X_5) and household size (X_8) were positive and significant at $P < 0.01$ and $P < 0.05$, respectively. This revealed that the more the utility and household size, the more the net income of the marketers in the area. As has been pointed out earlier, this could occur when marketers rely more on electricity as the main power source than generator. In the same vein, the more educated a marketer is the more the innovation and skills put into his/her marketing activities. Also, high household size could minimize the cost embedded in marketing thereby increasing

the revenue and net income of the marketers through the abundant availability of family labour to perform the various marketing activities. Babalola, Bajimi, and Isitor (2015) carried out a research on economic potentials of fish marketing and women empowerment in Ogun State and found out that value of sale per week, volume of trade per week, level of education, participation in cooperative marketing and cost of fish purchased were the determinants of marketing margin of the fish marketers in the area. Oluwasola and Ige (2015) conducted a research on factors determining the profitability of catfish production in Ibadan, Oyo State, Nigeria and found out that fish farming experience, labour and feed were the main determinants of net income of the farmers.

4. Conclusion and Recommendations

The paper carried out a comparative study of the demand for fresh fish (catfish) and frozen (mackerel) marketing in Niger State, Nigeria. The results of the determinants of demand for catfish showed that retail price of catfish and disposable income of the consumers had significant influence on the quantity of catfish demanded. Conversely, the result of determinants of demand for mackerel showed that retail price of mackerel, disposable income, retail price of turkey and retail price of chicken had considerable effect on quantity of mackerel demanded. The result of the elasticity of both catfish and mackerel revealed that the demand was inelastic while the income elasticity of demand showed that fish was a 'necessity'. The cross elasticity of demand of mackerel for chicken and turkey revealed that mackerel and chicken were substitutes while mackerel and turkey were complements. The costs and returns analysis showed that given the total cost outlays of both mackerel and catfish marketing, it is easier to start up frozen fish marketing than fresh fish marketing. The result of the analysis of the determinants of the net income of mackerel marketers revealed cost of transportation, age and capital input and utility.

4.1. Recommendations

Based on the findings, it is therefore recommended that:

1. Consumers of both breeds should diversify their income sources for increased consumption of fish since it is a necessity.
2. Since utility significantly affected the net income of mackerel marketers, they should source for alternative power supply such as solar energy to make up for short fall in electric power supply at any time.
3. Government in collaboration with non-governmental organizations should create enabling environment for catfish marketing so as to boost the morale of the producers thereby encouraging increased local production and sale.
4. Extension agents and non-governmental organisations should ensure training of marketers on preservation, processing and handling of fish and fish products to minimise losses.

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