Cost and Calorie Analysis of Food Consumption in Artisanal Fishery Households in North-Western and North-Central Nigeria

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Abstract — A study was conducted to assess the food calorie intake and factors that determine food security status of fisherfolks in North-Central and North-Western Nigeria. Data were collected from 267 rural fishery households using a multi-stage random sampling procedure. The main tools of analysis include descriptive statistics, Cost of calorie intake and Tobit models. The study revealed that the fishery household heads were male dominated (94%); average age of 49 years with mean adjusted household size of 8. The estimated mean years of schooling of sampled fisherfolks were 3.5 years, largely skewed towards the informal education and below 2015 UNDP mean education index of 5 years for Nigeria. The calorie intake for the secured fisherfolks households recorded higher values for the entire food intake than the insecure households. The result showed that only 35.58% of the sampled fisheries households were food secured while majority (64.42%) of the sampled households were food insecure. The determinants of food insecurity status were socio-economic variables and those factors that influenced the food secured fisherfolks showed slight variation from those influenced households that were food insecure and where it did, it was not by the same magnitude and direction. There is need for an appropriate policy mix that will promote the increased production of legumes and animal protein foods in the study area to raise and meet the minimum average protein required per caput per day. Food insecure households should be educated by extension agents through their cooperative societies to increase production of maize, sorghum, millet, rice and cowpea to enhance their food security status.

Keywords — Artisanal fishery, energy, food security index, per capita income, Nigeria

1. INTRODUCTION

Food is the most basic necessity of life that must be satisfied before any other developmental issue (Begum et al., 2010, Oladimeji et al., 2015a). Every human being needs a minimum amount of food for existence and a balanced diet to maintain sound health. According to Helen (2002), food security maintains political stability, and ensures peaceful coexistence among people while food insecurity results in poor health and reduced productivity of both children and adult. Food consumption is a complex and dynamic process, and is greatly influenced by size and composition of household, number of earning hands, prices of food items, educational level, individual preferences and geographical, cultural and climatic conditions in a region. Inadequate nutrition is synonymous to poverty or considered as a measure of poverty in many societies (Datt et al., 2000).

Oladimeji et al. (2015a) opined that the expenditure pattern of artisanal fisheries households in developing countries were largely skewed towards food consumption, yet rural households that provide the bulk of agricultural products still suffer from caloric and nutrition insufficiencies. The bulk of rural fishery households need to have an adequate amount of food to eat to surmount minimum daily energy level of 2260 kcal needed per caput per day as recommended by Food and Agriculture Organization (FAO) to eradicate hunger. The analysis from FAOSTAT indicates that per capita supply of calories has remained almost stagnant in Nigeria and has recently fallen in many homes due to economic recession and transition.

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In contrast, the per capita supply of energy has risen dramatically in North Africa from 2195 Kcal in 1997-1999 to 3090 Kcal in 2015 (FAO, 2015). For example, the daily calorie per capita intake of an average Nigerian was estimated to be lower than 1700 kcal with an average protein consumption of about 19.38g as against the recommended minimum requirement of 2100 kcal for moderate activity and 75 g protein per caput per day to meet the minimum protein requirement to maintain a balance diet and eradicate nutrition insufficiency. It important to note that both caloric and nutrition insufficiencies lead to various health problems, which ultimately affect the economic growth and prosperity of a country.

Studies on the food consumption of artisanal fisheries households are helpful to understand the importance of investing in fishery. This is because food security, nutrition and health status of fisherfolks are of great concern in the contemporary world. The fishery is a vital component in the livelihoods of people in many parts of the world. The fisheries sector contributes about 3.5% to the Nigerian country’s annual Gross Domestic Product (GDP), employs about 4.3% of Nigeria population and is an important contributor to the population’s nutritional requirements, constituting about 50% of animal protein intake (Oladimeji et al., 2015b). Therefore, fishery households are indispensable towards sustaining agricultural development and feeding an estimated 160 million Nigerians who needed to have adequate calorie and balanced nutrients.

The objective of this study was to estimate the cost and calorie of food consumed by artisanal fishery households in North-central and North-western Nigeria. In addition, factors influencing food security status of artisanal fishery households were determined.
2. RESEARCH METHODOLOGY

2.1 The Study Area

The study was conducted in North-central and North-western Nigeria. North-central region comprises of Benue, Kogi, Kwara, Nasarawa, Niger and Plateau States while North-western region include Jigawa, Kaduna, Kano, Katsina, Kebbi and Zamfara States. The two regions fall within the tropical Guinea and derived savannah zone of Nigeria with mean annual rainfall and temperature range of 787mm to 1500mm and 29.5°C - 35°C respectively. Specifically, North Central lies between latitudes 7°N to 12° N and longitude 2° 30’ E to 12° E while Kebbi State lies between latitudes 10° 8’ N and 13° 15’N and longitudes 3° 30’E and 6° 02’E (NPC, 2006). (See details of Kebbi and Kwara State features in Oladimeji et al., 2016 and Oladimeji et al., 2017).

2.2 Data Collection, Sampling Procedure and Sampling Size

Sample fisherfolks were randomly selected from the two States, Kwara and Kebbi. Data were collected from 267 fisherfolks using interviews and questionnaire in 2013/2014 (see details of basis for purposeful selection of the 2 States in Oladimeji et al., 2015a &b, Oladimeji et al., 2016 & Oladimeji et al., 2017). In addition, artisanal fisheries production is much favoured in both Central and North West part of Nigeria as a result of numerous tentacles of inland water and streams as well as flood plains of the River Niger that stretches from Niger Republic to Kebbi State [from Lolo (Bagudo LGA) to Ulafia (Ngaski LGA)] then to Kebbi State with prominence in Kainji lake reservoir [Borgu and Agware Local Government Areas, (LGAs)] through Kwara State [from Jebba (Moro) LGA to Lafiagi/Patigi (Edo) LGA] to Lokoja in Kogi State. Sixteen fishing settlements were randomly selected from both States. The selected fishing settlements in Kebbi State were Ngaski, Lolo, Bagudo, Koko, Besse, Ulafia, Dolekaina and Yauri and in Kwara State include Imagi, Rogun, Ellah, Sunkuso, Ikpata-Jebba, Lafiagi, Patigi and Gbaradogi fishing settlements.

The size of each sample from the two States was determined by Neyman method of sample determination (Yamane, 1967) given as:

\[ n = \frac{\sum N_{cw}S_d^2}{N_{cw}D^2 + \sum N_{cw}S_d^2} \]  \hspace{1cm} \text{(1)}

Where; \( n \) is the required sample size; \( N \) was the number of holdings in target population; \( N_{cw} \) was the number of the population in the North-central and North-western Nigeria, \( S_w \) was the standard deviation in the two zones, \( S_i^2 \) was the variance of in the two zones; \( d \) is the precision level, \( z \) was the reliability coefficient (1.96 which represents the 95% reliability) and \( D^2 = d^2/z^2 \).

Based on Equation 1, the sample size was calculated as 267 comprising 129 and 138 fisherfolks in Kebbi and Kwara States respectively.

2.3 Analytical Techniques

Descriptive statistics cost of calorie intake and Tobit models were employed to analyse the data. Household calorie availability was estimated using food nutrient composition of Oguntona and Akinyele (1995) tagged calorie content of some commonly eaten foods in Nigeria. The nutrients content of both produced and purchased food items were used to derive calorie availability. A daily recommended level of 2260kcal per capita per day defines the food security line used in this study.

The nutrient content of produce was used to derive the calorie availability following Amaza et al. (2009), Abdulrahman et al. (2017). It is stated as:

\[ Z = \frac{P_c}{R} \]  \hspace{1cm} \text{(2)}

Where: \( Z \) = Food Security Index,
\( P_c \) = Per capita calorie available to a household per day
\( R \) = Recommended per capita calorie intake per day.

For this study, a household is defined as a group of people living together and eating from the same pot. Thus, a household was said to be food secure if its calorie food intake was more than or equal to \( Z \), the estimated benchmark and food insecure if otherwise. Based on the estimated \( Z \), several food security measures were calculated as follows:

The short fall or surplus index, \( P \), which is given as:

\[ P = \frac{1}{m} \sum_{j=1}^{m} G_j \]  \hspace{1cm} \text{(3)}

Where \( m \) = number of households that were food secure (food surplus index) or food insecure (food short fall index). It was measured at the aggregate level, the extent at which the households were below or above the food security.

\[ G_j = \frac{x_j - R}{R} \]  \hspace{1cm} \text{(4)}

\( G_j \) = the deficiency or surplus faced by jth household,
\( x_j \) = average calorie available to the jth household

The Head Count Ratio (H) is defined as:

\[ H = \frac{M}{N} \]  \hspace{1cm} \text{(5)}

\( M \) = Number of food secure households and
\( N \) = Sampled population

The cost of calorie index method proposed by Foster et al. (1984) and employed by Amaza et al. (2009), Abdulrahman et al. (2017) was used in this study to determine a threshold food security line. The method yields a threshold value that is usually close to the minimum calorie requirement for human survival. Two steps, identification and aggregation, are involved in constructing the index. Identification is the process of defining a minimum level of nutrition necessary to maintain healthy living and this is referred to as the ‘food insecurity line’. In the context of this study, the food insecurity line was the calorie level below which people were classified as being food insecure or...
subsisting on inadequate nutrition. Calorie adequacy was estimated by dividing the estimated calorie supply for each household by the household size, adjusted for adult equivalent and using the consumption factors for various age-sex configurations. Following from above, the food insecurity line is given as:

$$\ln X = a + bC$$  \hspace{1cm} \ldots \ldots \ldots (6)$$

Where X is the adult equivalent food expenditure and C is the actual calorie consumption per adult equivalent in a household.

The recommended minimum daily calorie requirement per adult equivalent is 2260 kcal and this was used to determine the food insecurity line, using the equation:

$$S = e^{(a + bL)}$$  \hspace{1cm} \ldots \ldots \ldots (7)$$

Where, S = cost of buying the minimum calorie intake (food security line), a and b = parameter estimates, L = recommended minimum daily energy (calorie) level (2260 kcal).

Based on the S calculated, a household was classified as food secured or food insure, depending on which side of the line they fall.

Adult labour equivalent was generated from Organization for Economic Corporation and Development (OECD) Scale adopted by Oladimeji and Abdulsalam, (2017) as follows:

$$AE = 1 + 0.7(N_{\text{adult}} - 1) + 0.5N_{\text{children}}$$ \hspace{1cm} \ldots \ldots \ldots \ldots \ldots \ldots \ldots (8)$$

Where, AE represents adult equivalent, N\text{a} represents the number of adult aged 15 and above and N\text{c} is the number of children aged less than 15.

The Tobit regression was used to analyze the determinants of food security status of artisanal fisheries households. It measures the parameter of the conditional probability of being food secured and the effects of the marginal changes in explanatory variables on the food security status of households (Abdulrahman et al., 2017).

The model can be expressed as

$$Y_i^* = \sum X_i \beta + \mu_i$$ \hspace{1cm} \ldots \ldots \ldots \ldots \ldots \ldots \ldots (9)$$

$$Y_i = P_i = (X_i \beta, \mu_i), \text{if } P_i > R_i^* \hspace{1cm} \ldots \ldots \ldots \ldots \ldots \ldots \ldots (10)$$

$$0 = (X_i \beta, \mu_i), \text{if } P_i \leq R_i^* \hspace{1cm} \ldots \ldots \ldots \ldots \ldots \ldots \ldots (11)$$

\[ i=1, 2, \ldots, 267 \]

Where, \[ Y_i > z \text{ and } Y_i = (Z - Y)/Z \text{ for } Y_i < z \]

\[ Y_i^* = \text{calorie consumption status of household. } Y_i \text{ was measured by share of daily energy (calorie) consumed divided by recommended minimum daily energy level (2260 kcal). } P_i \text{ the food security (calorie) depth or intensity defined as } (Z - Y)/Z \text{ and } P_i^* \text{ the food security depth, when the food threshold line (Z) equals the calorie per adult equivalent, X_i the vector of explanatory variables. } \beta \text{ the vector of unknown co-efficients and } \mu_i \text{ is an independently distributed error term. In this study the explanatory variables that were used in the model include X_i = per capita household income (N), X_2 = education level of household (years of formal education), X_3 = fishing experience (years), X_4 = cooperative membership (years), X_5 = amount of credit obtained for fisheries activities (N), X_6 = length of fishing gears used (m), X_7 = per capita expenditure on food items (N) and X_8 = adjusted household size per adult equivalent (Number). The parameters of the Tobit regression model were estimated using the maximum likelihood approach.} \]

3. RESULTS AND DISCUSSION

3.1 Socioeconomic Status of Fisher Folks

Summary statistics of the data reported in Table 1 revealed that the fishery household heads were male dominated (94%); average age of 49 years with mean adjusted household size of 8. The estimated mean years of schooling of sampled fisherfolks were 3.5 years, largely skewed towards the informal education and below 2015 UNDP mean education index of 5 years for Nigeria (Oladimeji et al., 2016).

Therefore, the socio-economic and institutional characteristics and number of motorized canoes owned showed that artisanal fishery and fishery practices are still not developed and are largely subsistent and rudimentary and which culminated in the fishery households engaging in alternative activities as a means of generating income for livelihood subsistence. The results are comparable with studies of Oladimeji et al. (2015b). The results of the skewness and kurtosis of the credit beneficiaries and amount (1.84; 2.41), extension contact (1.8; 2.4) and per capital income (1.73; 2.04) show that the values obtained tend to be asymmetric and heavy tailed which imply there were wide differences among the means of these variables. However, the skewness and kurtosis values for adjusted household size, level of education and per capita expenditure tend toward being symmetric and light tailed. These suggest that changes in these variables have low mean differences which were also manifested in their standard deviations.

3.2 Calorie Intake of Secured and Insecured Fishery Households

The calorie intake of each food component by secured and insecured artisanal fishery household is presented in Figure 1. Throughout the calorie intake for each food component, the calorie secured fisherfolks households recorded higher values for the entire food intake than the insecured households. However, in spite of Nigeria’s abundant fisheries and livestock resources, both secured and insecured households consumed only 10.7% and 9.66% of animal source. Therefore, total protein consumption is below the UN/FAO’S estimated minimum of 75 g of daily per caput intake (Oladimeji et al., 2015a). The average protein consumption in Nigeria is about 19.38 g per caput consumption per day while the contribution of 7 g from animal source is below the expected level. However, per caput consumption per day of fish is higher than that of any other livestock product in Nigeria (Oladimeji et al., 2015a &b).
Table 1. Descriptive statistics of the households’ variables used in Tobit regression model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Min.</th>
<th>Max.</th>
<th>Mean</th>
<th>Stddev</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>THHI/month (‘000₦)</td>
<td>5.34</td>
<td>69.2</td>
<td>43.5</td>
<td>623.9</td>
<td>1.98</td>
<td>2.80</td>
</tr>
<tr>
<td>Age of household head (years)</td>
<td>23</td>
<td>71</td>
<td>49</td>
<td>12.04</td>
<td>1.00</td>
<td>0.87</td>
</tr>
<tr>
<td>Adjusted household size (No)</td>
<td>4</td>
<td>17</td>
<td>≈8</td>
<td>0.86</td>
<td>0.87</td>
<td>0.92</td>
</tr>
<tr>
<td>Level of education (years)</td>
<td>0</td>
<td>15</td>
<td>3.50</td>
<td>0.22</td>
<td>0.56</td>
<td>0.91</td>
</tr>
<tr>
<td>’ Credit accessed for prod. (₦)</td>
<td>0</td>
<td>500,000</td>
<td>75,348</td>
<td>23,053</td>
<td>1.80</td>
<td>2.41</td>
</tr>
<tr>
<td>Cooperative membership (Years)</td>
<td>3</td>
<td>41</td>
<td>≈20</td>
<td>3.3</td>
<td>1.03</td>
<td>1.10</td>
</tr>
<tr>
<td>Per capital expend./month (₦)</td>
<td>76.5</td>
<td>299.0</td>
<td>120.8</td>
<td>19.30</td>
<td>0.41</td>
<td>0.59</td>
</tr>
<tr>
<td>Extension contacts/session (No)</td>
<td>0</td>
<td>2</td>
<td>0.99</td>
<td>0.52</td>
<td>1.83</td>
<td>2.40</td>
</tr>
<tr>
<td>Canoe owned (1=Motorized)</td>
<td>-</td>
<td>≈29%</td>
<td>M</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Per capital income (’000₦)</td>
<td>0.98</td>
<td>5.12</td>
<td>1.63</td>
<td>902.7</td>
<td>1.73</td>
<td>2.04</td>
</tr>
<tr>
<td>LGA dummy (Urban=1)</td>
<td>0</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Field survey, 2014/2015; *credit beneficiaries; THHI = Total Household Head Income

Fig. 1: Food components of secured and insecure household/day/adult equivalent

Source: Field survey, 2014/2015, Note: 1 cal = 4.184 J (Thermochemical calorie)

Table 2. Summary of cost of food and calorie intake of artisanal fisheries households

<table>
<thead>
<tr>
<th>Items</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of calorie equation</td>
<td>Ln X = a + bc</td>
</tr>
<tr>
<td>Constant</td>
<td>11.321 (2.043)**</td>
</tr>
<tr>
<td>Slope coefficient</td>
<td>-1.623e-05 (-1.997**)</td>
</tr>
<tr>
<td>FAO recommended DEI intake</td>
<td>2260 Kcal</td>
</tr>
<tr>
<td>Variable Secure</td>
<td>Secured</td>
</tr>
<tr>
<td>Variable Insecured</td>
<td>Insecured</td>
</tr>
<tr>
<td>Per capita daily calorie (PCDC) (Kcal)</td>
<td>2404.6&lt;e,***</td>
</tr>
<tr>
<td>PCDC deficit/surplus (Kcal)</td>
<td>1847.5&lt;e,***</td>
</tr>
<tr>
<td>Food household expenditure/day (₦)</td>
<td>+144.6</td>
</tr>
<tr>
<td>Food household expenditure/day (₦)</td>
<td>-412.5</td>
</tr>
<tr>
<td>Number of adjusted households</td>
<td>451.0&lt;e,***</td>
</tr>
<tr>
<td>Food insecurity line (s): cost of minimum energy requirements per adult equivalent</td>
<td>375.8&lt;e,</td>
</tr>
<tr>
<td>Per day (N)</td>
<td>6.3</td>
</tr>
<tr>
<td>Per week (N)</td>
<td>7.9</td>
</tr>
<tr>
<td>Head count (H)</td>
<td>7.0</td>
</tr>
<tr>
<td>Mean Food Security Index</td>
<td>1.064</td>
</tr>
<tr>
<td>Food insecurity gap/Surplus index</td>
<td>0.768</td>
</tr>
<tr>
<td>Aggregate income gap (G): secured vs non</td>
<td>0.972</td>
</tr>
<tr>
<td>Number of observations</td>
<td>12882.0</td>
</tr>
<tr>
<td>Food households (%)</td>
<td>2935.8</td>
</tr>
<tr>
<td>Per month (₦)</td>
<td>129.004</td>
</tr>
<tr>
<td>Per month (₦)</td>
<td>-129.004</td>
</tr>
<tr>
<td>Number of observations</td>
<td>267</td>
</tr>
<tr>
<td>Food households (%)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Field survey, 2014/2015, *** = p< 0.01, **= p<0.05%, * = p<0.10
3.3 Food Security Status of Artisanal Fisheries Households

Food security status of fisheries households is presented in Table 2. Based on the recommended daily energy levels (L) of 2260 Kcal, the food security line (S) was estimated at ₦419.4 per day per adult equivalent which translates to ₦12582.0 per month. The result showed that only 35.58% of the sampled fisheries households were food secured while majority 64.42% of the sampled households were food insecure. The aggregate income gap (G) of ₦129.004 indicates that food insecure households would need 129.004 per adult equivalent to meet their daily basic food requirements. Differences in income levels predispose households to different consumption patterns due to their economic access to food. The mean food security index of food secured and food insecure households were 1.064 and 0.768 respectively. The food insecurity gap of 0.064 and -0.232 imply that on average the food insecure households consumed 23.2% less than their daily calorie requirements while food secured households consumed 6% in excess of their daily calorie requirements.

3.4 Level of food insecurity among the artisanal fisheries households

Figure 2 showed the degree of food insecurity among artisanal fisheries. The level of food insecurity according to Devereux (2006) and Meseret (2012) adopted by Keku (2017) and Abdulrahman et al. (2017) measures the calorie consumption directly by categorizing the degree of severity of food insecurity. This means that these households show zero or minimal evidence of food insecurity. However, 27.34% were marginally food insecure which means that these households show concern about the adequacy of the households food supply and therefore show adjustment in their daily food management. The insecurity level of these households has not reached a stage of experiencing physical sensation of hunger. About 20.23% and 16.85% of the respondents are moderately and severely food insecure respectively. In the former group of households, food intake reduced such that the adults had repeatedly experienced the physical sensation of hunger while in the latter, food intake of both adults and children reduced to an extent that they witnessed severe hunger. Keku (2017) opined that government and non-government organizations (NGOs) need to present food aids to this vulnerable group of people in order to ameliorate their standard of living and prevent food crisis, starvation and death.

3.5 Determinants of food security (Kcal) among artisanal fisherfolks

From the Maximum Likelihood Estimation (MLE) of the tobit regression in Table 3, the values for log likelihood function (104.083), LR Chi² (-36.091) and ANOVA based fit measure (0.000) suggested that the model has a good fit to the data. The result revealed the determinants of food secure household were determined by four variables: per capita household income (p<0.05), type of fishing gears (p<0.01), per capita household expenditure (p<0.05) and adjusted household size (p<0.10). These imply that a unit increase in per capita income and per capita food expenditure could increase calorie consumed by food secured household in the studied area. The results also indicated that type of fishing gears (p<0.05), per capita food expenditure (p<0.05) and adjusted household size (p<0.01) were statistically significant factors that determined calories consumed by insecure household. This result is consistence with a priori expectation and findings by Akbay et al. (2007), Oladimeji et al. (2015a) who observed that household with higher incomes are more likely to consume more food than those with lower incomes. Similarly, adjusted household size was negatively related to calories consumption among insecure fisherfolks. This result corroborates the findings of Sabur et al. (1997) who reported that the amount of food consumed by each household depended largely on household size.

The variable, length of fishing gears which was statistically significant in both households indicates increased efficiency and fish catch in secured household while negative and statistically significant fishing gears could imply less fish catch and invariably less per capita income. One other possible explanation for positive significance of the coefficient of fishing gears in food secured household is that fisherfolks operating with outboard engine would be able to venture further into the river reef and exploit both close and farther distance water with less effort and greater efficiency (Oladimeji et al., 2015a &b). This would lead to more fish catch and apparently increase income and food consumption. This result agrees with the finding of Squires et al. (2002) and Kareem et al. (2013) who stated that the length of fishing gears and types of gill net stocked were positive, statistically significant and that their use would increase fish catch.

![Food insecurity among fisherfolks](image-url)
4. CONCLUSION AND RECOMMENDATION

The study revealed that the degree of food insecurity among artisanal fisheries was high. The determinants of food secured and food insecure households were determined by socio-economic variables. Furthermore, the factors that influence the food secured fisherfolks showed slight variation from those that influenced households that were food insecure and where it was the same, it was not by the same magnitude and direction. The Nigeria fishery resources are grossly under-utilized. However, there is an enormous potential to increase the output of this sector to raise the income of the fishermen, calorie and nutrition requirements, and improved their welfare. There is need for an appropriate policy mix that will promote the increased production of legumes and animal protein foods in the study area to raise and meet the average protein required per caput per day. Food insecure households should be encouraged to increase production of maize, sorghum, millet, rice and cowpea to enhance their food security status. This could be done through improve access to better food production technologies and provision of incentives that will motivate farmers to produce more; such as good market, accessible road, electricity and buying off the excess produce in the market in order to prevent glut and stabilize price.

REFERENCES


