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Food Calorie Consumption and Vulnerability Status of the Rice Farmers in Ekiti State, Nigeria: Perspective for Commercialized Farming

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The research investigated the calorie consumption and vulnerability status among rice farmers in Ekiti State, Nigeria. Employing a multi-stage sampling technique, 420 respondents were selected, and data were collected through a well designed questionnaire. Analysis involved descriptive statistics, a vulnerability index, and an ordinary least squares regression model. Findings indicated that vulnerable rice farming households typically exhibit larger sizes with fewer working members, often headed by unmarried females. Additionally, factors such as adult equivalence, the head of the household's years of formal education, land ownership, membership in agricultural production groups, engagement in agricultural commercialization, contact with extension agents, and encounters with Fulani herdsmen significantly influenced households' food calorie consumption. Furthermore, all variables considered in the ordinary least squares regression, regarding vulnerability to food insecurity, exhibited a significant relationship with households' vulnerability to food insecurity. In summary, the study provides valuable insights into the demographic and socio-economic factors affecting calorie consumption and vulnerability among rice farmers, offering a foundation for targeted interventions and policy considerations.

Keywords: Calorie consumption; rice farming; vulnerability; commercialization; food insecurity; Nigeria.

1. INTRODUCTION

Despite the recent efforts of the international development community to get closer to the 2030 Agenda's "zero hunger" and "food and nutrition security" targets, there is still a remarkably high degree of food and nutrition insecurity worldwide. It is estimated that over 274 million people globally require humanitarian help and protection, at an estimated cost of over USD 41 billion [1]. Particularly in the sub-Saharan Africa (SSA) region, there is a remarkably high rate of food and nutrition insecurity, which is mostly caused by weak institutions and governance. These elements seem to reduce capital flows' ability to address the region's food and nutrition security [2-4]. In addition, several countries in Sub-Saharan Africa (SSA) heavily depend on imported agricultural inputs like fertilizers and crops like wheat and rice. Due to their greater reliance, these nations are more vulnerable to food and nutrition insecurity, especially when there are interruptions in the global supply chain. The current conflict in Ukraine and the issues brought on by the COVID-19 outbreak have further exacerbated the effects [5].

Nutrient deficiencies arise from both insufficient food intake and inadequate dietary variety, as the latter serves as a reliable gauge of overall nutritional well-being [6]. According to certain figures, more than 50% of Nigerians live in substantial socioeconomic hardship, and many households struggle with food security and nutrition [7]. Food shortfalls in Nigeria were documented as high as 20% in 1980 and 40% in 2023 [8,9]. Furthermore, the 2023 Global Hunger Index places Nigeria at the 109th position among 125 countries. The escalating food prices, malnutrition, and fatalities stemming from widespread poverty underscore the extent of food insecurity in Nigeria [10]. It also signifies immense misery for millions of impoverished individuals [6,11].

The minimal amount of money the government spends on health and agriculture (which is a vital source of nourishment for subsistence farmers) highlights how little attention is paid to initiatives that directly affect population health and well-being [6]. This gives enough evidence that the cost of nutrition, combating diseases, health and other problems by farmers is quite enormous, considering the frequency and prevalence of hunger, malnutrition, diseases and ill health among Nigerian rural farmers [6,12,13].

Furthermore, small-scale farmers and their households are disproportionately vulnerable to malnutrition [14,15]. It has also been noted that in Africa and Asia, the majority of malnourished people are rural dwellers who are smallholder farmers [16,17]. Key interventions targeted at low-calorie consumption and food insecurity in rural Africa include: a focus on income and promotion of commercial agriculture which will avail the rural dwellers improved purchasing power [18] and focus on households by supporting on-farm production and making food available locally to reduce food insecurity [18]. Nutrition is closely linked to agriculture since it is the sector that produces food but many of the

undernourished are smallholder farmers [19]. This study, therefore, seeks to examine the calorie consumption and vulnerability status of rice farmers in Ekiti State, Nigeria. This study specifically examined the socioeconomic characteristics of the respondents; estimated the food insecurity status of the respondents; examined the vulnerability status of the respondents; and determined the factors influencing food calorie consumption of the respondents.

2. METHODOLOGY

2.1 Description of the Study Area

The research was conducted in Ekiti State, Nigeria, situated in the South-West geopolitical zone. With a tropical climate featuring distinct rainy (April–October) and dry (November–March) seasons [20], the state has sixteen Local Government Areas. Ekiti State, endowed with water resources like Ero, Osun, Ose, and Ogbese rivers, boasts a culturally homogenous population speaking the Ekiti dialect of the Yoruba language. Agriculture is the backbone of the economy [21], with crops such as yam, maize, cassava, cocoyam, and rice, along with tree crops like cocoa, kolanut, and oil palm. The predominantly rural population faces poverty challenges, relying on agriculture for over 75% of employment and income.

2.2 Data Collection

Primary data were obtained through field survey using structured questionnaire and oral interview to elicit response from the respondents concerning their food consumption, socioeconomic characteristics, physical and financial endowments.

2.3 Sampling Techniques

The study was conducted using cross-sectional data obtained from rice farmers who are the target population in the study area. The study employed multi-stage sampling procedure in selecting the respondents. The first stage involved a purposive sampling of rice producing communities in Ekiti state.

Secondly, twenty-three rice growing communities were randomly selected in a manner that ensured representation of the three Agricultural Development Projects zones (ADPs). The ADPs zones were located in each of the three senatorial districts in the study area. In the third stage, a total of four hundred and forty-six rice farmers were selected from the list of rice farmers obtained from the ADPs office (state headquarters), for the study based on probability proportionate to size. However, out of the 446 questionnaire administered, 420 were correctly filled. Following [22], the following sample size determination was used in this study:

$$n = \frac{N}{1+N(e^2)} \quad (1)$$

Where,

N (1556) is the population size and e is the level of precision (4%), n is the sample size. The proportionality factor used in the selection of the sample for equal representation is stated as:

$$x_i = \frac{n}{N} * No\ of\ registered\ rice\ farmers\ in\ ith\ community \quad (2)$$

Where,

x_i = sample selected from ith community, n = total sample estimate obtained from Yamene 1967 formula and N= population of registered rice farmers in the study area. The sampling procedure is as shown in table one.

2.4 Data Analyses

Data collected were analysed with the use of descriptive statistics such as frequencies, averages and percentages. Calories consumption and Ordinary Least Square (OLS) regression were used in analyzing the data collected.

2.4.1 Determination of household food insecurity status

To realize household food insecurity status objective, firstly, quantities of the commonly consumed food items at the household level in the study area were calculated and converted to calories based on their composition [23,24]. Resulting calorie values were divided by the respective adult equivalent values of the households, in order to obtain numbers that are comparable across households of different sizes. The World Health Organization (WHO) considers 2850kilo calories as the required daily intake for a moderately active adult equivalent [25]. Food secure households are those whose daily per capita calorie consumed per Adult Equivalent (AE) is greater than or equal to the minimum

recommended daily calorie requirement of 2850kcal/day/AE, otherwise household was considered food insecure for this study. Therefore, household food security status assumed a binary choice of 1 for food insecure household, 0 otherwise.

2.4.2 Ordinary least square regression

The quantity of calorie consumed by the sampled households is assumed to be specified by the functional forms which were fitted to the data using Ordinary Least Square Regression (OLS) folowing [26]. The functional forms is specified as;

$$\ln C_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij}$$

Where

ln C = the log of consumption per adult equivalent per day in kilo calorie
X = characteristics of households β = the coefficients to be estimated e = error term
Definition of variables and measurement
Dependent variable
C = Calorie consumption in kcal/day/AE

Independent variables

X_1 = $Sex\ of\ the\ Household\ head$ (1=male; 0=otherwise)
X_2 = $Age\ of\ the\ Household\ head$ (Years)
X_3 = $Adult\ equivalence$ (Number)
X_4 = $Mode\ of\ rice\ farm\ cultivation$ (Lowland = 1, 0 otherwise)
X_5 =Years of formal education (Years)
X_6 = $Marital\ status$ (Married =1, 0 otherwise)
X_7 = $Ownership\ of\ land$ (Own land =1; 0 otherwise)
X_8 = $membership\ of\ agricultural\ production\ group$ (Yes = 1; 0=otherwise)
X_9 = $Agricultural\ commercialization\ status$ (Participant =1, 0 otherwise)
X_{10} = $Credit\ value$ (yes = 1; 0 $otherwise$)
X_{11} = Extension contact (Yes=1, 0 otherwise
X_{12} = $Incidence\ of\ illness$ (Yes =1; 0 otherwise)
X_{13} = $Incidence\ of\ crop\ loss$ (Yes =1; 0 otherwise)
X_{14} = $Fulani\ herdsmen\ challenge$ (Yes=1; 0 otherwise)

3. RESULTS AND DISCUSSION

3.1 Socioeconomic Attributes of the Respondents

According to Table 1, two-wave cross-sectional data were collected for the study. Based on the data collected, the major findings of the study are as follows; having disaggregated the sampled households based on commercialisation status, 64% (269) of the total 420 sampled households commercialized while the rest (36%) did not commercialize. The average age of the sampled respondents regardless of their commercialization status was 47.2 years. This implies that the sampled respondents were in their active and productive age. It is expected that being in their active and productive age would enable them engage in income – generating activities such as agricultural commercialization that has potential to reduce being vulnerable to food insecurity. This result agrees with [27,28] who found that being in productive age has a significant reduction on food insecurity. Also, the distribution shows that 68.4% of the respondents that commercialized were male while the remaining commercialized respondents were female. On the other hand 67.5% of non-commercialized respondents were male while the rest were female. This implies there were more male rice farmers than female rice farmers in the sampled respondents. This result corroborates [29, 30], that male farmers are more likely to engage labour intensive farming activities than female farmers.

The result showed that 58.7% of respondents that commercialized were married and for the non-commercialized respondents, 57% of them were married. Married respondents can pool resources together and engage in income generating activities, the gains can help them have access to adequate food.

The average household size of the sampled respondents regardless of commercialization status was about seven members. This is similar to the findings of [31-33]. Households comprising of 7 members is a fairly – large one which may reduce or threaten respondent's vulnerability to food insecurity. On one hand, large respondent size may serve as a source of labour supply on the respondent's farm. This may enable respondent to produce more output for consumption or sale to earn income. On the other hand, large – size respondent has the potential of exerting pressure on respondent available resources such that affected respondent experiences reduction in their per capita food consumption or entertain anxiety of food shortage. This result is in in line with [23,27,34], who reported that large-size households are more food insecure than small-size households.

The average number of years that commercialized and non-commercialized respondents spent to acquire formal education were about 10.5 years and 9.3 years, respectively. This implies that commercialized respondents were more educated than their non-commercialized counterparts. The level of education acquired by respondents could determine the range of opportunities available to improve livelihood strategies, access to market and enhance food security [35,36].

The rationale for adult equivalence inclusion was to account for variation in respondent food consumption. The results showed that the sampled respondents were composed of varying adult equivalent sizes. The average adult equivalence size for commercialized and non-commercialized respondents were 5.9 and 5.8, respectively. Respondent comprising of large adult equivalence size may threaten respondent's vulnerability to food insecurity. On the other hand, large adult equivalence size respondent may serve as source of labour supply on the respondent's farm where possible. This may enable respondent to produce more output for consumption or sale to earn income. Also, large – size adult equivalence respondent has the potential of exerting pressure on respondent available resources such that affected respondent experiences reduction in its per capita food consumption or entertain anxiety of food shortage. This result supports [30,37] that reported that large-size adult equivalence is associated with small per capita food consumption.

3.2 Respondents' Food Security Status

Table 2 presents the respondent distribution by amount of calories consumed during the two survey period. The study used calorie threshold of daily intake of 2850 kilo calories for moderately active adult equivalent as set by World Health Organisation [25] and used by [37] to categorise respondents calorie consumption. The distribution showed that more non-commercialized respondents (49%) consumed less than the calorie threshold value compared with commercialized respondents (27.5%) in the first period of the survey. However, more commercialized respondents (72.5%) consumed calorie above the threshold compared with non-commercialized respondent (51%) also in the first period of the survey. Again, in the second period of the survey similar results were observed as in the first period of the survey. More non-commercialized respondents (57%) consumed calorie below the threshold value compared with commercialized respondents (36.1%). However, in the same survey period more commercialized respondents consumed calorie above the threshold value compared with non-commercialized respondents (43%). This implies that in the survey periods commercialized respondents were more food secured compared with non-commercialized respondents. The average calorie consumed per adult equivalent by commercialized and non-commercialized respondents were 3274.2 and 3033.0 kilo calories respectively in the first survey period. Also, the average calorie consumed per adult equivalent by commercialized and non-commercialized respondents were 3144.1 and 2816.0 kilo calories respectively in the second survey period. This finding could be linked to seasonal effect/variation in food availability and prices. This result connotes instability of access to food among the sampled respondents. The results are similar to the findings of [26,34].

3.3 Respondents' Vulnerability Status

Table 3 presents the respondent distribution by vulnerability status. This study used a vulnerability threshold of 0.5 as done by [37] to categorise respondents into non-vulnerable and vulnerable groups. Respondent whose vulnerability index is equal to or below 0.5 is considered non-vulnerable while respondent whose vulnerability index is above 0.5 is considered vulnerable. On this basis, 59.5% and 31.8% of commercialized and non-commercialized respondents respectively were non-vulnerable. However, in terms of respondents being vulnerable, 40.5% and 68.2% of commercialized and non-commercialized respondents respectively were vulnerable. This means that commercialized respondents were less vulnerable compared with non-commercialized respondents. A respondent that can produce higher marketable surplus and possesses insurance mechanisms tend to be less vulnerable to food insecurity.

3.4 Factors Influencing Respondent Food Calorie Consumption

The results of the model of food consumption estimated using value at risk analysis to account for heteroscedasticity are reported in Table 4. In general the model performs well. The goodness of fit measure, R^2, is 0.43. Also, Prob>F is significant at 1%. Eight (8) out of the sixteen (16)

explanatory variables included in the regression model significantly influenced respondents' calorie consumption and showed expected signs. Adult equivalent size significantly and negatively influenced calorie consumption at 1% level of significance. This implies that small-size adult equivalent respondents were more likely to consume more quantities of calorie than similar respondents that have large – size adult equivalent. This finding could be linked to the possibility that as respondent equivalent size (a proxy for respondent size) increases, its consumption declines. This result supports [37], who found that large-size adult equivalent promotes vulnerability to food insecurity. Number of years spent in school to acquire formal education significantly and positively influenced calorie consumption at 5% level of significance. This suggests that respondents who spent more years in school were more likely to consume more calories than similar respondents that spent lesser years in school. This finding can be explained on the ground that additional year spent in school increases level of knowledge and skills acquired which translates to higher marginal productivity and more income [36,38]. This result agrees with [39], who found that educated respondents are less likely to be food insecure. Ownership of land significantly and positively affected calorie consumption at 1% level of significance. This suggests that respondents that owned land were more likely to consume more calorie than respondents that did not own land. This finding could be possible because land (a physical assets) is a very important factor in production. Land availability ranks high among agricultural production requirements. Engagement of respondents in farming is contingent primarily upon access to land to the extent that the level of agricultural output produced increases as the size of farm cultivated increases all things being equal. This result agrees with [36,40], who found that ownership of land is associated with reduced food insecurity. Membership of association significantly and positively affected calorie consumption at 5% level of significance. This suggests that respondents that were members of association were more likely to consume more calorie than respondents that are not members. This result could be attributed to the possibility that membership of association enables respondents to access a number of production and consumption – enhancing opportunities. These opportunities include information sharing, access to improved production technology, economy of scale, market linkages, reciprocity during rainy days/ hard times and so on. This result corroborates [41,42], who found that respondents who are members of association have access to a number of production and consumption – enhancing opportunities that can make them have access to food. Agricultural commercialization significantly and positively affected calorie consumption at 5% level of significance. This suggests that respondents that commercialized were to more likely to consume more calorie than similar respondents that did not commercialize. This result could be linked to the possibility that agricultural commercialization enables participants to earn income from the sale of their marketable surplus which they can use to buy food not produced by them in addition to their own – produced food. A similar result was obtained by [43,44], who found that income earned by respondents who commercialize is a potential instrument for acquiring food. Extension contact significantly and positively influenced calorie consumption at 1% level of significance. This suggests that respondents that had contact with the extension workers were more likely to consume more calorie than respondents that did not have contact with extension workers. This result could be explained by the possibility that contact with extension workers enables farmers to adopt improved production practices. Also, contacts with extension workers enables farmers to have access to information relating to obtaining productivity – enhancing inputs and market linkage. Therefore, access to these opportunities could help farmers to produce more own consumed food and marketable surplus. The result supports [45], who found that respondents that have contact with extension workers are likely to commercialize and produce more. Fulani herdsmen challenge significantly and negatively influenced calorie consumption at 1% level of significance. This suggests that respondents threatened by Fulani herdsmen counter – productive activities were less likely to consume more calorie than similar respondents not threatened by Fulani herdsmen destructive activities. This result could be related to the possibility that victims from respondents experienced loss of crops following the indiscriminate grazing of Fulani's cattle on their farms. Also, the fear of insecurity of being attacked by the Fulani herdsmen could make farmers stay off-farm or go to farm occasionally especially when they have feelers of the absence of the Fulani herdsmen around their farms. These scenarios have economic implications because affected respondents tend not be able to express their optimum production potential

due to restlessness occasioned by Fulani herdsmen threat. As such, crops on the farm would suffer improper maintenance which would result in low yield or crop failure. This result is in line with [46], who found that respondents that are exposed to shock that can disrupt their production activities are more likely to be vulnerable to poverty.

Table 1. Summary statistics of the socioeconomic attributes of the rice farmers

Variable	Commercialized (N= 264)		Non-commercialized (N = 156)	
	Mean	Standard deviation	Mean	Standard deviation
Age	47.20	35.20	47.20	23.80
Sex	0.68	0.29	0.68	0.41
Marital status	0.59	0.21	0.58	0.34
Household size	7.00	3.30	7.00	3.80
Year of schooling	10.53	2.30	9.32	3.76
Adult equivalent	5.93	3.30	5.81	3.12

Table 2. Distribution of respondents by calories consumed during the two survey periods

Calorie consumed	Commercialized				Non-commercialized			
	$Freq_1$	$Freq_2$	$\%_1$	$\%_2$	$Freq_1$	$Freq_2$	$\%_1$	$\%_2$
1850 – 2849	74	97	27.5	36.1	74	86	49.0	57.0
> 2849	195	172	72.5	63.9	77	65	51.0	43.0
Total	269	269	100.0	100.0	151	151	100.0	
						100.0		
Mean	3274.2	3144.4			3033.0	2816.0		

Note: $Freq_1$ = Frequency of respondents in period one of the survey
$Freq_2$ = Frequency of respondents in period two of the survey
$\%_1$ = Percentage of respondents in period one of the survey
$\%_2$ = Percentage of respondents in period two of the survey

Table 3. Distribution of respondents by vulnerability status vulnerability status

Status	Commercialized		Non-commercialized	
	Frequency	Percentage	Frequency	Percentage
Non-vulnerable (≤ 0.5)	160	59.5	48	31.8
Vulnerable (> 0.5)	109	40.5	103	68.2
Total	269	100.0	151	100.0
Mean		0.46		0.65

Table 4. Ordinary least square regression for determining factors influencing respondent calorie consumption

Variable	Coefficient	Standard error
Agricultural Commercialisation Status	0.076**	0.027
Sex	0.010	0.026
Age	-0.002	0.001
Adult Equivalence (household size)	-0.025***	0.005
Mode of Rice Farm Cultivation	0.033	0.025
Years of Formal Education	0.171**	0.081
Marital Status	0.010	0.025
Ownership of Land	0.044***	0.010
Membership of Agricultural Production Group	0.065**	0.030
Credit Value	1.60e-08	4.48e-07
Extension Contact	0.178***	0.039
Incidence of Illness	-0.008	0.024
Incidence of Crop loss	-0.008	0.024
Fulani Herdsmen Challenge	-0.085***	0.022
Constant	7.887***	0.085
Number of Observation	420	
R-squared	0.432	
Prob > F	0.000***	

*Note: Coefficients followed by *, **, and *** indicate significance at the 10%, 5% and 1% levels respectively*

4. CONCLUSION AND RECOMMENDATIONS

In conclusion, the study sheds light on the intricate dynamics of vulnerability and calorie consumption among rice farming households in Ekiti State, Nigeria. Vulnerable households, characterized by larger size and fewer working members, often led by unmarried females, face distinctive challenges. Factors such as adult equivalence, the head of the household's education, land ownership, group membership, engagement in agricultural commercialization, contact with extension agents, and encounters with Fulani herdsmen significantly impact food calorie consumption. Moreover, the Ordinary Least Squares (OLS) regression analysis reveals a substantial relationship between various variables and households' vulnerability to food insecurity. This underscores the multifaceted nature of vulnerability factors affecting food security within the studied population.

Based on the findings of this study, policies should prioritize support for vulnerable households, considering their unique characteristics. This may include tailored assistance programs and resources to enhance their resilience and reduce food insecurity. Again, investing in educational programs for household heads and strengthening extension services can contribute to improved agricultural practices, enhancing both productivity and food security. Efforts should be directed towards facilitating secure land ownership for farmers and promoting participation in agricultural commercialization initiatives. This can positively influence calorie consumption and overall food security. Encouraging the formation and active participation in agricultural production groups can foster community support systems, knowledge-sharing, and collective problem-solving. Addressing challenges posed by Fulani herdsmen is crucial. Implementing strategies to mitigate conflicts and ensuring peaceful coexistence can contribute to a more secure environment for agricultural activities. Lastly, given the influence of climate on agricultural activities, policies should focus on promoting climate-resilient farming practices and providing resources to mitigate the impact of environmental challenges.

5. LIMITATIONS AND FURTHER STUDY

The use of Geographic Information System (GIS) remote sensing to capture the demographic characteristics and location-specific farm-level information would have formed more and robust qualitative and quantitative data. It would have also help to compare results on farm and location basis. The further study should expand the scope by looking at the rural farming households and compare results across the regions in Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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