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SOCIO-ECONOMIC DETERMINANTS OF FOOD SECURITY AMONG HOUSEHOLDS IN BORNO STATE, NIGERIA: PROBIT REGRESSION MODEL APPROACH

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ABSTRACT

This study examined the determinants of household food security in Borno State. Multistage simple random sampling procedure was used in the drawing of sample. Structured questionnaires and focus groups discussions were used in collecting data for the study. Data were collected from 500 households in 18 villages in six Local Government Areas, of the region between 2008 and 2009. The data collected were analyzed using descriptive statistic and probit regression model. It has been identified that household size ($p<0.05$), TLU ($p<0.05$) (Tropical Livestock Unit) owned by the household, household per adult equivalent daily income ($p<0.01$), quantity of food from own production ($p<0.01$), dependency ratio ($p<0.05$) and extent of produce commercialization ($p<0.01$) are the significant determinants of household food security among the households. Based on the findings of the study, the following are possible areas of intervention to mitigate the problem of food insecurity of the households in the area: policies aimed at improving agricultural productivity through the use of improved technologies should be promoted; efforts that could boost household income generation should be promoted; the issue of child labour has to be seriously looked into in the State.

INTRODUCTION

Food is a basic necessity of life. Its importance is seen in the fact that it is a basic means of sustenance. Its adequate intake in terms of quantity and quality is a key for healthy and productive life (Tarasuk, 2001; Hamelin *et al.,* 2002; Vozoris and Tarasuk, 2003). Food security for the households means access by all members to enough food for an active healthy life. Food security includes' at a minimum, the ready availability of nutritionally adequate and safe food, and assured ability to acquire acceptable foods in socially acceptable ways (i.e. without resorting to emergency food supplies, scavenging, stealing or other coping strategies (USDA, 2000)), was formalized in the "Rome Declaration" (LeBlanc *et al.,* 2003) as an important objective of every nation. In recent times, the global focus has been on food insecurity alleviation.

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This is because the world is hungrier than ever before. About 850 million people in the world are food insecure (World Bank, 2008), a number that has hardly changed since the 1990-92 based period for the World Food Summit and Millennium Development Goal (MDG) commitments of reducing hunger by half by 2015. Barely four years to the target there appears to be doubt in achieving this objective in Nigeria and Borno State in particular. This is because one in every three persons suffers from hunger in Sub Saharan Africa (World Bank, 2008), and Nigeria accounts for one-fourth of the hungry people (Fakiyesi, 2001; World Bank, 2008). The choice of Borno State is premised on the fact, that the problem is more pronounced; rainfall is 600 millimeters or less per year, desertification, low productivity, and poorly diversified economies are more evident than elsewhere; high incidence of food insecurity of 72 percent for Maiduguri, the State capital, in 2008 (Mohammed *et al.,* 2009)) in the country (USAID, 2007). Hence the need to identify the determinants of food security with a view to providing suggestion for the achievement of the MDG of reducing the number of hungry people by half by 2015.

MATERIALS AND METHODS

Study area

The study was carried out in Borno State, located in the Northeast Nigeria. The State lies approximately between latitudes 10º02¹ N and 13º04¹ N and between longitudes 11º04¹ E and 14º04¹ E (Folorusho, 2001). The State shares borders with Adamawa State to the south, Yobe State to the west, and Gombe State to the southwest. It also shares international borders with Republic of Niger to the north, Chad Republic to the northeast and Cameroon to the east (BOSADP, 2008). It is the largest State in terms of land mass in Nigeria, covering an area of 69,434 km², about 7.67% of the total land area of the country (Folorusho, 2001). According to the 2006 census figures, Borno State has a population of about 4.15193 million people and annual growth rate of 3.2% (NPC, 2006). The State is presently structured into 27 local government areas. The State, which is predominantly agrarian, is characterized by three agro-ecological zones which comprised of the Semi-Arid Geidam-Ashagar-Monguno Plain in the north, dry Sub-Humid Gumel-Nguru-Maiduguri Plain in the central part and dry Sub-Humid Chibok-Biu-Mubi-Song High Plain in the southern part (Ojanuga, 2006). The characteristics of these zones according to Ojanuga (2006) are as follows:

Semi-Arid Geidam-Ashagar-Monguno Plain

The zone is characterized by less than 508mm mean annual rainfall. A very short rainy season (June to September) alternates with a long dry season of 8 months (October- May) annually. The growing season is about 75-89 days. The dry spells (droughts) are common in the growing season often resulting in crop failures. Agriculture in this zone is characterized by traditional bush-fallow shifting cultivation of arable crops; pastoral herding; and irrigation farming. Constraints facing farmers, (in their agricultural activities) among others, include: low rainfall, drought, low fertility of the sandy soils of the dunes and sand plain terrains and seasonal water-logging of the clay flats.

Dry Sub-Humid Gumel-Nguru-Maiduguri Plain

This zone is characterized by 508-1016mm annual rainfall and high temperatures 27-30ºC (mean annual temperature). Actually, the mean maximum temperatures are in the range of 30-40 ºC while the mean minimum temperatures are 11-25 ºC. A short rainy season occurring between June and October alternates with a long dry season of 6-8 months. The growing period is about 90-150 days, a much longer growing season than the semi-arid Geidam-Ashagar-Monguno plain.

Dry Sub-Humid Chibok-Biu-Mubi-Song High Plain

It has a sub-humid climate with mean annual rainfall in the range of 508-1016mm, a long dry season of 6-8 months and a mean annual temperature of 26-28 ºC. Coolest temperatures of 10-13 ºC over most parts of the zone are experienced from November to January or February in the dry season, with higher altitudes like the Biu plateau recoding the lowest. The length of the growing season is 4-5 months averaging 120-160 days. The rainy months are June, July, August and September, although the rain generally starts with a few showers in May. Land degradation and desertification have been on the increase, causing the desert to advance southwards. It has been estimated that between 50% and 75% of Borno State is being affected by desertification (FRN, 1999). The state is losing substantial hectres of its land mass to desert conditions annually, and such conditions are estimated to be advancing southwards at the rate of 0.6 km per year (FRN, 1999).

Sources of data and method of data collection

The study used both primary and secondary data. The primary data source comprised the use of questionnaire while secondary data were collected from published data and other literature sources. The collection of data was carried out with the aid of extension agents of the Agricultural Development Programme (ADP) in the study area through the use scheduled interviews, questionnaires distribution and focus group discussion.

Sampling frame and techniques

Extension cells (administrative units in each of the ADP zones) constituted the sampling frame. Each cell is headed by an extension agent. The sampling unit was the household. Multistage simple random sampling procedure was used in the drawing of sample. First there was random selection of two Local Government Areas each representing about 20% of the Local Government Areas in each of the three agro ecological zones in the state. Second, there was random selection of one cell out of the ten (10) cells in each of the Local Government Areas selected (each cell contains six (6) villages (some nearby smaller villages were merged with the larger ones)). Third, there was random selection of three villages in each of the cells selected. Thus a total of 18 villages were involved. Finally, due to lack of household data of the villages, the population figures of each Local Government Area for 2006 were divided by the number of villages in each of the Local Government Areas selected and the average household size for northern Nigeria as provided by Olayemi (1998) was used as a proxy for the household size in each of the selected village. The households were given identification numbers and selected by systematic sampling procedure. Finally, data were collected in all the households within the selected houses (as there were more than one household in some of the selected houses). Household heads were used in drawing of the data. A total of 630 questionnaires (35 questionnaires in each village which represent approximately 20% of the households in each of the villages with some adjustments) were distributed but 500 completed questionnaires were used in the analyses as others were discarded due to incompleteness or inconsistency, or lack of cooperation (see Table 3.1). Furthermore there was no significant difference in the number of households in all the villages across the zones. The data were collected between July 2008 and January 2009.

There are many methods for measuring food security status, each with different strengths and weaknesses. Alternative approaches can generally be categorized in three ways (Maxwell, 1995); those comparing estimates of dietary energy availability or intake with energy requirements; those measuring nutritional outcomes; and those measuring perceptions of food insecurity and hunger. Most conventional

approaches to food insecurity measurement have relied on what is viewed as objective (actually physical) measurement, which considers target level of consumption (Maxwell, 1995). According to Maxwell (1995), two major methods have been widely used. The first method is to estimate gross household production and purchases over a period of time, and presume that the food that has come into the household's possession and 'disappeared' has been consumed. The second method is to undertake 24-hour recalls of food consumption for individual members of a household and analyze each type of food mentioned for caloric content. Economists most often use the first method which is also used in this study. This is because of the drawbacks such as respondent fatigue, high data collection cost associated with the second method. To determine the food security status of the households in this study, food security line was drawn based on the recommended daily calorie required approach (A household who's daily per adult equivalent calorie intake is up to 2250 kcal, as recommended by FAO (1995), is food secure and those below 2250 kcal were regarded as food insecure households). The kilocalories of food consumed, was taken as a proxy for nutritional well-being of the household since availability of sufficient quantities of nutritionally adequate food is a prerequisite for food security (Qureshi, 2007).

Table 3.1. Sample size for household food security survey in Borno state Measurement of food security status

Agro ecological zones	Local Government Areas selected	Population	Number of villages	Villages selected	Average number of households per villages	Sample size (20% of household)
Semi-Arid Geidam-Ashagar-Monguno Plain	Gubio	152778	107	Ngetra Gazabure Gubio	179	108
	Marte	129370	100	Ala Njine Musne	162	96
Dry Sub-Humid Gumel-Nguru-Maiduguri Plain	Maiduguri	521492	398	Bolori Mafoni Bulumkutu	164	99
	Jere	211204	150	Dusman Khaddamari Gamboru	176	105
Dry Sub-Humid Chibok-Biu-Mubi-Song High Plain	Askira-Uba	138091	112	Wasada Pumbum Bdagu	154	93
	Kwaya-kusar	56500	61	Kurba Gadam Bamunda	116	69

Source: field survey 2008/2009

Furthermore, economic analysis of calorie consumption by households is derived from the important role calories play in the definition of important welfare concepts such as health and productivity (Aromolaran, 2004). According to Maxwell and Frankenberger (1992), enough food is mostly defined with emphasis on calorie and on requirements for an active, healthy life rather than survival. Moreover, food energy requirements are often used as proxy for all nutritional requirements, even though adequacy in calories may occur simultaneously with serious deficiencies in other nutrients (Stiglitz, 1976).

Food calorie intake has been found to have a strong empirical linkage with both human health and productivity. The human body needs energy to maintain normal body function (basic metabolic rate), engage in required minimal activity related to good health and hygiene (standard minimum requirement), and carry out productive activities to sustain the supply of energy and other required nutrients to the body. In addition, food calorie intake is needed for growth in children and also affects the assimilation of micronutrients, since the body may fail to assimilate other nutrients if there is food energy deficiency (Aromolaran, 2004). Thus the level of calorie intake by an individual should, therefore, be adequate to sustain these functions over his expected lifetime. Furthermore, when this lifetime calorie consumption pattern falls short of a minimum threshold, the individual is at health risk. Secondly, whenever there is a persistent shortfall in the flow of calorie intake to the amount required for optimal productive activity, the flow of other nutrients is likely to be affected, since the resources required for acquiring these nutrients is obtained from productive work. This situation is especially evident in population where the major income-earning asset is human labour. That is populations made up of poor households where non-earned income forms an insignificant component of full income. In such populations, increased calorie intake may imply increased productivity which subsequently leads to increased income and nutrition. For instance, Strauss (1986), using household level data from Sierra Leone, found significant effect of calorie intake on household labour productivity. Also, increased nutrition is associated with sustained increments in productivity and thus, sustained access to food energy intake. Hence adequacy of food consumption is the ultimate index of food security. This adequacy is directly reflected in the adequacy of food nutrient intake. This is because the calorie consumed in a region is a reflection of the food security situation of an area. Furthermore, knowing the number of calories missing from the diets of undernourished people helps round out the picture of food deprivation in an area (FAO, 2000).

The household's calorie intake was obtained through the household's consumption and expenditure data. From the data the quantity of every food items consumed by the households in a given period of time (as provided by the households) was estimated. The quantities were converted to kilogramme and the calorie content was estimated by using the food conversion table of commonly eaten food in Nigeria (Appendix 1 and 4). Per adult equivalent calorie intake was calculated by dividing the estimated total household calorie intake by the household size after adjusting for adult equivalent using the consumption factors for age-sex categories (Appendix 2). To get the household's daily per adult equivalent calorie intake the

household's per adult equivalent calorie intake was divided by the number of days over which a given food item was consumed. A household whose daily per adult equivalent calorie intake was up to 2250 kcal was regarded as food secure and those below 2250 kcal were regarded as food insecure households as stated above.

Analytical Techniques

Probit Regression Model

Probit regression model was used in determining the factors affecting food security in the area. It measures the parameters of conditional probability of being food secure and the effect of the marginal changes in the explanatory variables on the food security status of households.

Structurally, the model is expressed as follows:

$$Fsi = \beta Qi + ei \quad \ldots\ldots (1)$$

Where:

Fsi = vector of food security status, Fsi = 1 if household is food secure i.e. if household per adult equivalent calorie consumption (X) was ≥ 2250 (L) Kcal, Fsi = 0 otherwise.
Qi = vector of explanatory variables
βi = vector of respective parameters
ei = independent distributed error term
X = actual calorie consumption per adult equivalent per day (kcal)
L = FAO recommended daily calorie consumption per adult equivalent per day (kcal)
The independent variables which are the household socio-economic and demographic characteristics were captured as:
Q1 = age of household head (years)
Q2 = gender of household head (Q2 = 1, if household head is male and zero otherwise)
Q3 = household size (adult equivalent)
Q4 = land ownership (Q4 =1, if household own the land cultivated and zero otherwise)
Q5 = number of livestock owned by the household (TLU)
Q6 = household per adult equivalent income per day (Naira)
Q7 = stock of home produced food per adult equivalent (kcal)
Q8 = years of formal education of household head (years)
Q9 = dependency ratio
Q10 = extent of produce commercialization (percent)
Q11 = household farm size (hectre)

RESULTS AND DISCUSSION

Of the eleven variables considered in the model, six were found to have a significant impact in determining household food security (Table 1). These are household size; TLU owned by the household, per adult equivalent daily income, quantity of home produced food, dependency ratio and household's output commercialization. Household size has a negative and significant effect on the probability of food security, implying that *ceteris paribus* the probability of food security decreases with family size. Each additional increase in household size reduces the probability of food security by 0.0608. The coefficient of number of livestock owned by the household has a negative sign (-0.0136) (which is contrary to expectations) and significant ($p<0.05$). The negative sign of the coefficient implies that *ceteris paribus* as the number of livestock owned by the household increases the probability of household food security decreases. This is contrary to results of earlier studies such as that of Kassa *et al.* (2002), Maharjan and Khatri-Chhetri (2006), Babatunde *et al.* (2007). The deterioration of household food security status as the number of livestock owned increases might be traceable to the fact, from an economic perspective, it is important to remember that hunger and food insecurity are, in most cases, not a supply problem but a demand problem, caused by lack of purchasing power. However, while livestock may not directly take food from those who currently go hungry, they do contribute to raising overall demand. This might be as a result of the recent trend towards more concentrate-based diets for livestock (FAO, 2009).

Table 1. Probit Regression Estimates for Determinants of Household Food Security Status in Borno State

Independent variables	Coefficients	SE	b/se	Significance
Constant	-0.3131	0.5705	-0.549	0.3832ns
Age of household head	0.0068	0.0072	0.945	0.3440ns
Gender of household head	-0.0662	0.3987	-0.0166	0.8682ns
Household size	-0.0608	0.0297	-2.2048	0.0406**
Household land ownership	0.2045	0.1688	1.2120	0.2257ns
TLU owned by the household	-0.0136	0.0065	-2.1110	0.0348**
Per adult equivalent daily income	0.0020	0.0007	2.877	0.0040***
Quantity of home produced food	0.0001	0.0000	3.558	0.0040***
Education of household head	0.0108	0.0129	0.835	0.4038 ns
Dependency ratio	1.0125	0.4158	2.435	0.0149**
Output commercialization	- 0.0261	0.0044	-5.5810	0.000***
Household farm size	0.0045	0.0473	0.0950	0.9244ns
Log likelihood	-230.61			
r^2	0.1945			
Prediction	79%			

Source: Computed from household survey data 2008/2009; Dependent variable: food security status; Asterisks ***indicates significant at 1 % level ** indicates significant at 5% level.

Household income per adult equivalent per day has a positive coefficient (0.0020) and significant ($p<0.01$). This indicates that, *ceteris paribus* the higher the household per adult equivalent daily income, the higher the tendency that the household would be food secure. This agrees with Babatunde *et al*. (2007), Titus and Adetokunbo (2007), Sheikh (2007), Amaza *et al.* (2009). Since most of these households depend heavily on their own production, increases in their full income may induce them to invest more in activities that will improve the overall productivity, leading to improvement in food availability. This does not singularly increase food availability, but leads the households to have surplus to sell. The income may also be used to purchase those foods, for which the household derives from the market, such as meat. Per adult equivalent aggregate production is positive and significantly related to the probability of household food security. The marginal effect of a unit increase in per adult equivalent aggregate production on the conditional probability of food security is 0.0001. This means that each unit increase (kcal) in per adult equivalent aggregate production improves the probability of food security by 0.0001.

The coefficient of dependency ratio is positive (1.01258) and significant at $p<0.05$. The positive coefficient implies that as the dependency ratio increases the probability of household food security status improves. This is however, contrary to expectations and contradicts earlier studies by Titus and Adetokunbo (2007). This might be as a result of engaging under aged children in economic activities (child labour) such as street hawking, farm labour among others which contribute to the household income and hence increased access to food.

Extent of household produce sold**:** This has a negative (-0.00261) coefficient (as expected) and it is significant at ($p<0.01$). The negative coefficient implies that all things being equal, as the households' sell more of their produce (both crops and livestock) the household food security status worsens. In other words, commercialization of household produce (under subsistence production) is detrimental to household food security. This is contrary to the assertion that commercialization is the only way out of poverty and food insecurity (Kurwijila, 2004; Mupawose, 2004). However, this might be traceable to the fact that most household in the study area produce mainly for home consumption but may be forced to sell these produce when there are pressures to spend on other household needs most especially on medical care, education and festivities at the expense of their food security.

Conclusion

Based on the finding of the study using probit regression model approach; the study thus, conclude that dependence ratio contribute positively to being food secure among house hold in Borno State, contradictory previous study by Titus and Adetokunbo (2007), whereas age of the house hold head, gender, land ownership, education and farm size does not contribute significantly to being food secure.

The probability of being food secured rather depend significantly, on Household Size, Tropical Livestock Unit (TLU) own by household, Per Adult Equivalently Daily Income, Quantity Home Produced Food, Dependent Ratio and Output (Home Produced) Commercialization whereas Dependency Ratio, Per Adult Equivalent Daily Income and Quantity of Home Produced Food contribute positively, meaning; a unit increase in any increases the probability of being food secured significantly; the Output (Home Produced) Commercialization, Tropical Livestock Unit (TLU) own by Household and Household Size contribute negatively, meaning; a unit increase in any decreases the probability of being food secured significantly.

Policy Implications and Recommendations

The results provide significant implication for food security in Borno State. No single policy can be prescribed for improving food security, instead mixed policies has to be followed. Based on the findings of the study, the following are possible areas of intervention to mitigate the problem of food insecurity of the households in the area. Increasing the productivity of food crops through the increased use of modern farm inputs such as fertilizers, improved seeds, pesticides herbicides etc, is an urgent need. Yield increases are feasible only through the increase in both labour and land productivity. Extension services input supply; remunerative prices, etc. have to be tailored to support this possibility. Improving agricultural productivity is a means of increasing both the physical availability of food and the income of food-insecure people. In this respect, it offers a key and direct ingredient in the quantity of home produced food (one of the factors important for achieving food security listed in Table 1.

Furthermore, Policies that will lead to increase in farm income should be the priority of government as the income level of the households is a significant determinant of household food security status in the state. The issue of child labour has to be seriously looked into in the State. This is because there appeared to be the use of under-aged children in economic activities in the area as revealed by the study.

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