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Factors influencing food insecurity among small farmers in Nigeria

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This study estimates a food insecurity index and examines the factors that influence food insecurity among small farmers in Nigeria. Data for the study were collected from 400 farming households in Osun area of the southwestern Nigeria. Descriptive statistics, a cost of calorie function (COC) and a Tobit regression model were used to analyze the data. A regression model made up of 15 regressors was specified. Eleven of the specified variables were found to have significant influence on food insecurity. A decomposition of the total elasticity change in the dependent variables shows that three of the variables are elastic. The results showed that food insecurity among farming households in south western Nigeria was influenced by agricultural production inputs, remittances received from external members of household, improved asset base and production capacity of the households.

Key words: Food insecurity, determinants, cost of calorie function (COC) function, Tobit, small farmers, Nigeria.

INTRODUCTION

Inadequate food supply is one of the most critical problems facing Nigeria. The agricultural sector has not been able to meet the demand for food. This is due to the fact that the Nigerian agriculture is still predominantly small scale, rudimentary and largely unmechanised characterized by subsistent to semi-commercialized production systems. Farmers' average holding is two hectares of land on scattered plots (Falusi and Olayide, 1980; CBN/NISER, 1992; Yusuf and Falusi, 2000; Adejobi, 2004; Amaza et al., 2008). Farmers operate at a low level of production with highly labour intensive technology. Hired labour costs constitutes over 60% of total cash costs of production with family labour representing over 75% of the supply of farm labour. The sector is further characterized by low fixed capital

investment with practitioners having a low level of literacy (Anthonio, 1967; Olayemi, 1980; Amaza et al., 2008). Little is known about the food situation of these farmers who are expected to bring the country out of her state of food insecurity to that of food security. Amaza et al. (2008) in a study to identify and analyze the food security measures of rural households in Borno State of Nigeria revealed that the major determinants of food insecurity in the study area are household size, gender, educational level, farm size and type of household farm enterprise. Nyangwesoi et al. (2007) in a study of household food security in Vihiga district of Kenya established that household income, number of adults, ethnicity, savings behaviour and nutrition awareness significantly influence household food security.

Similarly, Kohai et al. (2005) found that the significant determinants of food security in the Mwingi district of Kenya were participation of households in the food for work program, marital status of the household head and their educational level. Further more in a study of food security in the Lake Chad Area of Borno State, Nigeria, Goni (2005) reported that factors influencing household food security, included household size, stock of home produced food and number of income earners in the household. Olayemi (1998) in a study of food security in Nigeria categorized factors affecting food security at the household level into supply-side factors, demand-side factors and stability of access to food, which include: household food and non-food production variability; household economic asset; household income variability; quality of human capital within the households; degree of producer and consumer price variability and household food storage and inventory practices. Food security is a prerequisite to good health while a combination of the two is necessary for labour productivity bearing in mind that the majority of the farmers operate a highly labour intensive production technology. The World Health Organization (WHO) recommends a calorie intake of 2250 Kcal per adult per day for healthy living in the rural area. A farmer who consumes less than this is categorized as food insecure.

The issue of food insecurity is of great importance to Africa. In Nigeria it remains a fundamental challenge due to the fact that average calorie and protein intake is only at the threshold of adequacy. Estimates show that at least 41% of the population were food-insecure; with 16% being severely undernourished in year 1996 and that 58% of the sampled households were food insecure by headcount (H) in year 2008 (Olayemi, 1996; Amaza et al., 2008). The daily per capital calorie supply as a proportion of requirement was 90% in 1988-1990 and 85% in 1992-1996 (FOS, 1999). National food expenditure data show that almost two thirds of total expenditure in 1980 was on food while the diet comprised of 64% cereals and roots and tubers. This food share rose by about 10% points by 1985, but dropped during the period 1985-1992. In the subsequent four year period, 1992-1996, a further drop of 5% points took place. The figures were 63.4, 74.1, 72.8 and 63.6% for 1980, 1985, 1992 and 1996 respectively. The average household in the rural areas earned ₦5590.00 (FAO, 2000). At the world food summit in 1996, Nigeria along with 184 other countries made a commitment to reduce the number of chronically undernourished people by half by the year 2015 (FAO, 2002). Therefore, in order to formulate effective policies for reaching this goal, a thorough understanding of the causes of food insecurity is needed. Also, the process of identifying the food insecure as target groups and achieving a better understanding of the determinants of food insecurity as policy instruments for development planners is crucial for designing effective food security programmes.

This study estimates a food insecurity index and examines factors that influence food insecurity among farming households in South Western Nigeria.

CONCEPTUAL FRAMEWORK

The definition of food insecurity adopted in this paper is: A state of food insecurity exists when members of a household have an inadequate diet for part or all of the year or face the possibility of an inadequate diet in the future. In this concept, food insecurity is defined in terms of the household and it relates to both the current and future adequacy of the household diet. Following Truman and Daphine (1990) the concept of food insecurity can be expressed mathematically as:

$$FS = CS + F (R, I, HT) \tag{1}$$

Where: FS =Future State of Household Food Insecurity, CS = Current State of Household Food Insecurity, I = Food Insecurity Insurance, R=Food Insecurity Risks, HT = Household Type.

Equation (1) expresses the determination of the future state of food insecurity as an assessment of the current state of food insecurity and the likelihood of deviation from this state. This deviation is a function of food insecurity risks, food insecurity insurances and household types.

Current state of household food insecurity (CS)

This refers to the adequacy of the household's present food consumption. The assessment is based on both the quality and the quantity of the household's diet and should indicate if the household is in a state of food security or a state of insecurity. States of food insecurity may be defined in terms of types of food insecurity (e.g. temporary, cyclical, and chronic), levels of food insecurity (e.g. dietary intake as a percentage of an acceptable standard) or a combination of both (Truman and Daphne, 1990).

Food insecurity risks (R)

These refer to events that increase food insecurity and lessen household food consumption. This can be measured in terms of damage caused by these events and by the likelihood that these events will occur. Examples of such risks include: Food shortages prior to harvest, temporary marketing problems, wastages due to inadequate storage facilities, seasonal or unforeseen unemployment, exceptional increases in prices, civil strife, chronic poverty etc. (Truman and Daphine, 1990).

Food insecurity insurances (I)

These refer to actions, which decrease the likelihood that risky events happen, or their resulting damage. These may be actions taken by households, communities, or nation. Examples of such insurances include: Increasing employment opportunities, land reform, use of improved agricultural production techniques, local charity, supplementary feeding programs, and emergency food aid. As these examples indicate, many food insecurity insurances are provided through government policy interventions and programs.

Household type (HT)

This reflect the means and methods by which household acquire food for consumption. A household can be defined as a group of individuals who contributed to and shared a common economic resource base and relied on the income from that base for the greater part of their food acquisition and utilization (Alumira, 2002). Household type can be market-food-oriented or non-market-food-oriented. Market-food-oriented households are those that acquire the bulk of their food through the exchange of resources such as cash, services or goods. A non-market-oriented household acquires the bulk of its food supplies through home food production. Household type can also be defined by sources of income, percentage of market dependence, resource base, location such as rural or urban etc.

Data

This study was carried out under the rural livelihood study of the food and marketing policy unit of the International Institute of tropical Agriculture, Nigeria. Data for the study were collected through a survey of 400 farming households in Osun area of the southwestern Nigeria. The study area constitutes an important agricultural zone of the country. The predominant occupation over all the villages is farming. Close to 61% of the population regard farming as the main occupation. Farming activities take place round the year. They also engaged in trading, hunting, tailoring, teaching, civil service, food processing, artisan etc. Farmers in the study area are predominantly smallholders. Common to them is a small unit of production, which may not encourage modern agricultural technologies. About 65% of the farming households have less than 1 ha of farmland under cultivation while 29% cultivated between 1 and 2 ha. Those that cultivated more than 2 ha of land constitute 6%. The average farm size among the sampled farming households is 0.9 ha with 0.5 ha land holding being the most common. Data collection was accomplished with the aid of pre-tested structured questionnaires. Information sought included:

Socio-economic/Demographic data

The various socio-economic/demographic data are age, gender of household head, marital status, educational level of household head, household type (monogamous or polygamous) and household size. Others are occupational status of household head, total household income, non-farm income, types of production enterprises, possession of assets, loan/credit facilities, membership of cooperative societies, gender ratio, dependency ratio and source-of-income ratio.

Agricultural production data

Years of farming experience, total farm size, number of farm sites operated, types of crops grown/combination, farming systems, farm labour, access to farming input, labour utilization, quantity marketed, quantity consumed, quantity produced, land acquisition and on-farm expenses.

Household demand data

Total expenditure, food expenditure, non-food expenditure, quantity of food purchased and quantity consumed. Data collection also comprised of a set of core-module questions which works systematically together to provide a measurement tool for identifying, with considerable sensitivity, the level of severity of food insecurity/hunger experienced in a household. The questions covered three major areas relating directly or indirectly to food insecurity that is,

(i) Household food expenditures (actual, usual and least amount needed)
(ii) Coping behaviors to augment food supply from emergency sources (e.g. borrowing)
(iii) Direct indicators of food insecurity and hunger

METHODS OF ESTIMATION

The approach taken in this study for the determination of food insecurity followed the identification procedures. Identification is the process of defining a minimum level of nutrition necessary to maintain healthy living. This is referred to as the "Food insecurity Line (Z)" for the society under study, below which people are classified as food insecure subsisting on inadequate nutrition. Calorie adequacy was estimated by dividing estimated calorie supply for the households by the family size adjusted for adult equivalence using the consumption factors for age-sex categories (Runge-Metzger and Diehl, 1993). Table 1 presents the nutrition (Calorie) based equivalent scale as calculated from world health organization data (Stefan and Pramila, 1998):

Cost-of-calorie (COC) function

In order to measure the extent of food insecurity among the

Table 1. Nutrition (calorie) based equivalent scales.

Years of age	Men	Women
0-1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.70
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	1.14	0.86
18-30	1.04	0.80
30-60	1.00	0.82
60 above	0.84	0.74

Source: Calculated from world health organization data (Stefan and Pramila, 1998).

households, an index of food insecurity was constructed. The COC method proposed by Greer and Thorbecke (1986) was used in the study for its simplicity and ease of computation. In this procedure COC function of the following forms was estimated.

$$\ln x = a + bC \tag{2}$$

Where: x=food expenditure (=N=), C=calorie consumption (kcal)
The calorie contents of the recommended daily nutrients level (L) were used to derive the food insecurity line Z:

$$Z = e^{(a + bL)} \tag{3}$$

Where Z gives the cost of buying the minimum calorie intake (L) and L=Recommended daily energy levels (2250 kcal).

Food insecure households are defined as those with less than minimum intake of 2250 kilocalories, recommended by the FAO/WHO (1973). The nutrient composition of commonly eaten foods in Nigeria (Oguntona and Akinyele, 1995, Table 2) was used to estimate the calorie intake of households.

Tobit regression model

The relationship between rural food insecurity and various Socio-economic/demographic and farm specific variables has been examined. The Tobit model was employed to identify the factors influencing food insecurity and the intensity of food insecurity in the study area. It measures the parameters of the conditional probability of being food insecure. It also shows the effects of marginal changes in the explanatory variables on the food insecurity status of the households (Tobin, 1958; and McDonald and Moffit, 1980). Following McDonald and Moffit (1980) and Omonona (2001) the model can be expressed as:

$$F_{insi} = \beta Q_i + e_i \tag{4}$$

Where, $F_{insi} = 0$ for $x_i \geq Z$, and $F_{insi} = (Z − x_i)/Z$ for $X_I < Z$, Q_i = Vector of explanatory variables, β= Vector of respective parameters, e_i = Independent distributed error term, F_{insi}= Food insecurity index of household i (0-1), Z = Food insecurity line, x_i food expenditure (=N=) of household i.

The variables, which are the Socio-economic, demographic, agricultural production and household food demand variables, are captured as: Household size, Gender of household head (1, if male and 0, if female), Age of household head (years), Food allocation (as a % of total expenditure), Value of crop output (=N=), Total expenditure (=N=), Household net worth (=N=), Child dependency ratio (ratio of ages 0-14 to household size), Diversification extent (measured by Herfindah Index, Omonona, 2001; Adejobi, 2004), Remittances received (=N=), Inputs usage (=N=) (naira value of seeds used in production), Educational level of household head (number of years of formal Education), Membership of cooperative (1, 0), Farm size (hectare) and Fertilizer usage (=N=) (naira value of fertilizer used in production) respectively. Naira (=N=) is local currency in Nigeria. One USD = (=N=) 150 in 2009. The regression parameters and diagnostic statistics were estimated using the maximum likelihood estimation (MLE) technique of Limdep 7.0.

RESULTS AND DISCUSSION

Here presents the results of the determinants of food insecurity among the rural households in the study area. Based on the recommended daily energy level (L) of 2250 Kcal, the food insecurity line (Z) for the households was estimated at =N= 69.14 per day (=N= 2143.47 per month) per adult equivalent. Table 3 presents the summary statistics of food insecurity measurement in the study area.

Determinants of food insecurity in the study area

In estimating the determinants of food insecurity among the households, a regression model was specified. Eleven of the specified regressors were found to have significant influence on food insecurity and its intensity (Table 4). The result shows that sigma is 0.199387 with a p-value that is less than 0.01 hence sigma is statistically significant. The p-value signifies that the model displays a

Table 2. Nutrients composition of commonly eaten foods in Nigeria (Raw, processed and prepared).

Food item	Kcal/kg
Gari	3840
Cowpea	5920
Rice	1230
Soybean	4050
Melons (shelled)	5670
Groundnut	5950
Bread	2330
Sugar	3750
Orange	440
Mango	590
Powdered milk	4900
Agric egg	1400
Fish	2230
Meat	2370
Maize	4120
Okra	4550
Pepper	3930
Tomatoes	880
Plantain	770
Yam	3810
Cocoyam	3830
Cassava flour	3870

Source: Oguntona .E. B and Akinyele .I. O (1995).

Table 3. Summary statistics of food insecurity measurement.

Variables	Value
Cost –of – calorie equation	$\ln x = a + bC$
Constant	4.08
Slope coefficient	0.0006942
Adj R^2	0.04691
Recommended daily calorie intake (L)	2250 kcal
Food poverty line (Z): cost of recommended	₦ 69.14 per day
Calorie intake per adult equivalent	₦ 2143.47 per month

Naira (₦) is local currency in Nigeria. One USD = (₦) 150 in 2009.

good fit. Variables with significant coefficients include household size, household net worth, input usage, diversification extent, remittances received, total expenditure (proxy to income), food allocation as a percentage of total expenditure, value of crop output, fertilizer usage and child dependency ratio. It should be noted that a positive sign on a parameter indicates that higher values of the variable tend to increase the likelihood of food insecurity. Similarly, a negative value of coefficient implies that higher value of the variables would decrease the probability of food insecurity.

Total expenditure was used as proxy to income. The

negative and significant effect of the household income conforms to a priori expectation. This is because income levels determine the quantities of food that is consumed, the composition of the diet and access to social services, which have some link with the nutritional conditions of individuals. An increase in the level of household income increases the capacity of farming households to consume more, especially of foods that are not produced by the household. An increase in remittance received will have an effect that is similar to that of household income. Stable income increases the capacity of households to consume more. The regression coefficient of

Table 4. Factors influencing food insecurity and intensity of food insecurity in the study area.

Variable	Coefficient	Standard error	t-value	Elasticity of		
				Probability of food insecurity	Intensity of food insecurity	Total Elasticity
Constant	0.831243	8.48E-02	9.797***			
Gender of household head	-3.61E-02	6.17E-02	-0.585	-0.1899	-0.31058	-0.50049
Age of household head (yrs)	9.15E-04	5.69E-04	1.609*	0.235716	0.385509	0.621224
Educational level of household head (yrs)	-2.08E-04	2.01E-04	-1.035	-0.00813	-0.0133	-0.02143
Household size	2.00E-02	2.93E-03	6.814***	0.820636	1.342135	2.16277
Child dependency ratio	-0.15733	5.80E-02	-2.714***	-0.24562	-0.40171	-0.64733
Household net worth (₦)	-1.42E-06	4.28E-07	-3.326***	-0.22219	-0.36339	-0.58558
Farm size (hectare)	-1.76E-05	3.12E-05	-0.565	-0.00274	-0.00448	-0.00721
Input usage (₦)	-3.76E-05	1.21E-05	-3.099***	-0.1079	-0.17647	-0.28438
Diversification extent	2.37E-04	6.51E-05	3.646***	-0.0875	-0.14311	-0.23061
Remittance received (₦)	-6.14E-07	1.87E-07	-3.281***	-0.17254	-0.28218	-0.45472
Membership of cooperatives	-1.65E-02	2.42E-02	-0.682	-0.03104	-0.05077	-0.08181
Total expenditure (₦)	-3.66E-05	3.28E-06	-11.161***	-1.33466	-2.18281	-3.51748
Food allocation (%)	-1.09E-02	7.48E-04	-14.622***	-1.99878	-3.26896	-5.26774
Crop output (₦)	-7.38E-07	2.93E-07	-2.52***	-0.14174	-0.23181	-0.37355
Fertilizer (₦)	-1.32E-05	5.18E-06	-2.547***	-0.0974	-0.15929	-0.25669

Asterisks indicate significant at *** 1%, ** 5%, *10%, Dependent variable, Food Insecurity Index (0 to I). Sigma = .199387, P < 0.01, Log likelihood function, -29.74397, Source: Computed from field data.

household's net worth shows that ownership of some assets by farming households also significantly reduces food insecurity. The effect of the net worth of the households is evident in the fact that low level of initial wealth is detrimental to food production and agricultural development leading to inescapable burden or cycle of poverty. Initial wealth can be examined from the perspective of providing finance for maintaining and sustaining the production process such as hiring labour, purchasing fertilizer, storage and processing particularly where production is largely seasonal. Also in times of emergency, assets meet needs and in addition can be good collateral for loan. Better quality of farm inputs used in

production (e.g. improved seeds etc.), led to higher output thus, a reduction in food insecurity. Furthermore, food allocation constitutes higher percentage of total expenditure among food insecure households. The more the quantity of fertilizers used in crop production, the more the output thus, a reduction in food insecurity. Higher value of Child dependency ratio reduces food insecurity in the study area. This is due to the fact that child labour constitutes a major source of labour thus income to the households in the study area. Other variables that reduce food insecurity in the study area include educational level, farm size, and membership of cooperative societies. Though they are insignificant, the finding implied

that increases in the values of these factors decrease the likelihood of food insecurity. The hypothesis, that collectively the variables considered will have significant influence on food insecurity status of households was accepted at 1% significant level.

Elasticity of the determinants of food insecurity

A decomposition of the total elasticity change in the dependent variable shows that three out of the variables are elastic (Table 4). These are household size, total expenditure and food

allocation.10% change in household size leads to about 21.6% total elasticity change in the dependent variable. This is decomposed into about 8.2% in the probability of food insecurity and 13.4% in the intensity of food insecurity. Similarly a 10% change in total expenditure leads to about 35.2% change in total elasticity. This is also decomposed into about 13.4% in the probability of reduction in food insecurity and 21.8% in the intensity of the reduction. Furthermore, 10% change in food allocation leads to about 52.7% change in total elasticity. This is similarly decomposed into about 20.0% in probability of reduction in food insecurity and 32.7% in the intensity of reduction. The effect of the household size variable is more on the intensity of food insecurity while that of total expenditure and food allocation is more on the intensity of reduction. All other variables are inelastic with 10% change in the variables leading to less than 10% change in the dependent variable.

Conclusion

The results showed that food insecurity among farming households in south western Nigeria was influenced by agricultural production inputs, remittances received from external members of household, improved asset base and production capacity of the households. The findings presented in this study have implications for government policy towards food security. Interventions should include a component of which the objective is to increase the minimum level of subsistence production. Measures must be taken to improve the access of households to more complementary inputs so that the amount of food produced by the households could increase to a level above food insecurity.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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