AJFAND ONLINE
Volume 10 No. 1
January 2010
ISSN 1684 5374
AFRICAN JOURNAL OF FOOD AGRICULTURE NUTRITION AND DEVELOPMENT

EFFECTS OF TENURE AND LAND USE FACTORS ON FOOD SECURITY AMONG RURAL HOUSEHOLDS IN THE DRY SAVANNAS OF NIGERIA

Bamire AS*[1]

Adebayo Bamire

*Corresponding author email: abamire@oauife.edu.ng, asbamire@yahoo.co.uk

[1]Department of Agricultural Economics, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria

AJFAND ONLINE
Volume 10 No. 1
January 2010
ISSN 1684 5374
AFRICAN JOURNAL OF FOOD AGRICULTURE NUTRITION AND DEVELOPMENT

ABSTRACT

Defining food security in terms of availability and access to sufficient food to meet dietary needs for a productive and healthy life, this paper assessed the effects of property rights to land on household food security in the Savanna zone of northern Nigeria. The paper analyzed household expenditure profile, examined households' tenure and land use factors, determined the effect of these factors on household food security status, and predicted/classified households into food security groups based on these factors. Primary data were generated from a cross-section of 180 farming households during the 2006/2007 production season, using pre-tested structured questionnaire. Data were collected on tenure and land use characteristics, input-output relationships, cropping patterns, land improvement techniques, and on household expenditure and income. Focus group discussions and key informant interviews were also conducted. Secondary data were obtained from Local Government secretariats and the National Population Commission. Data were analyzed using descriptive statistics, probit regression and discriminant techniques. Results showed that the customary tenure arrangement is the most important way by which farm households gain access and manage land in the zone. On the average, households cultivated less than two hectares of land with less than two years of fallow. Inorganic fertilizer was the most commonly used land improvement technique by all households, but at rates below recommended dosage due to scarcity and high cost. Only 25% of the households were categorized as food secure and 75% as food insecure. Expenditure on food accounted for over 30% of total expenditure and was significantly higher for the food secure households. Probit estimates revealed that age, farm size, use of land improvement techniques, membership of association, and access to extension service were significant determinants of households' food security options, while these factors except age were identified as the most powerful discriminators and predictors of household's food security options using discriminant analysis, with 92.7% of the sampled households correctly and satisfactorily classified. This suggests that meaningful land intensification through proper management and effective extension service is the likely development pathway in the study area. In addition, the classification of households can support policy making strategies that target specific groups for government and non-government programme implementation.

Key words: land, food, households, savanna, Nigeria

INTRODUCTION

Agriculture has been a major contributor to Nigeria's economy for several decades, as it provides food for the people, raw materials for the agro-allied industries and earns foreign exchange for the economy [1,2]. However, rising population and industrialization have increased the pressure on land resulting in reduced farm outputs that is not sufficient to meet national food demand. The farming households also have to cope with food supply shortages, inefficient storage facilities, price fluctuations, and resource limitations for their farm production operations. This further creates gaps in resource availability among the poor. The impact of this is far-reaching in that the food situation gets worse; farms are being abandoned to the elderly or for off-farm jobs, while the income from off-farm activities is not enough to meet household needs [3,4,5]. This situation calls for guided change. Concern over the food security situation in sub-Saharan Africa as indicated in the Millennium Development Goals is to reduce the number of the food insecure by half by 2015. Given that land plays an important role in the livelihoods of the majority of rural households, food security and poverty reduction cannot be achieved unless issues of access to land, security of tenure and the capacity to use land productively and in a sustainable manner are addressed. IFPRI's report on Vision 2020 pointed out that food security solution that fails to address natural resource issues effectively would not be sustainable.

Defined in terms of availability and access to sufficient food and other basic needs to meet dietary needs for a productive and healthy life, food security is a fundamental objective of Nigeria's agricultural policy [6,7,8,9]. However, the widening degradation of agricultural land, coupled with the low adoption/use of environmentally friendly and socio-economically robust technologies among resource-poor rural households have created a serious gap in meeting this objective. It is important to note that the tenure terms upon which land is held define the use relations of the land to the farm as an economic unit and also the price or performance required for the use of the land [10,11,12]. Thus, farmers' socioeconomic conditions, land tenure and land-use are important factors in agricultural production [10,11]. In the past, traditional agriculture had been compatible with the level of population and the ecological environment with effective restoration of soil fertility through long fallow periods for the level of crop yields and cropping intensity. In the last three decades, the land tenure systems have been confronted with problems of fast population growth and competing economic uses of agricultural land and have resulted in reduced land: man ratio, reduced fallow periods and the intensification of land-use [2,13,14]. This has prompted changes in land tenure systems with increasing land fragmentation and rapid soil degradation resulting in reduced farm yield and income/ expenditure levels, as well as unsustainable use of the productive capacity of the land resource base. The reduced yield and income levels are capable of worsening the standard of living of the people.

Various studies have applied different analytical techniques to evaluate the determinants of food security, and these techniques determine to a large extent, the robustness of the statistical results. For instance, using the Logit model to analyze

food security measures in Borno state, Nigeria, over 58% of the sampled households were found to be food insecure, with household size, gender, educational level, farm size and type of enterprise being major determinants of food insecurity [15]. Analysing data from 74 households in Kwara state using food indices and descriptive statistics, more than 60% of the households were found to be food insecure [16]. Other studies [17,18,19,20,21] have employed different methodologies including participatory rural appraisal (PRA), descriptive and inferential statistics to show that between 50-80 percent of rural households were food insecure. Fragmentation of land as a result of population pressure, inadequate access to farm inputs, and limited access to labour-saving implements were identified as causes of food insecurity. While these studies addressed the issue of food security with variations in techniques and results, least attention was placed on the specific effects of tenure rights and land-use factors on food security. This paper, therefore, analyzed household expenditure profile for categorization into food security groups, examined households' tenure and land-use factors, determined the effect of these factors on their food security status, and predicted the classification of the rural households into food security groups based on these factors.

METHODOLOGY

The study area

The study was conducted in 4 Local Government Areas (LGAs) in the dry savanna zone of Nigeria. This zone, located in the northern part of the country, is the most extensive vegetation belt representing about 13% of total land area. Two seasons can be distinguished - the rainy season from May/June to September/October and a long dry season from October to May. As a lowland area (elevation < 800m), the mean annual rainfall is between 1200 and 1700 mm, with 150-200 days growing period and temperature range from 27-34^{o}C. Population densities range between 200 and 700 persons per square kilometer in the area [22]. The region is dominated by cereal-based traditional agricultural production systems and major crops grown include maize, soybean, sorghum and cowpea.

Data collection methods and sampling procedure

Primary and secondary data were used. Primary data were generated from a cross-section of 180 farming households using a pre-tested structured questionnaire. Data were collected for the 2006/2007 production period on households' tenure and land-use characteristics including their food and non-food expenditures, input-output relationships, and land improvement techniques. Focus group discussions (FGDs) were conducted in each LGA to complement data from the survey questionnaire. Each FGD comprised 12 participants, male and female, who were traders and farmers of different wealth categories. Key informants such as village heads, heads of farmers and zonal chairmen of the state's Ministry of Agriculture in the LGA provided information about the beliefs, attitudes and practices of the people. Personal observations were also made. Secondary data on population, and vegetation were obtained from the publications of State Ministries of Agriculture, Local Government secretariats and the National Population Commission. A multi-stage random sampling

technique was employed in selecting respondents for the study. In the first stage, the 4 LGAs notable for agricultural production, were purposively selected in the zone; 5 communities, and between 8 and 10 households per community were then randomly selected in each LGA. A total of 180 household heads were selected for the study.

Techniques of data analysis

Data were analysed with descriptive statistics, probit regression technique and discriminant analysis. Frequency counts, means and percentages were used to describe study variables, including household consumption expenditure. Both discriminant and probit techniques have been employed in different situations to analyse data with categorical dependent variables. The use of household consumption (by measuring total expenditure or mean expenditure) as indicators to identify food insecure households and individuals have been well documented [6,8,9]. The probit model was used in this study to analyse the determinants of household food security status, while discriminant analysis was used to predict membership in two or more mutually exclusive groups from a set of predictors, when there is no natural ordering on the groups. In this study, farm households can be predicted to be food secure or food insecure from the knowledge of their tenure and land-use characteristics (such as farm size, age, and cropping pattern).

Specification of the probit model

The probit model employed is based on utility theory, or rational choice perspectives on behaviour [23]. For instance, it assumes that whether the *i*th household is food secure or not depends on an unobservable utility index I_i (also known as a latent variable), that is determined by one or more explanatory variables. The larger the value of the index I_i, the greater the probability of a household being food secure and vice versa. The index is expressed as

$$I_i = \beta_1 + \beta_2 X_i \quad \text{……………………………..……………………..…… ……..} (1)$$

where X_i are the land tenure and land-use factors such as farm size, crop mix, and use of land improvement techniques and socioeconomic factors such as age, level of education, extension contact, access to market and membership of social organizations.

To obtain the index, I_i, a nonlinear estimating procedure based on the method of maximum likelihood is employed, such that hypothesis testing can be done via the likelihood ratio test [24,25,26].

The discriminant model

In order to build a predictive model of group membership based on observed characteristics of each case (food secure and food insecure households), the technique of discriminant analysis was employed. The maximum number of unique functions that can be derived is equal to the number of groups minus one or equal to the number of discriminating variables, whichever is less. The coefficients for the first discriminant function are derived so as to maximize the differences between the group

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

means [27,28]. The discriminant analysis generates functions from a sample of cases for which group membership is known; the function can then be applied to new cases with measurements for the predictor variables but unknown group membership. That is, knowing a household's land tenure and land-use characteristics, the discriminant function can be used to determine whether the household belongs to 'the food secure' group or 'the food insecure' group. The linear combination of the discriminating variables, called discriminant function, is expressed as:

$$D_i = \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \beta_4 Z_4 + ... + \beta_n Z_n \quad \text{..... (2)}$$

D_i = the value (score) on the canonical discriminant function for case *m* in the group *k*.
Z_i = the value on discriminant variable X_i for case *m* in group *k*; (X_1 = age of household head, X_2 = level of education, X_3 = tenure rights, X_4 = farm size, X_5 = household size, X_6 = use of land improvement techniques, X_7 = cropping pattern, X_8 = membership of association, and X_9 = access to extension service), and β_i = coefficients which produce the desired characteristics in the function. The variables with the largest standardized coefficients are the ones that contribute most to the prediction of group membership. The Wilks' Lambda (λ) is a statistical criterion that is used to add or remove variables from the analysis. At each step, the variable that minimizes the overall Wilks' Lambda is entered [29, 30].

The *a priori* expectation of study variables considers household consumption expenditure as a proxy for wealth [31]. This is because wealthy households have sufficient resources to absorb the costs and risks associated with production failure and to invest in technologies that can enhance their food production potential. It is the dependent variable, measured in Nigerian currency (Naira). The expected signs on the coefficients of tenure and land-use factors are shown in Table 3. For instance, various studies [31,32,33,34] have shown that the tendency to adopt a new technology increases as farm size expands. This is capable of increasing farm production and subsequently lead to food security, hence the expected positive sign on the coefficient of farm size.

RESULTS

Household consumption expenditure and food security status

The expenditure profile and food security status of sampled households are presented in Table 1. Households' total expenditure was ₦127,384.3 per annum during the period under study and food constituted the major item of consumption accounting for about 31% of total household expenditure. This was followed by expenditure on festivities, transportation and savings. Tobacco accounted for the least item of expenditure. Based on a mean of ₦9,098.9, households expenditure that are higher than the mean value were categorized as food secure while those below are food insecure. Only 25% of the households were categorized as food secure, while majority (75%) were categorized as food insecure.

Household land tenure and land-use characteristics

About 84% of farmland was acquired through inheritance, predominantly through undivided inheritance. Other forms of land acquisition in the study area included purchased, borrowed, pledged and leased in order of predominance. Respondents generally managed small farm sizes ranging from 0.2 to 6.0 hectares with an average of about 1.87ha. Short fallow duration of 1½years was noted, with 66% of the household heads indicating that their farmlands were being continuously cultivated through the years. Focus group discussion participants claimed that this was not the case some twenty years back when average fallow period was between 10 and 20 years.

Households in the study area are predominantly male dominated, with an active mean age of about 46years but majority (79.4%) with no formal education (Table 2). The average household size is 11 comprising mainly of male and female children as dependants, and are capable of increasing household consumption expenditure. More than 70% of the respondents in the study area are non-members of social organisations, and do not have access to extension service and credit facilities. Focus group discussion with the participants however, revealed that most beneficiaries received the credit facilities at odd times and, therefore, diverted its use to non-productive activities. The major social organisations were farmers' union, crop specific associations such as maize farmers, association, women special saving groups called *adache* and local cooperative societies. Friends/relatives, money lenders and cooperative societies constituted the major sources of credit to few (about 19%) of the households.

Of the three main land improvement techniques used in the study area, inorganic fertilizer was most predominant, followed by crop rotation and organic manure. However, inappropriate timing and a low rate of fertilizer application, (about 165kg/ha) mainly (NPK) 15:15:15 type was recorded. This falls short of the recommended dosage of 300-400kg/ha in the area, depending on crop type [35,36,37].

Determinants of households' food security status

The results from probit model estimates, including the computed elasticity at the mean values of the dependent and the independent variables, and the expected signs on the coefficients of the explanatory variables are shown in Table 3. The statistically significant likelihood ratio chi-square at 1% level shows that the model as a whole is statistically significant, as compared to models with no predictors. That is, the explanatory variables have a significant effect individually and jointly on the probability of choice [26,38]. Five variables: age, farm size, use of land improvement techniques, membership of association, and access to extension service were significant and had positive coefficients. The high percentage of right predictions obtained (78%) shows that the predicted outcome has maximum probability.

Classification of households into food security groups

The discriminant function generated from discriminant analysis to classify households into food security groups based on tenure and other land-use factors is shown in Table

4a. The F-test (Wilks' Lambda) of 0.981 shows that the discriminant model as a whole is significant, and with significant difference in the group mean of the dependent variable for each independent variable. This shows that the discriminant function is good for discriminating households into food security groups. This is further supported by the standardized canonical discriminant function coefficients which showed the relative importance of these variables in predicting a household's food security group. Farm size, land improvement techniques, membership of associations, and access to extension service significantly contributed to predicting the households into food security groups. Extension service recorded the highest coefficient followed by land improvement techniques, farm size, and membership of association, with the smallest coefficient of 0.09. A summary of the classification matrix using the weighted average of the two groups showed that food secure households were more accurately classified with 93.3% of the cases correct, while 92.6% of the food insecure households were correctly classified (Table 4b). Overall, 92.7% of the original grouped cases were correctly classified.

DISCUSSION

The categorisation of 75% of the respondents into food insecure group supports the findings of other studies [6,14,15,18]. The statistically significant difference in mean expenditure of the two groups of households suggests that food secure households enjoyed higher consumption expenditure than the food insecure. This, therefore, provides opportunities for them to meet other household requirements for better living conditions. The expenditure of the food secure households was significantly higher on food, transport, festivals, clothing, savings, gifts/donations and ceremonies in order of predominance. However, food insecure households recorded a significantly higher expenditure on tobacco. Though the mean expenditure of food secure households was significantly higher, food expenditure accounted for the largest component of total expenditure of the two groups of households. This implies that any developmental strategy targeted at meeting the food needs of the people will go a long way towards improving their living standard.

The analysis of tenure rights and land-use factors showed that the customary tenure arrangement was the most important way by which farm households gained access and managed land in the study area (see Table 2). This is capable of negatively affecting the productive investments on the farmland [13,32]. A common feature of the tenure system is that all eligible members of local lineage or kinship groups have assured access to at least some land. However, at the same time, full ownership rights over land traditionally reside with the king (*Emir)*, and individuals have a more restricted set of use, exclusion, and transfer rights over the land they farm as allocated by the village head (*Seriki*). The changing trend in land tenure systems and short fallow periods found in the study area were attributed to population pressure and the use of agricultural land for other national developmental programmes such as road construction. This supports the assertions of other studies that the changing pattern of land-use affects agricultural production efforts [3,11,14]. The shortened fallow periods over time and the continuous use of land by majority of the respondents

signified the intensification of land-use. Focus group discussion with participants revealed that this has affected the soil fertility status and consequently reduced crop yields and household income and expenditure levels. This, therefore, commands the use of land improvement techniques. In addition, farmers' claim of low rates of fertilizer use was adduced to its non-availability and high cost. Their experience overtime and belief that inorganic fertilizer promotes crop growth was the basis for their continued use of some quantity of fertilizer on the farm irrespective of the recommended dosage. The farmers engaged in crop rotation basically for investment diversification and soil fertility improvement; and not geared towards increased farm income. A similar reason was given for the predominance of mixed cropping practice in the area. Focus group discussion participants agreed that mixed cropping guarantees a level of food security while guiding against risks associated with farm production. Few respondents who had farms closer to the homestead used organic manure, mainly cow dung and poultry waste.

The low membership of respondents in social organisations and the inaccessibility to credit facilities could be attributed to inadequate extension agents that would have provided necessary advisory services to the farming households on appropriate use of various agronomic practices and the importance of associations. Focus group discussion participants revealed that Agricultural Development Programmes in the zone were the major source of extension service, but their effectiveness was limited by problems of infrastructural facilities (such as good roads and transportation) and inadequate staff strength.

The results of probit model that age, farm size, use of land improvement techniques, membership of association and access to extension service significantly and positively influenced household food security options were consistent with the hypothesized relationships. This implies that the food security status of a household is enhanced for every unit increase or improvement in these variables. For instance, the coefficient of farm size was 0.07 units to two decimal places. This shows that a one-unit increase in farm size results in a 0.07 standard deviation increase in the predicted probit index of rural farm households. In other words, a one-unit increase in farm size increases the probability of a household being food secure by 0.07 units. This suggests that increasing the land holdings of farm households in the study area is capable of improving their food security situation. This is corroborated by findings that large farm sizes may be a proxy for access to credit and other inputs that are likely to increase agricultural productivity [32]. However, in view of the contending pressure of population and the use of land for other economic purposes, the appropriate use of land improvement technologies may be a workable alternative in the area. This is also supported by the estimates obtained for use of land improvement techniques which shows that as farm households change their attitudes from non-use towards the use of land improvement techniques, their food security situation improves by 0.20 standard deviations. Also, with a mean age of 45.7, a one-unit increase in farmers' age will increase their chances of being food secure by 0.01 units. Focus group discussion participants adduced this to the active nature of most farmers and their readiness to adopt new technologies that can enhance their farm production efforts. The coefficient

for membership of association and extension service showed that these variables increase the predicted probit index by 0.14 and 0.10 standard deviations, respectively. This further corroborates the findings from other studies [13,20].

Though not significant, the negative coefficient of tenure status may be associated with the undivided inheritance pattern of land acquisition by majority of households. This does not encourage investment in land improvement techniques [39]. Where plots are divided, population pressure results in small average land holdings, which are cultivated almost on a continuous basis. These observations were supported by FGD participants.

The results of discriminant analysis indicating a positive significant influence of farm size, land improvement techniques, membership of association, and access to extension service imply that these variables are the most powerful discriminators that can be used to predict households into food security groups in the study area. Thus, using the discriminant function developed from the analysis of land tenure and use factors is a successful approach for predicting household membership of food security groups. In this regard farm size, use of land improvement techniques, membership of association and access to extension service are important variables that allow for discrimination and prediction of households into food security groups.

CONCLUSION

Based on the findings of this study, food expenditure has been found to account for the largest component of total household expenditure in the study area. This suggests that any developmental strategy aimed at improving food production in the area will improve the livelihood of the people. Farm size, farmer's age, use of land improvement techniques, membership of association, and access to extension service are important determinants of household food security status that have to be taken into consideration by governments and development agencies wishing to promote the food security status of households in the study area. For instance, the farming households are capable of benefiting from economies of scale by increasing their landholdings. However, the increasing man-land ratio resulting from population pressure suggests that meaningful intensification associated with proper land management is the likely development pathway. In addition, farmers need be enlightened, through intensified and vibrant extension services, on good agronomic practices and on the appropriate use of farm resources, and the importance of using credit for productive purposes rather than diverting such opportunities to unintended uses. This could be achieved by encouraging farmers to be members of associations through which adequate training opportunities could be made possible.

Also, classifying households into food security groups supports strategic policy making. Therefore, access to extension service, membership of associations, farm size and use of land improvement techniques are the most powerful variables in categorizing households into food security groups. This will streamline the activities of governmental and non-governmental food policy programmes in targeting specific

group of households for programme implementation. The findings of this study thereby provide strategies aimed at improving the food security conditions of farm households. However, food security is a multifaceted concept, and cannot be treated in isolation from other indices of living standards. Therefore, efforts geared towards achieving food security should also address other areas of human and infrastructure development.

ACKNOWLEDGEMENTS

The author expresses gratitude to UNU-INRA's support for this study. The farmers who provided information used in this paper as well as the Obafemi Awolowo University, Ile-Ife, Nigeria which provided the enabling environment for the conduct of this study are highly appreciated.

Table 1: Household expenditure profile by food security status

S/No	Item	Mean expenditure per annum (₦)			Level of significance (5%)
		Whole sample (n=180)	Food secure households (n=45)	Food insecure households (n=135)	
1	Food	39,500.7(3084.74)	54,397.8(4904.20)	28,382.5 (2842.76)	S
2	Rent	5,800.4(894.43)	5764.7(970.14)	6000.10 (680.04)	NS
3	Clothing	10,406.3(8152.15)	15,444.4 (9840.91)	9,830.26 (6636.51)	S
4	Transportation	12,160.2(1724.83)	22,852.6 (1960.69)	17,073.75 (878.71)	S
5	Electricity	1,769.1(259.44)	1,787.2 (361.3)	1,701.3 (159.45)	NS
6	Water	1,000.0 (0.013)	1,130.2 (0.04)	901.0 (0.003)	NS
7	Education	7,325.0(193.57)	7,430.0 (234.4)	7,304.3 (171.08)	NS
8	Health care	7,347.8(502.86)	7,492.3 (697.76)	7,265.7 (345.71)	NS
9	Savings	10,640.4 (573.09)	12,870.5 (612.45)	10,003.0 (434.07)	S
10	Festivals	15,620.1(3141.78)	18,688.9(4394.90)	11,622.5(1097.02)	S
11	Ceremonies	4,238.0(4245.28)	4,470.3(5114.14)	3,985.0 (3606.98)	NS
12	Tobacco	199.5(94.78)	150.9 (67.55)	226.8 (97.53)	S
13	Social Associations	3,281.2 (256.12)	3,470.0 (197.01)	3,193.3 (268.20)	NS
14	Gifts/Donations	8,095.6 (773.39)	9,050.0 (1201.02)	5,721.2 (911.27)	S
15	Total household expenditure (₦)	127,384.3(8,013.04)	142,525.6(9790.81)	92,640.6 (7268.43)	S
16	Mean expenditure	9,098.9	14,252.6	8,421.9	S
17	Food expenditure as % of total expenditure	31.0	38.2	30.6	S
8	N (%)	100.0	25.0	75.0	

1US$ = 128 Nigerian Naira (₦)

Table 2: Summary of households' tenure and land-use characteristics

Item	Whole sample (n=180)	Food secure households (n=45)	Food insecure households (n=135)	Significance level (5%)
Gender (% male)	92.2 (0.269)	95.5 (0.208)	91.1 (0.286)	S
Mean farm size (ha)	1.87 (0.063)	1.92 (0.071)	1.85 (0.066)	S
Mean age of household head (years)	45.7 (15.43)	46.044(15.53)	45.615 (15.45)	NS
Mean fallow duration (years)	1.5 (0.411)	1.2 (0.489)	1.8 (0.384)	S
Mean household size (#)	11.4 (3.49)	11.356 (2.99)	11.459 (3.65)	NS
Level of education (% literate)	20.6 (0.405)	22.2 (0.420)	20.0 (0.401)	NS
Access to extension service (%)	9.0 (0.285)	13.3 (0.344)	7.4 (0.263)	S
Membership of association (%)	29.4 (0.457)	35.6 (0.484)	27.4 (0.448)	S
Inheritance land acquisition (%)	92.8(0.260)	95.6 (0.208)	91.9 (0.275)	NS
Land improvement techniques (%):				
Mixed cropping pattern (%)	96.1 (0.194)	97.8 (0.149)	95.6 (0.027)	NS
Inorganic fertilizer	67.8	66.7	68.2	S
Organic manure	3.3	2.2	3.7	NS
Crop rotation	28.9	31.1	28.2	S

Figures in parentheses ( ) are standard deviations

Table 3: Probit estimates of the determinants of household food security status

Probit Parameter		Expected sign	Estimate	Std. Error
Age of household head (years)(X_1)		±	0.014*	0.002
Level of education (literate 1, 0 otherwise)		+	-0.060	0.062
Tenure security (inheritance/purchase 1, others 0)		+	-0.138	0.085
Farm size (ha)		+	0.069*	0.014
Household size (#)		±	0.067	0.108
Land improvement techniques (use 1, non-use 0)		+	0.196*	0.072
Cropping pattern (mixed 1, mono 0)		+	0.057*	0.112
Membership of association (yes 1, no 0)		+	0.143*	0.052
Extension service (yes 1, no 0)		+	0.098*	0.043
Intercept			-3.105*	0.195
Chi-Square Tests (Pearson Goodness-of-Fit Test):	χ^2	1.795E16		
	df[c]	166		
	Sig.	0.000		
Percentage of right predictions		78.0		
Total number of iterations		5		

Grouping variable: Households' mean expenditure
*Significant at 5% level.

Table 4a: Discriminant analysis and household classification into food security groups

Parameters	Discriminant coefficients
Age of household head (years)(X_1)	0.034
Level of education (literate 1, 0 otherwise)	0.280
Tenure security	0.476
Farm size (ha)	0.154*
Household size (#)	-0.164
Land improvement techniques (use 1, non-use 0)	0.414*
Cropping pattern (mixed 1, mono 0)	0.236
Membership of association (yes 1, no 0)	0.088*
Extension service (yes 1, no 0)	0.521*
Wilks' Lamda	0.981
Chi-Square (χ^2)	203.909

* Significant at 5% level of probability

Table 4b: Summary of classification results from discriminant analysis

Actual Group	No. of cases	Predicted Group Membership	
		1	2
Group 1 – Food security	45	42	3
		(93.3%)	(6.7%)
Group 2 – Food insecurity	135	10	125
		(7.4%)	(92.6%)
Percent of "Grouped" cases correctly classified 92.7%			

REFERENCES

1. **FAO.** Food and Agriculture Organization. Declaration on World Food Security and World Food Summit Plan of Action, FAO document, Rome, 1996.

2. **FGN.** Federal Government of Nigeria. Millennium Development Goals Report, Abuja, 2004.

3. **Aina TA and AT Salau** The challenge of sustainable development in Nigeria. Nigerian Environmental Study/ Action Team (NEST), 1992; 1– 6.

4. **Bamire AS and YL Fabiyi** Economic implications of property rights on smallholder use of fertilizer in southwest Nigeria. *Land Reform, Land Settlement and Cooperatives,* 2002; **2**: 86-92.

5. **FAO.** Food and Agriculture Organization. The State of Food Insecurity in the World. FAO, Rome, 2003.

6. **Chung K, Haddad L, Ramakrishna J and F Riely** Identifying the food insecure, the application of mixed-method approaches in India, International Food Policy Research Institute, Washington, D.C., 1997.

7. **Smith LC and L Haddad** Explaining child malnutrition in developing countries: A cross- country analysis, International Food Policy Research Institute (IFPRI), Washington, D.C., 2000.

8. **Pinstrup-Andersen P, Pandya-Lorch R and MW Rosegrant** Global food security: A review of the challenges, in the *Unfinished Agenda*, perspectives on overcoming hunger, poverty, and environmental degradation. Pinstrup-Andersen P, Pandya-Lorch R (eds), pp. 7-17, 2001.

9. **Smith LC, Alderman H and D Aduayom** Food security in sub-Saharan Africa, new estimates from household expenditure surveys, Research Report No. 146, International Food Policy Research Institute, Washington, D.C., 2006.

10. **Famoriyo S** Land Tenure and Agricultural Development in Nigeria, Ibadan University Press, Nigeria, 1979.

11. **Fabiyi YL** Land administration in Nigeria: Case studies of the implementation of the land use decree (Act) in Ogun, Ondo and Oyo States of Nigeria. *Journal of Agricultural Administration* (UK), 1984; **16(1)**: 21-30.

12. **Parsons KH** The land tenure problem in Nigeria. A.I.D. *Spring Review of Land Reform,* 1970; **2(9)**: 4-7.

13. **Adesina A, Chianu J and D Mbila** Property rights and alley farming technology adoption in West and Central Africa. Paper presented at the

workshop on property rights, collective action and technology adoption, ICARDA, Aleppo, Syria, 1997.

14. **Awe OA** Soil fertility management using organic fertilizers and low-external-input techniques. Paper presented at the national workshop on soil conservation and soil fertility management for sustainable rural development, Owerri, Imo state, Nigeria, 1997.

15. **Amaza PS, Umeh JC, Helsen J and AO Adejobi** Determinants and Measurements of Food Insecurity in Nigeria: Some Empirical Policy Guide, Annual Meeting of International Association of Agricultural Economists, August 12-18, Queensland, Australia, 2006.

16. **Muhammad-Lawal A and OA Omotesho** Cereals and farming households' food security in Kwara State, Nigeria. *Agricultural Journal* **3(3):** 235-240, 2008.

17. **FAO.** Food and Agriculture Organization. Participatory rural appraisal on household food security and nutrition, Kano State, Nigeria. *Summary Report*, FAO/TCP/NIR/4555 (T), Rome, 1997.

18. **Okorie P** Prospects of food self reliance. In perspectives of food security in eastern Nigeria. Doppler W and S Bauer (eds.), *Farming and Rural Systems Economics*, Vol. 46. Weikersheim, 2002.

19. **Okuneye SA** Rising cost of food prices and food insecurity in Nigeria and its implication for poverty reduction" *CBN Economic and Financial Review* **39(4)**: 1-14, 2002.

20. **Akinsanmi A and W Doppler** Socio-economics and food security of farming families in south east Nigeria. Tropentag 2005, Stuttgart-Hohenheim, Conference on International Agricultural Research for Development, October 11-13, 2005.

21. **Oyefara Jl** Poverty, food insecurity and HIV/AIDS pandemic: evidence of relationship from reproductive behaviour of commercial sex workers in Lagos metropolis, Nigeria. A paper presented at the International Conference on HIV/AIDS, food and nutrition security, organized by International Food Policy Research Institute, Durban, South Africa, April 14-16, 2005.

22. **Kamara AY, Kureh I, Menkir A, Kartung P, Tarfa B and P Amaza** Participatory on-farm evaluation of the performance of drought-tolerant maize varieties in the Guinea savannas of Nigeria. *Journal of Food Agriculture and Environment*, 2006; **4(1)**: 192-196.

23. **McFadden D** Conditional logit analysis of qualitative choice behaviour. In P. Zarembka (ed.), Frontiers in Econometrics, Academic Press, New York, 1973.

24. **Maddala GS** Limited Dependent and Qualitative Variables in Econometrics, Cambridge University Press, New York, 1983.

25. **Pindyck RS and DL Rubinfeld** Econometric Models and Economic Forecasts. McGraw-Hill International Editions, New York, 1997.

26. **Gujarati DN** Basic Econometrics, Tata McGraw-Hill Publishing company Limited, New York, 2006.

27. **Klecka WR** Discriminant analysis, quantitative applications in the social sciences series, No. 19, Thousand Oaks, CA: Sage Publications, 1980.

28. **ISS.** Information Systems and Services. University of Newcastle upon Tyne, NE1 7RU, United Kingdom, 2005.

29. **Huberty CJ** Applied Discriminant Analysis. NY: Wiley-Interscience, Wiley Series in Probability and Statistics, 1994.

30. **Tabachnick BG and SF Linda** Using Multivariate Statistics, Fourth ed. Boston: Allyn and Bacon, 2001.

31. **Polson RA and DSC Spencer** The technology adoption process in subsistence agriculture: The case of cassava in South Western Nigeria. *Agric. System*, 1991; **36**: 65-77.

32. **Feder G, Just RE and D Zilberman** Adoption of agricultural innovations in developing countries: A survey. *Economic Development and Cultural Change*, 1985; **33(2**): 255-298.

33. **Norris PE and SS Batie** Virginia farmers' soil conservation decisions: An application of Tobit analysis. *South J. Agric. Econs*. 1987; 19: 79-89.

34. **Akinola AA** An application of the probit analysis to the adoption of the tractor hiring service scheme in Nigeria. *Oxford Agrarian Studies*, 1987; **16**: 70-82.

35. **Aduayi EA** Making the soil nutritious to plants. Inaugural Lecture Series No. 78, Obafemi Awolowo University Press, Ile-Ife, Nigeria, 1985.

36. **IART.** Institute of Agricultural Research and Training, The fourteenth package of recommendations for food crops and livestock production in Southwestern Nigeria. Federal Ministry of Science and Technology, Moore Plantation, Ibadan, Nigeria, 1991.

37. **OSSADEP.** Osun State Agricultural Development Programme. A report of crop area and yield survey, Planning, Monitoring and Evaluation Department, Osun State, Nigeria, 1996.

38. **McLachlan GJ** Discriminant Analysis and Statistical Pattern Recognition. NY: Wiley-Interscience, 2004.

39. **Manyong VM and AV Houndekon** Land tenurial systems and the adoption of mucuna planted fallows in the derived savannas of West Africa. Paper presented at the workshop on property rights, collective action and technology adoption, ICARDA, Aleppo, Syria, 1997.