Determinants of Land Management Practices among Food Crop Farmers in North Central Nigeria

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Abstract
The study examines the factors influencing the use of Land Management practices among food crop farmers in North central, Nigeria. In so doing, Data were collected using a multistage sampling technique for the selection of states, local governments, communities/ villages and lastly farming household heads. Out of 400 questionnaire administered, only 345 with useful information were used for the analyses. Factors influencing the use of land management and conservation practices by the farming household head were determined using multinomial logit model. Variables that significantly explain the use across different land management practices at different levels of significance were age of household head, levels of education, household size, value of livestock owned, off farm income, tenancy security, farm size, distance from plot to residence, distance from plot to the nearest market and distance from plot to all weathered road. Findings emanating from this study show that both traditional and modern land management practices coexist with the sampled household head giving multiple responses to their use. Classification under a particular land management practices implies the one that the household head has preference for, the determinants of which are combination of human, physical and financial capitals, others include parcel/ plot level factor as well as institutional factors.
Keywords: Determinants, Land management, food crop farmers, North Central Nigeria

1. Introduction

Land is an important resource in farming. Recent estimates indicate that nearly 2 billion hectares of land worldwide – an area twice the size of China – are already seriously degraded, some irreversibly (FAO, 2010). About 16%, representing over 494.2 million hectares of land is degraded in Africa with an annual monetary value of lost production through land degradation of $65 million (Ezeaku and Davidson, 2008). Land degradation (in the form of erosion in particular) has greatly affected commercial agriculture and the environment in Nigeria. Some communities in the country have had over 10% of their land mass wasted by erosion and still stand the chance of losing more of their cultivable land in the nearest future (Titilola *et al.*, 1990).

Efforts have been made to reverse the ugly trend of land degradation. However, most public intervention on soil conservation and land management practices in developing countries especially Nigeria has performed below expectation (Fameso, 1992). The reasons for this low performance could be traced to the nature of soil conservation technologies introduced (Anande-Kur, 1986) and socioeconomic conditions of the users of the technologies among other factors (Jansen *et al.*, 2006; Bravo-Ureta *et al.*, 2006). Such series of uncoordinated attempts to address the problem of land degradation and soil depletion in Nigeria since 1950 includes; the tree planting and mechanical devices of erosion control legislation of 1950; the setting up of an inter-ministerial committee on soil conservation and erosion control in 1984; the inauguration of national task force on soil conservation and erosion control in 1986; the commissioning of a multi-disciplinary soil conservation and erosion control project supported by EEC linkage p rogramme in 1989, the introduction of mulching and zero tillage methods as well as alley cropping by International Institute of Tropical Agriculture (IITA) (Rahji, 2005).

Projected reductions in crop yields as a result of land degradation in some Sub-Sahara African countries could be as much as 50 percent by 2020, while crop net revenues could fall by as much as 90 percent by 2100, with small-scale farmers being the most affected (Woodfine, 2009). This will inevitably affect food security adversely. Thus, combating land degradation has become an urgent priority in global efforts to encourage commercial farming and ensure food security of millions of people.

Sequel to this, the United Nations Convention to Combat Desertification (UNCCD) came by March 2002 with the recommendation that the development and use of sustainable land management practices is one of the major solutions to combating the problem of land degradation and sustaining commercial arable farming (WMO, 2005). It is therefore pertinent to identify the social, human, financial and physical capitals, plot level characteristics as well as institutional factors influencing the use of soil conservation practices in this region with a view to proffering solution to overcome the obstacle.

Analytical models widely used to assess adoption/use of conservation technologies include binary probit or logit models (Babalola and Olayemi 2013; Simeon *et al.*, 2013; Boundeth *et al.*, 2012; Ezekiel *et al.*, 2012; Raufu and Adetuji 2012; Awoyinka 2009; Jansen *et al.*, 2006; Adeoti and Adewusi 2005), using such bivariate models excludes useful economic information contained in the interdependent and simultaneous adoption decision (Birungi 2007). It is therefore important to treat use of soil conservation measures and soil nutrient enhancing technologies as multiple-choice decisions simultaneously made. In this study, and as adopted by (Birungi 2007;

Akinola *et al.,* 2011 as well as Ayuya *et al*., 2012) farmers' use of land management practices was modeled using the multinomial logit model (MNL) because of its computational simplicity in calculating the choice probabilities that are expressible in analytical form. This model provides a convenient closed form for underlying choice probabilities, with no need of multivariate integration, making it simple to compute choice situations characterized by many alternatives. The main limitation of the model is the independence of irrelevant alternatives (IIA) property, which states that the ratio of the probabilities of choosing any two alternatives is independent of the attributes of any other alternative in the choice set (Hassan and Nhemachena 2008).

Studies like this have been carried out in Nigeria; most of who were concentrated in the southern part of the country; Babalola and Olayemi (2013) in Ogun State, Awoyinka (2009) in Ekiti and Osun State, Adeoti and Adewusi (2005) in Oyo State, Rahji (2005) in Oyo State. There is dearth of information in this direction in the Northern part despite the fact that farmers in the zone have to contend with the threat of desertification (Akinyosoye 2000). It is based on this that this study attempt to examine those factors that affects the choice of land management practices in North Central Nigeria.

2. Materials and Methods

2.1 Area of Study

The study was carried out in the North Central Nigeria which serves as a gateway between the Northern and Southern part of the Country. The selection of the study area was based on the criteria that the area is prone to nutrient mining as a result of intensive cultivation practices. The zone comprises Kwara, Kogi, Niger, Benue, Nassarawa, Plateau States and the Federal Capital Territory (FCT) representing about 13% of the land mass in the country (Manyong *et al*., 2001), with an estimated population of 20,266,257 (NPC 2006). The zone is located between Latitude 11^0 07 and 13^0 22 North and Longitude 06^0 52 and 09^0 22 East of Greenwich meridian. Two seasons can be distinguished – the rainy season from May to September/October and a long dry season from October to May. Temperature during the rainy period is between 27.0-34.0^0C (maximum) and 18.0-21.0^0C (minimum). Soil in the zone have sandy loam to clay loam textured topsoil with a pH of 5 to 7 and an organic carbon content ranging between 0.5 and 1.5%. The soil properties as described by (Norman *et al*., 1982) are leached ferruginous tropical soil, the surface soil is reddish fine loam clay to sandy loam. Among the states in the zone, two states were randomly selected namely Benue and Kogi states.

2.2 Sampling Technique and Data Collection Method

The study population was crop farmers living in the study area; the data used were collected from the 2012 production season. A multistage sampling technique was used in the study. The first stage was the selection of Benue and Kogi states from the states in the North Central geopolitical zone; the second stage was the random selection of four (4) local government areas from each of the state, the third stage was the random selection of twelve (12) communities/ villages from each of the state, with the number of communities/villages selected from each local government based on probability proportion to the number of communities / villages in each local government. The last stage was the proportionate selection of the farmers from the selected villages/ communities. A total of 400 questionnaire were administered with only 345 returned with useful information that could be used for the analysis.

3. Method of Data Analysis

3.1 Multinomial Logit Model

In this study, farmers' use of land management practices was modeled using the MNL model following (Birungi 2007; Akinola *et al.,* 2011 and Ayuya *et al*., 2012). The different land management practices available to farmers in the study area in line with (Ayodele *et al*., 2012) were; organic manure, bush fallow, crop rotation, inorganic fertilizer, alley cropping, cover crop, and mulching are classified as the dependent variables. It is supposed that the dependent variables Y_{it} can take on one of j categories 1, 2, -----, k (different land management practices).

Use of soil conservation and nutrient enhancing technologies by households can be evaluated on the basis of alternative decision choices, which can easily be linked to utility. According to Greene (2000), the unordered choice model could be motivated by a random utility framework, where the i^{th} household faced with j technology choices, the utility of technology choice j is given by

$$U_{ij} = \beta'_j X_{ij} + \varepsilon_{ij} \quad \ldots\ldots (1)$$

where U_{ij} is the utility of household i derived from technology choice j, X_{ij} is a vector of factors that explain the decision made, and β'_j is a set of parameters that reflects the impact of changes in X_{ij} on U_{ij}. The disturbance term ε_{ij} are assumed to be independently and identically distributed. If farmers choose technology j, then U_{ij} is the maximum among all possible utilities. This means that

$$U_{ij} > U_{ik}, \ \forall ik \neq j \quad \ldots\ldots (2)$$

where U_{ik} is the utility to the i^{th} farmer of technology k. Equation 2 means that when each technology is thought of as a possible adoption decision, farmers will be expected to choose a technology that maximizes their utility given available alternatives (Birungi 2007). The choice of j depends on X_{ij} which includes aspect specific to the household and plot and among other factors. Following (Greene 2000), if Y_i is a random that indicates the choice made, then the multinomial logit form of the multiple choices problem is given by:

$$\text{Prob}(Y_i=j) \quad \frac{e^{\beta'_j X_{ij}}}{\sum_{j=1}^{j} e^{\beta j' X_{ij}}} . j = 0,1,2 \ldots\ldots\ldots j \quad \ldots\ldots(3)$$

Estimating equation 3 provides a set of probabilities for j+1 technology choices for a decision maker with characteristics X_{ij}. The equation can be normalized by assuming that β = 0, in which case the probabilities can be estimated as

$$\text{Prob}(Y_i = j) = \frac{e^{\beta'_j X_{ij}}}{1+\sum_{k=1}^{j} e^{\beta'_j Z_{ij}}} \quad \text{and} \ldots\ldots(4)$$

$$\text{Prob}(Y_i = O) = \frac{1}{1+\sum_{j=1}^{j} e^{\beta'_j X_{ij}}} \quad \ldots\ldots(5)$$

Normalizing on any other probabilities yields the following log- odd ratios

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = X'_i(\beta_j-\beta_k) \ldots\ldots(6)$$

In this case, the dependent variable is the log of one alternative relative to the base/ reference alternative.
The coefficients in a multinomial logit model are difficult to interpret, so the marginal effects of the explanatory variables on the choice of alternative management strategies are usually derived as (Green, 2000):

$$M_j = \frac{\partial P_j}{\partial X_i} = P_j\left[\beta_j - \sum_{k=0}^{j} P_k K_k\right] = P_j\left[\beta_j - \bar{\beta}\right] \ldots\ldots(7)$$

The sign of these marginal effects may not be the same as the sign of respective coefficients as they depend on the sign and magnitude of all other coefficients. The marginal probabilities measure the expected change in the probability of a particular choice being selected with respect to a unit change in an independent variable (Long, 1997; Greene, 2000). Also important to note is that in a multinomial logit model, the marginal probabilities resulting from a unit change in an independent variable must sum up to zero, since the expected increases in marginal probabilities for certain options induce a decrease for the other options within a set. In this case, the choice of land management practices is then modeled as a function of social, human, financial and physical capitals, plot level characteristics as well as institutional factors. This can be presented as a general form equation:

$Z_{it} = f(X_i)$ ……(8)

Where Z_{it} takes on values 1, 2… k, if individual i chooses alternative j

The MNL model is however operationalized empirically with the following equations.

$Z_{ot} = \alpha_o + \beta_{10}X_1 + \beta_{20}X_2 + \text{-----------} + \beta_n X_n + \varepsilon_1$ ……(9)

$Z_{1t} = \alpha_1 + \beta_{11}X_1 + \beta_{21}X_2 + \text{-----------} + \beta_n X_n + \varepsilon_1$ ……(10)

$Z_{2t} = \alpha_2 + \beta_{12}X_1 + \beta_{22}X_2 + \text{-----------} + \beta_n X_n + \varepsilon_1$ ……(11)

$Z_{3t} = \alpha_3 + \beta_{13}X_1 + \beta_{23}X_2 + \text{-----------} + \beta_n X_n + \varepsilon_1$ ……(12)

$Z_{4t} = \alpha_4 + \beta_{14}X_1 + \beta_{24}X_2 + \text{-----------} + \beta_n X_n + \varepsilon_1$ ……(13)

$Z_{5t} = \alpha_5 + \beta_{15}X_1 + \beta_{25}X_2 + \text{-----------} + \beta_n X_n + \varepsilon_1$ ……(14)

$Z_{6t} = \alpha_6 + \beta_{16}X_1 + \beta_{26}X_2 + \text{-----------} + \beta_n X_n + \varepsilon_1$ ……(15)

X_i………………X_n represent vector of the explanatory variables where n = 1---------17

β_1……………… β_n represent the parameter or coefficients

ε_i represents the independent distributed error term and α_0, α_1, α_2…..shows the intercept or constant term.

The independent variables were selected based on Adeoti and Adewusi (2005); Awoyinka, Awoyemi and Adesope (2005); Getachew (2005); Birungi (2007); Awoyinka (2009); Olayide *et al.,* (2009); Wanyama *et al.*, (2010); and Akinola *et al.,*(2011).

Human capital

X_1 = Age (year)

X_2 = Primary education (year)

X_3 = Secondary education (year)

X_4 = Tertiary education (year)
X_5 = Household size (number)
X_6 = Years of farming experience (number)
Social Capital
X_7 = Membership of production association (1=yes, 0= no)
Physical capital
X_8 = Value of livestock owned (naira)
Financial Capital
X_9 = Access to credit (1=yes, 0= no)
X_{10} = Non-farm income (naira)
Parcel or Plot level factor
X_{11} = Tenancy security
X_{12} = Farm size cultivated (ha)
X_{13} = Perceived nutrient deterioration (1= observed deterioration, 0= if not)
Institutional factors
X_{14} = Contact with extension agent (1= if household had access, 0= if not)
X_{15} = Distance from plot to residence (Km)
X_{16} = Distance from plot to nearest market (Km)
X_{17} = Distance from plot to all weathered road (Km)

3.2 Estimation of Multicollinearity and Goodness of the Model

In this study, before estimating the model, it became necessary to check for the degree of multicollinearity among the hypothesized explanatory variables. According to Gujarati (2004) there are various indicators of multicollinearity and no single diagnostic test will give us a complete handle over the collinearity problem. For this particular study, Tolerance level (TOL) and Variance Inflation Factor (VIF) were used in line with (Agboola 2015; Akpan *et al.*, 2013 and Hassan and Nhemachena 2008). VIF shows how the variance of an estimator is inflated by the presence of multicolinearity (Gujarati, 2004). The larger the value of VIF_j, the more troublesome or collinear the variable X_i is. As a rule of thumb, if the VIF of a variable exceeds 10 (this will happen if R^2_j exceeds 0.95), that variables are said to be highly collinear (Gujarati, 2004). Following Gujarati (2004), the VIFj is given as: $VIF(Xj) = \frac{1}{1 - Rj^2}$

Where, Rj^2 is the coefficient of multiple correlations when the variable Xj is regressed on the other explanatory variables.

On the other hand, tolerance level (TOL) is an inverse of VIF. A small tolerance value indicates that the variable under consideration is almost a perfect linear combination of other independent variables in the equation and that it should not be added to the regression equation. In other words; when R^2_j =1 (i.e. perfect collinearity), TOLj = 0 and when R^2_j= 0 (i.e. no collinearity), TOLj will be equal to 1. Hence, both VIFj and TOLj can be used interchangeably.

4. Results and Discussion

4.1 Test result for multicollinearity among specified variables in the model

Table 2 presents the Variance Inflation Factors (VIF) and Tolerance (TOL) test showing the degree of multi collinearity among the explanatory variables used in the analysis. The result reveals that, the problem of multicollinearity in the data set could be tolerated since it has not exceeded the threshold mark. This means that the VIF has not reached the 10th point mark; on the other hand, the tolerance factor is above 0.1 point mark for all the explanatory variables in the model. The result implies that the degree of multi collinearity among the hypothesized explanatory variables could be tolerated.

4.2 Determinant of Land Management Practices in the Study Area

This section presents the multinomial logit regression results for the factors that influence the choice of land management practices among farming household heads in North Central Nigeria using STATA 11 software.

Table 3 reveals the results of the multinomial logit estimations in which seven different types of land management practices were used as the dependent variables; organic manure, bush fallow, crop rotation, inorganic fertilizer, alley cropping, cover crop and mulching, where inorganic fertilizer was chosen as reference or base category. Chi-square distributions was used to test overall model adequacy at specific significant level. Likelihood ratio also determines the goodness of fit or whether the multinomial Logit model is preferable to binomial Logit model, while the McFadden's Pseudo R^2 also confirmed that all the slope coefficients are not equal to zero. In other words, the explanatory variables are collectively significant in explaining the classification of the household heads by their land management choices. The results of the estimated equations are discussed in terms of the significance and signs of the parameters. However, evidence from the model as contained in Table 3 shows that the set of significant explanatory variables varies across the groups in terms of the levels of significance and signs. Twelve out of seventeen variables were found to be significant, though at different level and signs under different land management practices. The significant variables were; age, primary, secondary and tertiary education of household heads. Others value of livestock owned, off farm income, tenancy security, distance from plot to the nearest market as well as distance from plot to all weathered road.

It was observed that age of crop farming household was negatively significant at 10% in the choice of Bush fallow as a land management device. The result implies that a unit increase in the age of crop farming household heads decrease the probability of using bush fallow reference to inorganic fertilizer. This is because as farmers advance in age, the agility or strength to cope with such a labour intensive practice comes down. The negative coefficient is in line with (Rahji 2005; Wanyama *et al*.,2010; Akinola *et al.,*2011; Simon *et al*., 2013). Primary education was found to be negative but significant (10%), implying that a unit increase in the number of years of primary education reduces the probability of making use of bush fallow reference to making use of inorganic fertilizer. The argument is that higher education levels are associated with greater information on conservation measures and the productivity consequences of land degradation, as well as higher management expertise.

The human capital variables (education of household head) showed a negative but significant relationship with use of cover crop and mulching. While secondary education was significant at 1% and 10% respectively with cover crop and mulching, tertiary education was significant at 1% with respect to mulching. A unit increase in the number of years of those variables reduces the probability of making use of cover crop and mulching as a land management practices, i.e. household heads having secondary and tertiary education will prefer being in the reference category (inorganic fertilizer) to being in the comparison group (cover crop and mulching). The implication of this is that the opportunity cost of labour of highly educated farming household heads will be higher than for him/her to use it on labour intensive land management like mulching. The negative coefficient of tertiary education is consistent with (Kato *et al.,* 2011).

Household size was found to be significant (1%) but negatively related under bush fallow, the negative coefficient of household size indicates that a unit increase in household size is not associated with the use of bush fallow. Specifically, an additional member to the household decreases the likelihood of using bush fallow by .020. This implies that larger households tend to hold smaller farms as a result of pressure on land which brings about land fragmentation and cannot afford to fallow; hence the use of bush fallow as a land management technique might not be feasible. The negative coefficient tallies with the findings of (Awoyinka, Awoyemi & Adesope 2005). On the other hand, household size impacted positively and significant (5%) on the use of alley cropping. As shown in Table 3, the positive coefficient of household size indicates that a unit increase in household size is strongly associated with the use of alley cropping. Specifically, an additional member to the household increased the likelihood of using alley cropping by .013. This implies that larger households are likely to be faced with the problem of liquidity constraint which may inform their choice of a management technique that is not capital intensive while the labour required will be supplied by the family members. Positive coefficient in respect of household size tallies with the findings of (Getachew 2005; Birungi 2007; Oladeebo 2008; Awoyinka 2009 Akinola *et al.,*2011 Simon *et al*., 2013).

Value of livestock owned was also found to be positive and significant at 1% and 10% respectively under organic manure and bush fallow meaning that a unit increase in the value of livestock owned increases the likelihood of the household head making use of bush fallow and organic manure as against the use of inorganic fertilizer. The argument here is the increase in the value of livestock make available the cash requirement needed the for tillage operations required in opening the new land while leaving the old one to fallow as well as generate significant amount of organic manure that could be used on the farm. Positive coefficient agrees with the findings of (Akinola *et al.,* 201; Raufu and Adetunji 2012). Negative but significant coefficient at 10% and 1% respectively was reported in the case of crop rotation and alley cropping.

Off-farm income was negatively significant (10%) in relation to the use of bush fallow. Hence a unit increase in off-farm income will lead to a decrease in probability of using bush fallow with reference to inorganic fertilizer. The reason is that off-farm investment may crowd out investment resources for land-quality improvement and that increasing dependence on non-agricultural activities may translate into a shift of interest away from farming. This result agrees with (Adeoti & Adewusi 2005). On the other hand, off farm income was also found to be a positive and significant variable (1%) under mulching, a positive coefficient for off-farm income suggests that the larger the income earned from non-farm sources, the greater the level of use of a particular technology. The argument is that off-farm income may ease the liquidity constraint needed for soil-conservation investments. This is in consonance with (Akinola *et al.,* 2011).

The tenancy security variable was positively and significantly related with the use of mulching in the study area. A positive co-efficient for the tenancy security variable implies that more ownership of land is associated with better use of land management practice in question (mulching) i.e the household head will prefer being in the comparison group to be in the reference category. Positive coefficient in in tandem with (Adeoti & Adewusi 2005; Rahji 2005; Wanyama *et al*., 2010). Distance from plot to all weathered road was also found to be a positive and significant variable at 5%, i.e. a unit increase in the distance from plot to all weathered road increase the probability of using mulching by 0.030.

Farm size was found to be negative but significant at 5% under crop rotation. A unit increase in farm size leads to a reduced probability of household heads making use of crop rotation reference to inorganic fertilizer. The argument is that farm size is often correlated with peasant wealth that may help ease liquidity constraints. Similarly, wealthier farmers are more likely to be able to apply expensive fertilizer on their farms. Besides, large farmers generate more income which provides a better capital base and enhances risk-bearing ability. Distance from plot to residence was positive and significant at 5% meaning that a unit increase in the distance from plot to residence increases the probability of using crop rotation. The positive and significant relationship between distance from plot to residence shows that farmers tend to use crop rotation on far off plots. The result is consistent with (Getachew 2005; Ezekiel *et al*., 2012; Raufu and Adetunji 2012).

Distance from plot to residence was a positive and significant variable at 5% under bush fallow. A unit increase in the distance from plot to residence increases the probability of making use of bush fallow reference to inorganic fertilizer. This makes sense as when farms are closer to homestead; there could be competition between the use of land for agricultural and residential purposes. Hence, the justification for the positive relationship between bush fallow and distance from plot to residence. Positive coefficient in respect of distance from plot to residence is consistent with the findings of (Getachew 2005; Ezekiel *et al*., 2012; Raufu and Adetunji 2012).

Distance from plot to market was also found to increase the likelihood of using cover crop as a land management device. The positive and significant coefficient at 5% in respect of distance from plot to market was observed to be .019 indicating that better access to market increased the probability of adopting cover crop category reference to the base category.

5. Conclusion and Recommendations

Result of multinomial logit model reveals the variables that significantly explain the determinants across different land management practices at different levels of significance were age of household heads, level of education, household size, value of livestock owned, off farm income, tenancy security, farm size, distance from plot to residence, distance from plot to the nearest market as well as distance from plot to all weathered road. The positive coefficient in respect of household size, value of livestock owned, off farm income, tenancy security, distance from plot to residence, distance from plot to the nearest market and distance from plot to to all weathered road indicates implies the probability of the household head being in the land management practices under consideration rather than being in the reference category. While negative coefficient in respect of age, primary, secondary and tertiary education, household size, value of livestock owned, off farm income and farm size implies the probability of a household heads being in the reference category rather than being in the land management practices under consideration.

Household size was negatively related to land management. Controlling the increase in the family size should be of priority to address problems of resource degradation. Policy related to family planning, education and other means of reducing family size and dependency ratios will help reduce land degradation and increase crop production and per capita income.

Positive and significant contribution of distance from plot to all weathered road facilitate market access, it is therefore recommended that access to feeder roads should be considered as important prerequisites on which the outcome of other agricultural programmes can be based.

Negative coefficient in respect of farm size implies that household heads with large farm size could not management their farmland sustainably; hence smaller farm size is hereby advocated for.

Negative coefficient in respect of age implies that older household heads might not be able to cope with the labour intensive nature of some land management practices; hence such programme as e-wallet that makes inorganic fertilizer available to farmers should be sustained.

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Table 1: Sampling Procedure for the Selection of Farmers

States	LGAs	Communities	Number of questionnaire administered	Number of questionnaire retrieved
Benue	Buruku	Abwa, Biliji, Mbatsaase and Mbaya	66	53
	Oju	Obotu Ororu-Ainu, Okpoma Ainu, Oyinyi Iyeche and Uchuo	66	52
	Otukpo	Otukpo icho and Okete	34	29
	Ushongo	Sati Ikov and Bilaja Ikom	34	27
Kogi	Adavi	Edavi Eba, Inoziogolo and Osara	50	48
	Bassa	Gbokolo, Oguma and Sheria	50	44
	Igalamela	Akpanya, Amaka and Ogboligbo	50	45
	Yagba East	Ilafin Ishanlu, Itedo Ishanlu and Mopo	50	47

Source: field survey 2013

Table 2: Test for the Degree of Multicollinearity among the Explanatory Variables used in the Multinomial Logit Model

Variables	VIF	TOL
Age of household head	2.330	0.429
Primary education of household head	2.003	0.499
Secondary education of household head	2.353	0.425
Tertiary education of household head	2.545	0.393
Household size	1.797	0.556
Farming experience	2.039	0.490
Membership of production association	1.291	0.774
Value of livestock owned	1.377	0.726
Access to credit	1.224	0.817
Non-farm income	1.711	0.584
Tenancy security	1.148	0.871
Farm size cultivated	1.212	0.825
Perceived nutrient deterioration	1.256	0.796
Access to Agricultural extension	1.429	0.699
Distance from plot to residence	3.371	0.296
Distance from plot to nearest market	3.438	0.291
Distance from plot to all weathered road	3.590	0.278

Source: Computed from survey data

Table 3: Factors Affecting the Choice of Land Management Practices in the Study Area (Marginal Effects)

Variables	Organic manure	Bush fallow	Crop rotation	Alley cropping	Cover crop	Mulching
Age	-.004	-.006	.001	.0001	-.0007	.001
	(-1.04)	(-1.85)*	(0.43)	(0.07)	(-0.19)	(0.38)
Priedu	.218	-.073	.034	-.039	.035	-.014
	(1.54)	(-1.73)*	(0.36)	(-1.20)	(0.49)	(-0.25)
Secedu	.196	.039	-.008	-.031	-.143	-.095
	(1.36)	(0.63)	(-0.08)	(-0.88)	(-2.52)**	(-1.81)*
Tertedu	.224	.022	.073	-.039	-.061	-.230
	(1.59)	(0.36)	(0.71)	(-1.07)	(-0.95)	(-4.16)***
Hhsize	.009	-.020	.004	.013	-.005	-.003
	(1.19)	(-2.72)***	(0.50)	(2.27)**	(-0.63)	(-0.48)
Farmexp	.004	.003	.004	-.001	-.0007	.0007
	(1.09)	(1.12)	(1.06)	(-0.89)	(-0.19)	(0.24)
Mem. Ass.	-.045	-.087	.113	.036	-.034	-.089
	(-0.46)	(-1.12)	(1.52)	(0.98)	(-0.38)	(-1.04)
Lstock	1.14e-06	3.31e-07	-6.01e-07	-1.06e-06	-9.35e-08	-4.39e-08
	(4.70)***	(1.95)*	(-1.92)*	(-4.91)***	(-0.34)	(-0.18)
Crdtacc	.030	.009	.028	-1.06e-06	-.032	.033
	(0.54)	(0.26)	(0.46)	(-0.10)	(-0.65)	(0.70)
Offinc	4.50e-08	-1.83e-07	-1.95e-08	-2.80e-08	-4.44e-08	2.27e-07
	(0.51)	(-1.83)*	(-0.19)	(-0.49)	(-0.46)	(3.15)***
Tensec	-.011	.013	-.032	-.062	-.059	.147
	(-0.20)	(0.39)	(-0.54)	(-1.62)	(-1.17)	(3.15)***
Fmsize	-.043	-.022	-.068	-.019	-.009	-.034
	(-1.41)	(-1.02)	(-2.04)**	(-1.12)	(-0.37)	(-1.38)
Perception	-.034	-.072	.042	.020	.065	-.072
	(-0.41)	(-1.20)	(0.56)	(0.58)	(1.24)	(-1.02)
Extcon	.011	.023	-.006	.029	.048	-.039
	(0.19)	(0.55)	(-0.11)	(0.90)	(0.90)	(-0.72)
Plotdist	-.004	.017	.033	-.011	-.013	-.011
	(-0.30)	(2.06)**	(2.44)**	(-1.21)	(-1.04)	(-0.88)
Mktdist	.008	.000	-.017	-.001	.019	-.010
	(0.96)	(0.07)	(-1.63)	(-0.23)	(2.48)**	(-1.27)
Roaddist	-.018	-.007	.007	.012	-.012	.030
	(-1.23)	(-0.87)	(0.50)	(1.35)	(-0.93)	(2.36)**

Source: Computed from 2013 survey Data *** Significant at 1%, ** at 5%, * at 10%
The value in parenthesis represents the Z value while those not enclosed in parenthesis are the marginal effects of the different variables
Log likelihood = -477.9972 Observations = 345 LR Chi2 (102) = 376.08
Prob > Chi2 = 0.0000 R^2 = 0.2823