J Agri Sci, 3(2): 121-123 (2012)
PRINT: ISSN 0976-6898 ONLINE: ISSN 2456-6535 DOI: 10.31901/24566535.2012/03.02.02

Multinomial Logit Analysis of Factors Affecting the Choice of Enterprise Among Small-holder Yam and Cassava Farmers in Niger State, Nigeria

M. A. Ojo*, J.N. Nmadu, L.Tanko and R.S. Olaleye

Department of Agricultural Economics and Extension Technology, P.M.B. 65, Federal University of Technology, Minna, Niger State, Nigeria

KEYWORDS Multinomial Logit Regression. Choice of an Enterprise

ABSTRACT This study analyzed the factors affecting the choice of an enterprise among small holder yam and cassava farmers in Niger State, Nigeria. Data used for the study were obtained from primary source using a multi-stage sampling technique. Structured questionnaire was administered to 150 randomly selected yam and cassava farmers to elicit relevant information from respondents in the study area. Multinomial logit regression model was used to estimate factors influencing the choice of enterprise among small holder yam and cassava farmers in the study area. The findings revealed that most (65.33%) of the farmers chose sole yam enterprise while 4.67% and 30.0% of the farmers chose sole cassava enterprise and yam and cassava as mixed enterprise respectively. The study further revealed the mean of 1.83 tons of combined yam and cassava output of per annum and an average farm size of 2.84ha per farmer, an indication that the study covered small holderfamily managed farm units. The farmers were relatively young and with basic formal education. The multinomial logit regression model showed that income, farm size and output from the chosen enterprise had positive and significant effect on farmer's choice of an enterprise. This implies that the probability of choosing yam or cassava enterprise increased with income earned from the enterprise, farm size and output from chosen enterprise. The partial elasticiticies of income and output for cassava and combined enterprises were elastic, while all other factors across the groups as classified were inelastic. The study therefore recommended that extension agents should create more awareness on different types, methods and techniques available for yam and cassava cultivation to further improve their adoption. Also, training and farm advisory services on improved management practices to boost yam and cassava production should be given to the farmers.

INTRODUCTION

Yam and cassava belong to the class of foods that basically provide energy in the human diet in the form of carbohydrates. These crops refer to plants that store edible material in subterranean root, corm or tuber (FAO 1990). Yam and cassava were regarded as food mainly for the poor, and have played a very minor role in international trade. This misconception has lingered for so long because of the lack of appreciation of the number of people who depend on these root crops, and the number of lives that have been saved during famine or disasters by root crops (FAO 1990). Yam and cassava are often the main dietary staple for low-income consumers. They are grown by farmers as subsistence crops on small plots of land ranging from two to twenty hectares depending on the region. In Africa, yam and cassava are usually subsistence crops grown mainly as food, so the farmer keeps sufficient to feed his family and sells only the surplus. However, there is now a growing commercial market for them. Cassava is commercially processed into *gari*, a staple food in parts of Nigeria, and into *kokonte* in Ghana. According to FAO (2004), Nigeria is the largest producer of cassava in the world. Its production is currently put at least at 34million metric ton a year. Total area cultivated of the crop (cassava) in 2001 was 3.125 million hectares with an average yield of 10.83metric ton per hectare.

Yam and cassava are important, not only as food crops but even more as major sources of income for rural households. Their use in some industries as livestock feed is well known but is gradually increasing. They have become prominent in the industrial sector of the economy. As food crops, cassava and yam have some inherent characteristics, which make them attractive, especially to smallholder farmers in Nigeria. First, they are rich in carbohydrates especially starch and consequently have a multiplicity of end users. Secondly, they are available all the year round making it preferable to other more seasonal crops such as grains, peas and beans, and other crops for food security. Moreover, cassava and yam are tolerant to low soil fertility,

*Address for correspondence:
Phone: +234-8033674308
E-mail: akinmikky@yahoo.co.uk

and highly resistant to drought, pests and diseases. Furthermore, their roots are storable in the ground for months after they mature.

However, agricultural production involves risks and farmers have to adapt or adjust their farming practices so as to avoid loss since poor management of risks can result in crop failures leading to low production and unstable income. To deal with this problem, diversification into production of other crops and livestock by farmers has been recognized as a means to ensure stable income (Ali 2004). Intercropping cassava with other food crops such as cocoyam, yam, maize etc as mean of diversification can also ensure food security and income stability (Aneani et al. 2007). Diversification affects the choice made by farmers in term of enterprise combination on their farms. Different farmers may have different attitudes towards the enterprise chosen. Sometimes farmers who have good attitudes also may not plant certain crops due to some factors that affect their decisions. Farmers who plant yam and cassava cultivate them as sole or mixed crops together. The question is that, what are the factors that influence their decisions? This study is set out to examine the factors influencing the choice of an enterprise among small scale yam and cassava farmers in Niger State, Nigeria.

METHODOLOGY

Description of Study Area

The study was conducted in Niger State of Nigeria. Niger State is located between latitudes 8º112 N and 11° 202 N and longitude 4° 302 E and 7° 202 E. The State covers an estimated land area of 76,363 square kilometers and a population of 4,082,558 people (Wikipedia 2011). The state is agrarian and well suited for production of arable crops such as cassava, cowpea, yam, and maize because of favourable climatic conditions. The annual rainfall is between 1100mm – 1600mm with average monthly temperature ranges from 23 º C and 37 º C (Wikipedia 2010). The vegetation consists mainly of short grasses, shrubs and scattered trees.

Sampling Technique and Sample Size

A multi-stage sampling technique was employed. The first stage involved the random selection of 3 Local Government Areas (LGAs) (Shiroro, Lapai and Gurara LGAs). The second stage involved a simple random selection of five villages from each LGA The third stage involved random selection of ten yam and cassava farmers in each village respectively to give a total of 150 sampled farmers as respondents for this study.

Method of Data Collection

A limited cost-route approach method was used in data collection for this study. The data mainly from primary sources were collected with the use of structured questionnaire designed in line with the objectives of the study. Data collected include total output produced per annum in tonnes, while the inputs include the size of farm land in hectare, quantity of seeds as planting materials in kg; quantity of fertilizer used in kg; quantity of herbicides used in litres and total labour in man-days which include family and hired labour utilised for pre and post planting operations and harvesting; prices of yam and cassava in Naira; total production cost per year; average wage rate per man days of labour, price per kg of planting materials, average price of agrochemicals, average price of fertilizer and average price of farm tools. Also, data collected include the farmer's socio-economic variables such as farmer's age, years of schooling, household size, number of contact with extension agents, accessibility to credit etc.

Analytical Techniques

The multinomial logit regression model was used following Budry et al. (2006), Bandara and Thiruchelvam (2008), Rahji and Fakayode (2009) to express the probability of a farmer being in a particular category. The farmers were categorized into three based on the type of enterprise chosen. The enterprises included yam enterprise, cassava enterprise and both enterprises (combination of cassava and yam enterprises).

The general form of the multinomial Logit model is:

$$\Pr(y_i = j) = \frac{\exp(X_i\beta_j)}{1 + \Sigma_{j=1}^{J}\exp(X_i\beta_j)} \quad \ldots\ldots (1)$$

And to ensure identifiability,

$$\Pr(y_i = 0) = \frac{1}{1 + \Sigma_{j=1}^{J}\exp(X_i\beta_j)} \quad \ldots\ldots (2)$$

where for the ith individual, y_i is the observed outcome and X_i is a vector of explanatory variables. β_j is the unknown parameters.

This model for this study was summarized as follows:

$$P_{ij} = \frac{\exp(\gamma_j X_i)}{1 + \sum_{j=1}^{3} \exp(\gamma_j X_i)} \text{ for j = 1,2,3.} \quad \ldots (3)$$

P_{ij} is the probability of being in each of the groups 1and 2.

$$P_{i0} = \frac{1}{1 + \sum_{j=1}^{3} \exp(\gamma_j X_i)} \text{ for j = 0} \quad \ldots (4)$$

P_{io} is the probability of being in the reference group or group 0.

In practice, when estimating the model, the coefficients of the reference group are normalized to zero (Maddala 1990; Greene 1993; Kimhi 1994; Rahji and Fakayode 2009). This is because, the probabilities for all the choices must sum up to unity (Greene 1993). Hence, for 3 choices only (3 -1) distinct sets of parameters can be identified and estimated.

The natural logarithms of the odd ratio of equations (1) and (2) give the estimating equation (Greene 1993) as:

$$\ln = \frac{(P_{ij})}{(P_{i0})} \gamma_j X_i \quad \ldots (5)$$

This denotes the relative probability of each of the group 1 and 2 to the probability of the reference group. The estimated coefficients for each choice therefore reflect the effects of Xi's on the likelihood of the farmers choosing that alternative relative to the reference group. However, following Hill (1983) and Rahji and Fakayode (2009), the coefficients of the reference group may be recovered by using the formula

$$\gamma_3 = -(\gamma_1 + \gamma_2) \quad \ldots (6)$$

For each explanatory variable, the negative of the sum of its parameters for groups 1 and 2 is the parameter for the reference group. The explicit form of the functions is specified as follows:

$$P_{ij} = \beta_0 + \beta_1 EDU + \beta_2 INC + \beta_3 AGE + \beta_4 FSZ + \beta_5 EXP + \beta_6 TRA + \beta_7 CYD \quad \ldots (7)$$

The independent variables in the model are defined in Table 1.

Marginal Effects and Quasi – Elasticities

The marginal effects or partial derivatives ("P_j/"X_i) are obtained by differentiating equations (3) and (4) with respect to the particular explanatory variable. The derivation techniques implicitly indicate that neither the sign nor the magnitude of the marginal effects need bear any relationship to the sign of the coefficients used in obtaining them (Greene 1993). The Stata11.2 software provides the partial derivatives. These are converted to quasi elasticities by using ηJi = Xi ("Pj/"Xi), where X_i is the mean value of X_i.

The quasi-elasticity represents the percentage point change in P_j upon a one percent increase in X_i. These elasticities are superior to the coefficients and the partial derivatives by their ease of interpretation. However, like the derivatives they too may change sign as well as value when evaluated at different points (Basant 1997).

RESULTS AND DISCUSSION

A summary of the distribution of the respondents according to the choice of an enterprise is expressed in Table 2.

The results in Table 2 show that majority (65.33%) of the respondents chose sole yam enterprise in the study area. This implies that sole yam enterprise is the most prevalent cropping pattern in the study area. This confirms the report of the International Institute for Tropical Agriculture (IITA) (2004) which indicated that Niger State was one of the highest yam pro-

Table 1: Definition of the independent variables used in adoption models of the various enterprises

Variables	*Definitions*
EDU	Education (years spent in formal school)
INC	Income from the enterprise(s) measured in (naira)
AGE	Age of the farmer in year
FSZ	Size of land allocated to the chosen enterprise(s) in hectare
EXP	Years of experience in the chosen enterprise
TRA	Training in the chosen enterprise(s) (1 if respondent has a training; 0 otherwise)
CYD	Crop yield (tonnes) (the outputs of yam and cassava were aggregated using wheat grain equivalent table)

Table 2: Distribution of the respondents according to the choice of an enterprise in the study area

Enterprise	*Frequency*	*Percentage*
Yam	98	65.33
Cassava	7	4.67
Both yam and cassava	45	30.00
Total	150	100.00

Source: Field survey 2011

ducing States in Nigeria. The summary statistics of the variables for the multinomial logit regression analysis for yam and cassava production in Niger State is presented in Table 3. They include the sample mean and the standard deviation for each of the variables. The results from Table 3 show that the mean of 1.83 tons of outputs per annum was obtained from the data analysis with a standard deviation of 2.51 in the study area.

Table 3: Summary of the descriptive statistics of the variables used in the multinomial logistic regression model in Niger State

Variables	*Mean*	*Standard deviation*	*Minimum*	*Maximum*
Total output (tons)	1.83	2.51	0.05	25.60
Total farm size (ha)	2.84	1.74	0.53	9.00
Experience	22.67	12.45	0.00	52.00
Income (Naira)	113296	145096	240	693000
Age (years)	37.54	8.49	20.00	61.00
Education (years)	9.63	5.41	0.00	19.00

Source: Data analysis 2012

Analysis of other variables also revealed an average farm size of 2.84ha per farmer, an indication that the study covered small scale family managed farm units. The average years of experience, age of the farmers and year of schooling, were 22.67, 37.54 and 9.63 respectively, meaning that the farmers were relatively young and with little or no formal education.

Factors Influencing Choice of Enterprise Among Small Holder Yam and Cassava Farmers in the Study Area

The results of the multinomial logit analysis showed the factors that influence the choice of the enterprise adopted by yam and cassava in Niger State are shown in Table 4. The effect coefficients were estimated with respect to the combined yam and cassava enterprise (group 3), as the reference group. Therefore, the inference from the estimated coefficients for each choice category was made with reference to group 3. Table 4 shows that, the likelihood ratio (χ^2) value was 88.92 and this is significant at 1% level of probability. This test confirms that all the slope coefficients are significantly different from zero. The pseudo R^2 value of 0.3789 also confirmed that all the slope coefficients are not equal to zero. In other words, the explanatory variables are collectively significant in explaining the enterprise choice by yam and cassava farmers in the study area. In the literature, Hill (1983) obtained pseudo R^2 values of between 0.3226 and 0.3484 while Zepeda (1990) and Rahji and Fakayode (2009) reported pseudo R^2 values of 0.25 and 0.3145 respectively as representing a relatively good-fit for a multinomial logit model. Hence, the pseudo R^2 value of 0.3665 in this study is indicative of good fit and the correctness of the estimated model.

Table 4: Results of the estimated multinomial logit model for factors influencing the choice of enterprise among small scale yam and cassava farmers Niger State

Variables	*Yam enterprise (Group 1)*	*Cassava enterprise (Group 2)*	*Both yam and cassava enterprises (Reference group)*
Education (years)	-0.0670	0.0418	0.0252
	(-1.32)	(0.28)	
Income (₦)	0.0002	0.0002	-0.0004
	(3.90)***	(2.80)***	
Age (years)	0.0539	0.0761	-0.1300
	(1.29)	(0.72)	
Farm Size (ha)	0.1517	1.3386	-1.4903
	(2.58)**	(2.34)**	
Farming Experience (years)	0.0014	0.0421	-0.0435
	(0.04)	(0.49)	
Training on the chosen enterprise	0.8886	1.3817	-2.2703
	(1.55)	(1.32)	
Total Output (tons)	2.1355	0.0898	-2.0457
	(5.18)***	(3.55)***	
Constant	1.1338	-6.5399	5.4061
	(0.80)	(-1.48)	
No of Observations	98	7	45

Number of observation = 150. Numbers in parenthesis are Z-values
Log likelihood = -72.887***
LR Chi-square = 88.92***
Pro > Chi-square = 0.0000
Pseudo R^2 = 0.3789
*** = Significant at 1% level of probability, ** = Significant at 5% level of probability,
Source: Field Data Analysis, 2012

The results of the estimated equations were discussed in terms of the significance and signs on the parameters. Therefore evidence from the model as contained in Table 4 shows that the set of significant explanatory variables varies across the groups in terms of the levels of significance and signs However income, farm size and output with estimated parameters of 0.1517 and 1.3386 respectively from the chosen enterprise are positive and significantly associated with the classification of the two groups relative to the reference group. The positive sign implies that the probability of chosen yam or cassava enterprise tends to increase with the income, farm size and output from the chosen enterprise in Niger State.

Table 5 contains the values of the estimated marginal effects and the quasi – elasticities calculated for the significant variables. Apart from the partial elasticiticies of income and output for cassava and reference groups respectively that were elastic, all other factors across the groups as classified were inelastic. For the variables that are elastic, one percent change in these explanatory variables leads to a more than proportionate change in the probability of other classified groups relative to the reference group. For the variables that were inelastic, the probability of classifying the farmers into any particular group is not greatly affected by marginal changes in these variables as a one percent change in the variables led to a less than proportionate change in the probability of classification.

Table 5: Marginal effects and the quasi – elasticities estimated

Variables	**Yam enterprise (Group 1)*	**Cassava enterprise (Group 2)*	**Both yam and cassava enterprises (Reference group)*
Income (₦)	0.0002	0.0005	0.0002
	(0.6867)	(1.6665)	(1.1611)
Farm size (ha)	-0.0084	-0.0505	0.03567
	(-0.06421)	(-3.8762)	(0.5146)
Total output (tons)	-0.2537	0.0072	0.1689
	(-2.1936)	(0.3359)	(1.1159)

* = Marginal effects are above while partial elasticities are in brackets.
Source: Field Data Analysis 2012

CONCLUSION

This study examined analysis of the factors affecting the choice of an enterprise among small scale yam and cassava farmers in Niger State, Nigeria. The result of the multinomial regression model showed that the probability of choosing yam or cassava enterprise increased with the increase in income from enterprise, farm size and output from chosen enterprise. Higher output connotes higher income.

RECOMMENDATIONS

It is recommended that extension agents should create more awareness on different types, methods and techniques available for yam and cassava cultivation to further improve their adoption . Also training and farm advisory services on improved management practices to boost yam and cassava production should be made available to the farmers. Research should be intensified in the area of identifying well adapted, high yielding varieties of these crops within the contexts of sustainable farming systems approach to boost productivity and livelihoods of small holder farmers.

REFERENCES

Ali M 2004. Agricultural Diversification and International Competitiveness. Tokyo, Japan: The Asian Productivity Organization. pp. 1-3. From <http://www.apo-tokyo.org,> (Retrieved on November, 2012).

Aneani F,Anchirinah V M, Owusu-Ansah F, Asamoah M 2007. An analysis of the extent and determinants of crop diversification by cocoa (theobroma cacao) farmers in Ghana. *African Journal of Agricultural Research,* 6(18): 4277-4287.

Bandara D, Thiruchelvam S 2008. Factors affecting the choice of soil conservation practices adopted by potato farmers in Nuwara Eliya District, Sri Lanka. *Tropical Agricultural Research and Extension,* 1: 49-54.

Basant R 1997. Technology strategies of large enterprises in Indian industry: Some explorations. *World Development,* 25(10): 1683 – 1700.

Budry B, Curtis M J, Dennis A S 2006. The adoption and management of soil conservation practices in Haiti: The case of rock walls. *Agricultural Economic Review,* 7(2): 29-39.

FAO 1990. Roots, Tubers, Plantains and Bananas in Human Nutrition. FAO Food and Nutrition Series, No. 24. FAO, Rome, Italy. From <http://www.fao.org/docrep/t0207e/T0207E00.HTM> (Retrieved on July, 2011).

FAO 2004. Online Statistical Database. Rome, Italy: Food and Agriculture Organization of the United Nations. From <http://www.fao.org/> (Retrieved on August, 2012).

Greene W H 1993. *Econometric Analysis*. London: Macmillan.

Hill M A 1983. Female labour force participation in developing and developed countries: Consideration of the informal sector. *Review of Economics and Statistics*, 63(3): 459-468.

IITA 2004. *Nigerian's Cassava Industry: Statistical Handbook.* 3 (2): 3-5.

Kimhi A 1994. Participation of farm owners in farm and off-farm work including the option of full-time off-farm work. *Journal of Agricultural Economics*, 45(2): 232-239.

Maddala G S 1990. *Limited Dependent and Qualitative Variables in Econometrics.* Cambridge: Cambridge University Press.

Wikipedia 2011. Encyclopaedia. From <http://en.wikipedia. org/wiki/Niger_State> (Retrieved on December, 2012).

Zepeda L 1990. Adoption of capital versus management intensive technologies. *Canadian Journal of Agricultural Economics*, 38: 457-469.