



## Determinants of Income Diversification Among Farm Households In Kaduna State: Application of Tobit Regression Model

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### Abstract

Farm households in Nigeria have many challenges which include poverty and income variability. One of the strategies often adopted to tackle this is income diversification. This study was therefore designed to identify determinants of income diversification among farm households in Ikara, Makarfi and Giwa Local Government Areas of Kaduna State. A three stage random sampling technique was used to collect primary data from two hundred and twenty-two (222) households distributed across the study area. Analytical tools used were descriptive statistics and Tobit regression model. The Tobit model was used to capture determinants of income diversifications (agricultural and non- agricultural enterprises) among farm households. Majority (43%) of respondents had an average non-farm income of ₦199, 950.45 per year with 11% of respondents in full time farming. The significant variables that increase income diversification strategies of farm households were educational level, farm size, membership of cooperatives and non-farm income while farm size decreases the income diversification of households with the highest elasticity of 0.41. This study suggests the need for provision of basic infrastructure in the farming communities to increase their non-farm activities.

**Key words:** farm household, income diversification, determinants

### Introduction

Diversification at the individual or household level (livelihoods diversification) simply means adding new activities. This can include agricultural or non-agricultural work, work for oneself or for an employer, home based work or work at other places. Rural livelihood diversification could be described as the process by which rural households construct an increasingly complex portfolio of activities and assets in order to survive and to improve their standard of living (Ellis, 2000).

There are mounting evidences in the literatures that participation in non-farm activities creates favorable conditions for poverty alleviation in rural areas and by extension food security (FAO, 1998). Ellis (2000) and Lanjouw (1999) gave reasons for this observed income diversification to include declining farm income and desire to insure against agricultural production risk.

A number of recent studies on Nigeria (DFID, 2004; Okali, *et al.*, 2001) also points to the fact that income from household members' participation in non-farm activities has been contributing significantly to farm households' welfare in Nigeria as it

does in other parts of the world. For example, DFID (2004), reported that as much as 60 per cent of an average Nigerian farm household's cash income were derived from non-farm activities, with an average of 36 per cent adult working hours devoted to non-farm activities.

Quantifying the level of income diversification requires a richer measure of income diversification than the simple farm and non-farm income categorization and this can be measured using the share of non-farm income in total household income approach (Barrett and Reardon, 2000; Escobal, 2001; Block and Webb, 2001; and Ersado, 2006). The share of non-farm income as a measure of the degree of income diversification assumes that a higher share of non-farm income amounts to higher income diversification. The share of income approach assumes that income shares coming from farm, wage employment, non-farm self-employment and non-labour income are a function of exogenous input and output prices and the different fixed assets (land or cattle); fixed non-farm assets (experience in trade); financial assets that facilitates access to credit; human capital including family size and composition (by age and gender) as well as education; public assets such as electricity, roads. In using this approach, it is important to provide a breakdown of non-farm income share into categories; in addition, the share of non-farm income approach requires accounting for the level of income from farm and non-farm sources (Ersado, 2006).

Towards this end, this study has been conducted to identify factors determining income diversification and to predict the rate at which these factors explain the variation in income diversification using Tobit model. The application of Tobit Regression Model is not common in agricultural researches, however Olarinde and Manyong (2007) used Tobit model in their study to determine the degree of farmers' susceptibility to risk in maize production in Northern Nigeria. They found out that susceptibility to risk was highly premised on age of household, proportion of income from maize and level of probability of sale. Adebayo (2010) employed Tobit model to identify factors determining the food security status of beneficiaries and non-beneficiaries of United Nations Development Program's (UNDP) micro credit scheme in Kaduna state, Nigeria. Total farm size, access to UNDP credit, membership of cooperatives and diversification levels were major determinants. Therefore, this study seeks to identify determinants of the income diversification among farm households in the study area.

### **Theoretical framework**

From literatures, two approaches on rural income diversification have emerged: the livelihood linking assets with activities choice and incomes; and demand-pull/distress-push approaches. The conceptual framework used in this study is that of demand-pull/distress-push approach. Reardon *et al* (1998) suggest that when relative returns are higher in rural non farm employments than in farming, and returns to

farming are relatively more risky, pull factors are at work. Demand pull also includes any increase in the demand for rural products resulting from increase in income for lower and middle-income rural households and increased demand from urban areas.

Conversely, distress-push diversification occurs in an environment of risk, market imperfections and open and /or hidden agricultural unemployment. Thus, when rural populations engage in economic activities that are less productive than agricultural production and are motivated by the need to avoid further income decreases, push factors are at work. One implication of this approach is that the distribution of diversification over households would follow a bimodal distribution over households incomes in the presence of both demand-pull and distress push diversification (Rajan, 2008)

### **Materials and Methods**

**Area of study:** This study was conducted in Kaduna State, located in the Northern Guinea Savanna ecological zone. It occupies almost the entire central portion of the Northern part of Nigeria and shares common borders with Zamfara, Katsina, Niger, Kano, Bauchi, Nassarawa and Plateau States. To the Southwest, the state shares border with the Federal Capital Territory, Abuja. The global location of the state is between longitude 06° 00 and 09° 00 east of the Greenwich Meridian and also between latitude 09° 00 and 11° 30, north of the equator. The state occupies an area of about 48,473.2 square kilometers (FOS, 2006). It has a population of 6,066,562 people (NBS, 2007); and a projected population of 6,527,620 in 2009.

Agriculture is the major occupation of the people. Farming is mainly traditional in nature, though this is gradually giving way to modern methods. Crops produced in the state include cotton, groundnuts, soybean, tobacco, maize, yams, beans, guinea corn, millet, pepper, rice, cassava etc. The state is also one of the leading producers of ginger, sugar cane and maize in the whole country (Kaduna State Government 2000). The cropping pattern in the area is dominated by mixed cropping, although sole cropping is also practiced. Some farmers keep intake like cattle, goats, pigs, sheep, donkey and poultry.

Kaduna state is divided into 3 agricultural zones namely Maigana, Samaru and Birnin Gwari. The population for this study comprise of all farm households in Kaduna state. A 3 stage random sampling technique was used in selecting the sample for this study. The first stage involved the random selection of Maigana zone. The second stage involved a random selection of three (3) local government areas namely Ikara, Giwa and Makarfi. The third stage involved a random selection of 80 households in each local government area. Out of the 240 households selected for this study 222 supplied complete data that were used for analysis. The main instrument used for collecting primary data was a well structured questionnaire.

**Methods of data analysis:** Shares of household income derived from various farm and non-farm sources as well as the inverse of the Herfindahl index of overall income diversification was computed, following Ersado (2006) and Kaija (2007) as follows:

$$D = \sum_i^n S_i^a \quad (1)$$

Where:

D = Diversity index

S<sub>j</sub> = Share of income source with respect to the total income,  $S_j = \frac{Y_j}{Y}$

Y<sub>j</sub> = Total income from source j

Y =  $\sum_{j=1}^n Y_j$  is total household income from all sources; j= 1, 2, 3, ..n.

a = Diversity parameter, such as a = 0 and a = 1, 2 and 3.

As a approaches 1, the index becomes the entropy-index which is calculated as

$D = [-\sum S_i \log S_i]$  where log is the natural logarithm

For a = 2, the index D becomes the inverse of the Herfindahl index which is commonly used as income diversification index (Ersado, 2006) the Herfindahl index is computed as

$$D = \sum_{j=1}^n S_j^2 \quad (2)$$

The general index (equation 3) measures the number of income sources and the evenness of income shares, with the parameter a determining the weight of the number of sources versus evenness in the distribution of shares.

Determinants of non-farm income diversification was analysed at the household level. It was targeted at assessing the influence of various socio-economic factors on the extent of non-farm income diversification adopted by each household. Since the dependent variable is bounded between 0 and 1 (i.e the variables are censored at 0.0 and 1.0), conventional regression methods fail to take into account the qualitative difference between zero and continuous observations (Schwarze, 2004). Furthermore, Tobit model combines the properties of multiple regression and probit/logit model (Rhaji, 2000) Therefore Tobit model which was originally developed for censored data was applied for the analysis.

Following Ersado (2006) and Kaija (2007), the determinants of overall diversity was estimated using standard Ordinary Least Squares (OLS) estimation. The OLS specification is as follows:

$$D = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \mu \quad (3)$$

Where D= Income diversification index (Herfindal Index value; 1,2,3)

X<sub>i</sub> = Vector of exogenous explanatory variables

X<sub>1</sub> = Age of household head (years)

X<sub>2</sub> = Educational level (Numbers of years in school by household head)

X<sub>3</sub> = Household size (number)

X<sub>4</sub> = Household farm size (Ha)

X<sub>5</sub> = Annual crop production (Grain equivalent)

X<sub>6</sub> = Number of Dependents (those not contributing economical to the household)

X<sub>7</sub> = Membership of Cooperatives

X<sub>8</sub> = Non-farm income (₦)

μ = Error term

## Results and Discussion

### Household Non-Farm Income

The non-farm income is a major determinant of farm households' income diversification strategy. The non-farm income per year was categorized into five; majority of households (43%) had an average annual non-farm income of ₦199,950.45. This is an indication that the respondents have not significantly benefited from the diverse non-farm income generating opportunities in the study area. The major economic activities/ occupations of household heads are trading, civil service, artisan, tailoring, carpentry, operator of commercial motorcycle and milling machines. Table 1 further showed that only about 11 per cent of respondents were full time farmers, this could be attributed to declining farm incomes and to farmers' perception that farming is less profitable than other enterprises.

**Table1: Distribution of Households' Non-Farm Income**

Non-Farm Income/year	Frequency	Percentage
<100,000	25	11.26
100,001-200,000	95	42.79
200,001-300,000	33	15.76
300,001-400,000	22	9.90
>400,000	22	9.90
Farm Income only	25	11.26
Total	222	100.00

Field Survey, 2009

**Determinants of Income Diversification among Households**

The determinants of farm household income diversification practices were identified using censored regression model of eight regressors. The variables that were used were age, educational level, household size, farm size, annual crop production, number of dependents, membership of cooperatives, and non-farm income. The result presented in Table 2 was obtained after four iterations. The result revealed that sigma was 0.288 and statistically significant at 1 percent. This shows that the model has good fit to the data. Also four out of the eight variables were statistically significant at 1% and 5% levels of probability. The variables were educational level, farm size, membership of cooperatives and non-farm income.

**Table 2: Maximum Likelihood Estimates of Tobit Regression for Households Income Diversification**

Variables	Coefficient	Standard Error	T-Value
Age of Head (X <sub>1</sub> )	0.008115	0.01613	0.93705
Educational Level (X <sub>2</sub> )	0.01724*	0.02174	1.4775
Household Size (X <sub>3</sub> )	-0.02610	0.04965	-0.9795
Farm Size (X <sub>4</sub> )	-0.17199*	0.12743	-2.5146
Annual Crop Production(X <sub>5</sub> )	0.0000534	0.00012	0.79248
No. of Dependents (X <sub>6</sub> )	0.26248	0.56093	0.87188
Membership of Cooperatives (X <sub>7</sub> )	0.20690*	0.16694	2.3093
Non-farm income (X <sub>8</sub> )	0.000009*	0.000004	3.5493
Constant	1.5993*	0.65043	4.5814

\* indicate significant at 1% Dependent variable is Income Diversification levels (1-3) Log Likelihood function = -77.289  
 Source: Computed from field data, 2009.

The educational level had a coefficient of 0.017. This means that a unit increase in educational level of farm households will raise the autonomous income diversification by 0.017. This is in agreement with a priori expectation, because the more educated (literate) a household is the more likely such household will be able to diversify their income generating sources. A study by Central Bank of Nigeria/World Bank (1998) showed that education is crucial as it provides skills and abilities which allow households to secure productive and well-paying jobs.

The coefficient of farm size is -0.171 which means that autonomous income diversification will be lowered by 0.171. The implication is that a hectare increase in farm size will reduce the income diversification practice by 0.171. This is true as farm size increase it will in turn generate additional income all things being equal; conversely a farming household is likely to reduce other non-farm activities. The coefficient of membership of cooperatives is 0.21, this means that the income diversification will

increase by 0.21 for every increase in membership of cooperatives. This conforms to the a priori expectation, that membership of cooperatives increase access to more credit and therefore can increase their income diversification. The purpose of income diversification is to increase the non-farm income which is associated with higher level of consumption expenditure of a household. This is confirmed by the regression coefficient of 0.0000091 which indicates that a unit increase in non-farm income will raise the income diversification practices by 0.0000091.

### **Elasticity of Income Diversification**

Elasticity of income diversification measures the response of farming household income diversification to changes in every significant factor influencing it. Elasticity coefficient of probability and intensity of income diversification were computed for farm size, dependency ratio, membership of cooperatives and non-farm income. All the variables were inelastic and positive except that of farm size. The elasticity of probability of income diversification as a result of educational level was 0.057. This means that for the more educated the household head is, the probability of participating in income diversification increased by 5.7 percent. The intensity of income diversification as a result of increase in educational level is 5.4 percent for every 100 percent increase (Table 3)

The coefficient of elasticity of income diversification as a result of increase in farm size was -0.211. This shows that 100 percent increase in farm size will reduce the probability of participation in income diversification by the censored households by 2.1 percent. On the other hand, the coefficient of elasticity of the intensity of income diversification was -0.199 (inelastic). This means that for every 100 percent increase in farm size will decrease intensity of income diversification by 19.9 percent.

Membership of cooperatives probability of participation in income diversification was 0.149. This means that for every 100 per cent increase in membership of cooperatives, the probability of income diversification increases by 14.9 percent. As for the intensity of income diversification, the elasticity of coefficient increases by 14.1 percent for every 100 percent increase in probability of income diversification than intensity. The elasticity of income diversification as a result of non-farm income was 0.099. This means that for every 100 per cent increase in non-farm income, the probability of participating in income diversification increase by 9.9 percent. The intensity of the income diversification has elasticity coefficient increase of 9.4 percent for every 100 percent increase in probability of income diversification than intensity of income diversification (Table 3).

**Table 3: Coefficients of Elasticities of Probability and Intensity of Income Diversification among Farm Households**

Variables	Elasticities of Prob. of Income Diversification	Elasticities of Intensity of Income Diversification	Total Elasticities
Educational Level( $X_2$ )	0.057	0.054	0.111
Farm Size ( $X_6$ )	-0.211	-0.199	-0.410
Membership of Cooperatives ( $X_7$ )	0.149	0.141	0.290
Non-farm Income ( $X_8$ )	0.099	0.094	0.193

Source: Derived from the Result of Tobit Regression.

## CONCLUSION AND RECOMMENDATIONS

Majority of households had an average of ₦199, 950.45 per year from non-farm income with about 11% of respondents in full time farming. The significant variable that increased the income diversification of farm households were educational level, membership of cooperatives and non-farm income while farm size decreases the income diversification of household with the highest total elasticity of 0.41.

Therefore, households need to be acquainted with educational programmes (formal and non-formal), importance of cooperative societies, and accessibility to credit schemes which can facilitate the establishment of off-farm businesses among them. This could increase the off-farm activities that could generate more income for the household and thereby reduce food insecurity among them.

## References

- Adebayo, C.O. (2010). Evaluation of United Nations Development Programmes (UNDP) Micro Credit Scheme on Food Security Status of Farm Households in Kaduna State. Unpublished PhD Thesis, Ahmadu Bello University, Zaria. 110 p.
- Agboola, P.O., Awotide, D.O., Ikpi, A.E, Kormawa, P., Okoruwa, V.O. and Babalola, D.A. (2008). Effect of Income Diversification Strategies on Food Insecurity Status of Farming Households in Africa: Results of Analysis from Nigeria. Paper Presented at the 12<sup>th</sup> European Association of Agricultural Economists (EAAE) Congress, 26-29 August.
- Barret, C. B. and Readon, T. (2001). Asset, Activity and Income Diversification Among African Agriculturists: Some Practical Issues. In: *Income Diversification and*



*Livelihoods in Rural Africa: Cause and Consequence of Change. Special Edition of Food Policy.*

- Block, S. and Webb, P. (2001). The Dynamics of Livelihood Diversification in Post Famine Ethiopia. *Food Policy*. 26(4): 333-350.
- Clark, C. and Hasswell, M. (1970). *The Economics of Subsistence Agriculture*. 4<sup>th</sup> ed. Macmillan Co. Limited, London and Basingstoke.
- Department for International Development (2004). Rural Urban Development: Case Study- Nigeria: Oxford Policy Management, June 2004: 22 pp.
- Ellis, F. (2000). The Determinants of Rural Livelihood Diversification in Developing Countries. *Journal of Agricultural Economics*. 51(2):289-302.
- Ersado, L. (2006). Income Diversification in Zimbabwe: Welfare Implications from Urban and Rural Areas. *World Bank Policy Research Working No. 3964*, July. The World Bank, Washington, D. C.
- Food and Agricultural Organisation (FAO) (1998). The State of Food and Agriculture, 1998. Food and Agricultural Organisation of the United Nations, Rome.
- Federal Office of Statistics (2006). Nigerian Living Standard Survey. Federal of Statistics, 2006. Unpublished Draft Report.
- Kaduna State Government, Ministry of Commerce, Industry and Tourism (2000). Guide to Investment Opportunities in Kaduna State. Jokeno Nigeria Company, Kaduna. Pp.2.
- Kaija, D. (2007). Income Diversification and Inequality in Rural Uganda: The Role of Non-Farm Activities. A Paper Presented for the Poverty Reduction Equity and Growth Network (PEGNet) Conference, Berlin. 6-7 September.
- Lanjouw, P. (1999). Rural Non-Agricultural Employment and Poverty in Ecuador. *Economic Development and Cultural Change*. 48(1):91-122.
- National Bureau of Statistics (2007). Nigeria Poverty Assessment. National Bureau of Statistics (NBS)/World Bank, December. Pp. 48-49.
- Okali, D., Okpara, E. and Olawoye, J. (2001). The Case of Aba and its Region, South Eastern Nigeria. Working Paper Series on Rural óUrban Interactions and Livelihood Strategies. Human Settlements Programme, IIED, October.
- Olarinde, L.O and Manyong, V.M (2007). Risk Aversion and Sustainable Maize Production in Nigeria: Some Challenges and Prospects for Agricultural and Economic Development. *American Association of Agricultural Economists Conference Proceedings* 177-182.
- Ranjan, S. (2008). Occupational Diversification and Access to Rural Employment: Revisiting the Non-Farm Employment Debate. MPRA paper No. 7870. *Munich Personal Repec Archive, India*.

- Reardon, T.K., Stamoulis, A., Balisaca, M.E., Cruz, J; Banks, B. (1998). Rural Non-Farm Income in Developing Countries. Special Chapter in the State of Food and Agriculture 1998. Rome *FAO of the United Nations*
- Rhaji, M.A.Y (2000). An Analysis of the Determinants of Agricultural Credit Approval/Loan Size by Commercial Banks in South Western Nigeria. *Nigerian Agricultural Development Studies 1(1):16-25.*
- Schwarze, S. (2004). Determinants of Income Generating Activities of Rural Households: A Quantitative Study in the Vicinity of Love-Lindu National Park in Central Sulawesi, Indonesia. Institute of Rural Development. University of Goettingen, Goettigen.

#### **APPENDIX: Indices for Conversion into Kg-Grain Equivalents**

Crops	Index
Rice (rough)	0.80
Rice (clean)	1.19
Maize	0.75
Millet	0.68
Sorghum	0.60
Groundnut (shelled)	1.83
Groundnut (unshelled)	1.30
Soybean	1.30
All pulses	1.12

Source: Clark and Hasswell (1970)