TOBIT ANALYSIS OF THE EFFECTS OF INSTITUTIONAL SERVICES ON INPUT USE INTENSITY AMONG SMALLHOLDER FARMERS IN OYO STATE, NIGERIA

Adio, M. O.*

Olarinde, L. O.*

Adeniyi, O. A.*

ABSTRACT

This study examined the Tobit analysis of institutional services of credit, input supply, and extension in the overall commercial transformation process of smallholder agriculture in Oyo State, Nigeria. Multistage sampling technique was used to select the smallholder farmers in the study area. A total of 350 copies of questionnaire was desired and was administered. Data were subjected to descriptive statistics and tobit regression analysis. The literacy level of the respondents revealed that 45.27% of the respondents had no formal education; others (54.73%) had formal education ranging from primary to tertiary. The mean age in Ogbomoso Zone was 51 years, while that of Oyo Zone was 52 years. Average land holding in the zones was about 2 hectares. The two zones recorded lower number of extension visit in the farming year under study. Tobit estimates showed that simultaneous access to credit for fertilizer, access to credit for agro chemical, access to credit for seed, access to improved seeds, farm size, and years of schooling were important determinant factors of fertilizer, agro chemical and seed use intensity. It was concluded that, smallholders' simultaneous access to well integrated institutional support services is crucial in getting farmers to participate both in input and output markets for a better income through intensified and market oriented agriculture.

Keywords: *Institutional support services, credit, fertilizer, improved seeds and Tobit.*

* Department of Agricultural Economics, Ladoke Akintola University of Technology, P. M. B 4000, Ogbomoso, Nigeria.

Introduction

The Millennium Development Project's Hunger Task Force concluded in 2005 that "the world could meet the MDG of halving hunger by 2015", and that "development of agriculture is critical to that goal" (World Bank, 2007). Rural areas are the home of the majority in Africa and small scale agriculture is the mainstay of the rural economy serving mainly as a source of food income (Govereh et al., 1999). The literature shows that "with the adoption of improved technologies and modern techniques, access to agricultural inputs and investment in infrastructure, rapid growth in agricultural incomes is achievable in Africa" (World Bank, 2007). Smallholder agriculture, which is the predominant source of livelihoods in Africa, has proven to be as at least as efficient as larger farms when farmers have received similar support services and inputs (seed, fertilizer, and credit) (IFPRI, 2002). Many countries and international development agencies give due concern to intensification and commercialization of smallholder agriculture as a means of achieving poverty reduction; and thus they have reflected it in their official policies (Leavy and Poulton, 2007).

Smallholders manage over 80 per cent of the world's estimated 500 million small farms and provide over 80 per cent of the food consumed in a large part of the developing world, contributing significantly to poverty reduction and food security. Yet small-scale farmers often live in remote and environmentally fragile locations and are generally part of marginalized and disenfranchised populations.

Smallholders have often been neglected in debates on the future of agriculture, and left out of policy making at numerous levels (Wiggins, 2011). Of the developing world's three billion rural people, over two-thirds reside on small farms of less than two hectares; there are nearly 500 million of such small farms. Despite recurring predictions that small farms will soon disappear, they have proved remarkably persistent. Indeed, an increasing part of agricultural land in the developing world is being operated in small farms. The importance of farming in household incomes may have declined, but the number of rural households that use farming as a platform for their livelihood strategies continues to grow (IFPRI, 2005).

Meeting the challenge of improving rural incomes will require some form of transformation out of the semi-subsistence, low income and low-productivity farming system that currently characterize much of rural area in Oyo state, Nigeria

However, inadequate institutional services (credit, input supply and extension) and polices may have rendered commercial transformation improper or impossible among the smallholders. Also, identification of the single constraint that must be addressed in order for smallholders to flourish and thrive, e.g. credit or extension or input supply has not yielded the needed commercial transformation.

Literature further reveals the pervasive inefficiency of Nigerian farmers as most smallholder farmers produce significantly below their production frontiers. As a result, they produce less than optimal levels of output as revealed by studies of productivity (mostly land productivity). (Saweda et al, 2011).

A critical look into a study as this study will reveal ways of going around these problems. This study is therefore, intended to provide empirical evidence on the effectiveness of this largely public agricultural service provision in Oyo State, Nigeria in improving smallholder productivity and in inducing market oriented agricultural development.

The main objective of the study was the tobit analysis of the effects of institutional services on input use intensity and commercial transformation among smallholder farmers agriculture in Oyo State, Nigeria. The Specific Objectives are to:

- describe the socioeconomic characteristics of smallholder farmers in the study area
- examine the effects of access to institutional support service on input use intensity
- examine the effects of access to institutional support service on the adoption of improved seeds

Theoretical and Conceptual framework

Theoretical arguments and empirical evidence suggest that in poor agrarian economies, both the processes of structural change within national economies and micro-economic relations within rural economies give agriculture a pre-eminent and unique role in economic development and in poverty reduction. Rural growth is seen to be most effective in simulating sustained poverty reduction where there are strong consumption linkages between the sector 'driving' growth and other sectors. (Dorward et al, 2002)

Existing theoretical models also affirmed that farm households maximize their utility derived from net revenue, which is affected by the transaction costs of input use (Jayne et al. 2003). These models assume that, in developing countries, imperfect markets, inadequate

institutions, and credit constraints may lead to higher transaction costs. The model implies that farmers' decisions to use a given input are affected by input price, variable transaction costs, and fixed transaction costs. The relative magnitudes of these transaction costs depend on the farmers' accesses to infrastructure (roads) and agricultural services. For example, subsidized input supply services, if appropriately targeted, can help increase input use among poor farmers, while agricultural extension services might positively influence input use by improving the farmers' knowledge of the benefits of modern inputs. Similarly, access to all-season roads can reduce farmers' travel costs, thereby positively influencing input use. Furthermore, access to credit is likely to ease the farmers' financial constraints, consequently increasing input use (World Bank 2007).

Methodology

The study was carried out in Oyo State. Oyo State is located in the South West geopolitical zone of Nigeria, carved out of the former western state of Nigeria in 1976. Oyo State lies between latitude 7°N and 8°N of the equator and between longitude 3°E and 5° E of the Greenwich meridian in the rainforest zone and also extends forward to derived savanna zone. It is bounded in the west by Ogun State and partly by the Republic of Benin, in the North by Kwara State, in the East by Osun State and on the South by Ogun State. The population of Oyo State according to the National Population Commission is 6,617,720 (NPC, 2012 estimated). The State is made up of 33 local government areas. The state capital is Ibadan. It covers about 27,107.5 km² land area with annual rainfall of 1091.4mm and average maximum and minimum temperature of 44.56°C and 24.43°C. The State enjoys a tropical humid climate with two climatic seasons, the rainy season that prevails from April to October and the dry season that lasts from November to March.

Primary data was used in this study through well structured questionnaire. The Oyo State Agricultural Development Programme (OYSADEP) structure was used to draw the appropriate sample of the study. There are about 415,030 farm families in Oyo state being catered for by the Agricultural Extension Field Staff (Aderonmu T, 2008). (OYSADEP) is divided into four (4) zones namely, Saki, Ogbomoso, Oyo and Ibadan/Ibarapa. The ADP zoning in the state was used to select the smallholder farmers. Multistage sampling technique was used to select the

smallholder farmers in the study area. The first stage was the purposive selection of Ogbomoso and Oyo Zones. This is informed by the high and rapid increase of smallholders in the area. The second stage involved a random selection of three (3) Local Government areas from each zone. The third stage involved a random selection of four villages from each of the selected local government areas which was obtained from the information units of each of theses Local Government Areas (LGAs). The final stage involved proportionate (the final number of respondents to was selected from each village/community have been estimated using proportionality factor) and random selection of smallholder from the list of registered farmers in the zones. A total of 350 copies of questionnaire was desired and administered based on available cost and time.

Analytical Technique:

The dependent variables analyzed in this study are the intensity of input use per hectare (fertilizer, agrochemicals, and seed), The econometric models used and variables included is as follow:

Tobit Model

The Tobit model is a statistical model proposed by James Tobin (1958) to describe the relationship between a non-negative dependent variable y_i and an independent variable (or vector) x_i. The word Tobit is taken from Tobin and adding "it" to it. The tobit model is also called a censored regression model. The tobit model can be describe in terms of a latent variable y*. Suppose, however that y_i* is observed if y_i*> 0 and is not observed if y_i* ≤ 0. Then the observed y_i will be define as

$$Y_j = \max(Y_{j,}^* \ 0)$$

Where the$Y_{j,}^*$'s are latent variables (the variable of primary interest). Of course, we do not actually observe this variable for all the observation. We only observe it for those observations which use fertilizer, agro-chemicals and improved seed because of censoring.

$$\boldsymbol{Y_j^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \ldots + \beta_n X_n + u_j}$$

$$Y_j^* = \beta' X_j + U_j, \; Y_j = \{Y_j^* \; if \; Y_j^* > 0$$

$Y_i^* < 0$

Where X_j denotes vector of regressors, possibly including 1 for the intercept, and β' the corresponding vector of parameters. The model errors U_j, are assumed to be independently normally distributed with zero mean and constant (or homoscedastic) variance:

$$u_j \sim N(0, \sigma^2)$$

The dependent variable (Y_j^*) is the amount of fertilizer, agro-chemicals and seed used per hectare (in Kg/ha)

And the independent variables (Xs) are:

X_1 = access to services (whether household had access to credit and input supply for fertilizer (CRDTFERT)

X_2 = whether household had access to input supply and credit for agrochemicals (CRDTCHM),

X_3 = whether household had access to credit for improved seeds (CRDTSEED),

X_4 = whether household had access to improved seeds (ACCTIMPSD),

X_5 = household involvements in extension the previous year (LSTEXT),

X_6 = age

X_7 = sex

X_8 = literacy level (SCHLATT),

X_9 = Household size

X_{10} = Household labour supply (NFMLYLBR),

X_{11} = Hired Labour (HRDLBR)

X_{12} = Farm size (FRMSIZE)

X_{13} = plot distance (PLTDIST),

Discussion

A descriptive analysis was used to describe the population and the result of the socio-demographic profile of the respondent of this study. The data values such as the demographic profile include age, education level, years of farming, marital status, etc.

Tables 1 and 2 revealed the results of the socio-demographic profile of the respondent of this study.

Age distribution of the respondent

Table 1: Distribution of the respondent by their Age and Farming Experience

	Ogbomoso		Oyo	
Age range	Frequency	Percentage	Frequency	Percentage
21-30	3	1.46	9	6.25
31-40	6	2.93	16	11.11
41-50	92	44.88	43	29.86
51-60	71	34.63	44	30.56
61-70	24	11.71	21	14.58
71-80	8	3.90	10	6.94
81-90	1	0.49	1	0.69
Total	205	100	144	100
Experience				
0-10	20	9.76	7	4.86
11-20	52	25.37	38	26.39
21-30	72	35.12	50	34.72
31-40	39	19.02	29	20.14
41-50	16	7.80	14	9.72
51-60	5	2.44	5	3.47
61-70	1	0. 49	1	0.69
Total	205	100	144	100

Source: Field Survey, 2013

Marital Status, level of education, and cropping systems distribution of the respondent

Table 2: Distribution of the Respondent by Marital Status, level of education, and cropping systems

Marital Status	Frequency	Percent	Cumulative
Married	344	98.57	98.57
Single	5	1.43	100.00
School Attended			
No formal education	158	45.27	45.27
Primary education	85	24.36	69.63
Secondary education	103	29.51	99.14
Tertiary education	3	0.86	100.00
Crop Mixture			
Maize/Yam	67	19.20	19.20
Yam/Cassava	95	27.22	46.42
Maize/Yam & Yam/Cassava	187	53.58	100.00
Source of Credit			
Comm./Micro. Bank	2	0.57	0.57
Cooperative Society	138	39.54	40.11
Gov. Credit Agency	15	4.30	44.41
Daily/Monthly Cont.	69	19.77	64.18
Others	125	35.82	100.00
Farm size			
<1	56	16.04	16.04
1-2	94	26.94	42.68
>2-3	199	57.02	100
Inst. Support Service	**Yes**	**No**	**Total**
Access to credit for Fertili.	220	129	349
Access to credit Chemicals	218	131	349
Adopt Improved seed	123	226	349

Source: Field Survey, 2013

The mean age in Ogbomoso Zone is 51 years, while that of Oyo Zone is 52 years. Majority of the farmers, 57 (39.58%) and 101(49.27%) are within this age range in Oyo and Ogbomoso zone respectively. This show that most of the respondents are agile, active and in

their productive years when they can put in their best for optimum productivity. This implies that about half of the population in the zones under study was involved in active farm production. Also age is considered to be of relevance to the quality of physical labour, especially in developing countries where health and nutritional levels are poor (Fapohunda, 1984). This assertion could contribute to their level of receptivity to new technology. Average land holding is about 2 ha.

About 34% of the sample households had access to credit and input supply services for fertilizer. Slightly above 3% of the sample households had access to credit and input supply services for chemicals had access to credit and input supply for chemicals. These results indicate that credit and input supply services for an input may be jointly provided. The private sector (agro dealers) seems to be more active in agro-chemicals, although its involvement in fertilizer and improved seeds is very limited.

From the total sample households about 39% of them participated in extension program the previous year.

Econometric results: Intensity of input use

The results on Tables 3-5 show that access to institutional support services of credit, input supply for fertilizers and agrochemicals play an important role in enhancing intensity of fertilizer, chemical, and seed inputs use and adoption of improved seeds.

Fertilizer use intensity:

Table 3: Tobit estimation results for fertilizer use per hectare (Kg/ha)

Variables	Coefficient	Std. err.	P	Marginal Effects	
				A	B
Access to credit for fertilizer	0.00385**	0.00186	0.040	0.912	0.039
Access to credit for seed	-0.000112	0.00185	0.952	0.974	0.952
Access to improved seed	0.00423*	0.000440	0.000	0.000	0.000
Access to last yr extsn. servs.	0.00342	0.00228	0.135	0.702	0.134
Age (Actual)	0.0000189	0.0000144	0.190	0.595	0.189
Sex	-0.0000918	0.000403	0.820	0.607	0.820
School attended (years)	0.0000869	0.000291	0.766	0.200	0.765
Farm size (actual)	0.000162	0.000201	0.420	0.218	0.419
Number of hired labour	-0.00164*	0.000326	0.000	0.000	0.000

Number of family labour	0.000188	0.000179	0.286	0.915	0.285
Plot distance	-0.00284*	0.000405	0.000	0.009	0.000
Constant	0.00314	0.00271	0.248		
Sigma	0.00246	0.000128			
Number of observation	349				
LR chi^2 (11)	434.09				
Pro > chi^2	0.0000				
Pseudo R2	0.3542				
Log likelihood	829.806				

* significant at 1%, ** significant at 5%, *** significant at 10%

a: Marginal effects on the censored expected value, *dE*[Fertilizer/Fertilizer>0]*dx*

b: Probability of being censored, Pr(Fertilizer > 0)

Source: Field Survey, 2013

Access to credit for fertilizer and access to improved seed have positive relationships with the intensity of fertilizer use and are significant at 5% and 1% respectively. Hired labour and plot distance have negative relationships with the intensity of fertilizer use and are significant at 1%. On the whole, this result revealed that access to credit for fertilizer and access to improved seed will increase the intensity of fertilizer use. In addition, hired labour and plot distance will also leads to fertilizer use intensity but at a decreasing rate. This invariably explains the consequent effect spending more on labour as this could increases cost of production and invariably affects the profit. Also, the more distance a farm to the farmer , probably the more discourage the farmer could be. These results show that improving access to the services for fertilizer can significantly enhance fertilizer use by farmers in the zones. (The coefficient of 0.00385 in Table means that, holding other variables constant, if household had access to credit and input supply of fertilizer, its direct impact on intensity of input use will be an increase by about 0.385kg year and the probability fertilizer use will also increase 0.385 percent increase)

Intensity of chemical use:

Table 4: Tobit estimation results for chemical use per hectare (Kg/ha)

	Coef.	**Std. err.**	**Marginal Effects**		
			P	A	B
Access to credit for chemical	0.0049968**	0.00240	0.071	0.821	0.037

Access to credit for seed	0.0000101	0.00238	0.880	0.707	0.997
Access to last yr extsn. servs.	-0.0023437	0.00250	0.315	0.867	0.348
Age (Actual)	-0.0000273	0.0000173	0.040	0.028	0.113
Sex	-0.0000191	0.000488	0.581	0.528	0.969
School attended (years)	0.000768	0.000351	0.052	0.128	0.029
Farm size (actual)	0.000458***	0.000246	0.101	0.125	0.063
Number of hired labour	-0.00212*	0.000392	0.000	0.000	0.000
Number of family labour	-0.0000405	0.000215	0.941	0.478	0.850
Plot distance	-0.00439*	0.000473	0.000	0.000	0.000
Constant	0.00967	0.00300			
Sigma	0.00307	0.000160			
Number of observation	349				
LR chi^2 (11)	315.31				
Pro > chi^2	0.0000				
Pseudo R2	0.2423				
Log likelihood	808.27814				

* significant at 1%, ** significant at 5%, *** significant at 10%

a: Marginal effects on the censored expected value, *dE*[Fertilizer/Fertilizer>0]*dx*

b: Probability of being censored, Pr(Fertilizer > 0)

Source: Field Survey, 2013

Access to credit for agro chemical and farm size have positive relationships with the intensity of chemical use and are significant at 5% and 10% respectively. Hired labour and plot distance have negative relationships with the intensity of agro chemical use and are significant at 1%. On the whole, this result revealed that access to credit for agro chemical and farm size will leads to increase the intensity of chemical use. In addition, hired labour and plot distance will also leads to agro chemical use intensity but at a decreasing rate. These results show that improving access to the services for agro chemical can significantly enhance agro chemical use by farmers in the zones. (The coefficient of 0.004997 in Table means that, holding other variables constant, if household had access to credit and input supply of agro-chemicals, its direct impact on intensity of input use will be an increase by about 0.5kg and the probability fertilizer use will also increase 0.5 percent increase)

Intensity of seed use:

Table 5: Tobit estimation results for seed use per hectare (Kg/ha)

	Coefficient	Std. err.	Marginal Effects		
			P	A	B
Access to credit for fertilizer	-0.00167	0.00231	0.469	0.469	0.469
Access to credit for chemical	0.00692**	0.0226	0.002	0.002	0.002
Access to credit for seed	0.00197**	0.00080	0.015	0.014	0.014
Access to last yr extsn. servs.	-0.00308	0.00236	0.193	0.192	0.192
Farm experience	-0.0000529***	0.0003	0.079	0.078	0.078
Farm size (actual)	0.000605**	0.000269	0.025	0.025	0.025
Hired labour	-0.00106**	0.000522	0.043	0.043	0.043
Family labour	-0.0000784	0.000281	0.780	0.780	0.780
Plot distance	-0.00415*	0.000560	0.000	0.000	0.000
Age (Actual)	-0.0000606**	0.0000315	0.056	0.055	0.055
Sex	0.0000203	0.00613	0.974	0.974	0.974
School attended (years)	0.00164*	0.000396	0.000	0.000	0.000
Constant	0.00917	0.00321	0.005		
Sigma	0.00278	0.00020			
Number of observation	349				
LR chi^2 (11)	339.16				
Pro > chi^2	0.0000				
Pseudo R2	0.5607				
Log likelihood	472.0362				

* significant at 1%, ** significant at 5%, *** significant at 10%

a: Marginal effects on the censored expected value, dE[Fertilizer/Fertilizer>0]dx

b: Probability of being censored, Pr(Fertilizer > 0)

Source: Field Survey, 2013

Access to credit for seed, agro chemical, education and farm size have positive relationships with the intensity of seed use and are significant at 5%, 5%, 1% and 5% respectively. Age, hired labour and plot distance have negative relationships with the intensity of agro chemical use and are significant at 5%, 5% and 1%. On the whole, these result revealed that access to credit for seed, years of schooling and farm size will leads to increase the intensity of

seed use. This implies that the more education the farmers have, the more efficient they will be as a result of their skills, decision making, accurate resource combination and above all the willingness to identify and adopt new innovation. In addition, age of household head, hired labour and plot distance will also lead to seed use intensity but at a decreasing rate. For the negative relationship between intensity of input use and plot distance, it implies that probably, the more you move away from your residence, the more opportunity of breaking a fallow ground. These results show that improving access to the services for seed supply can significantly enhance seed use by farmers in the zones. (The coefficient of 0.00197 in Table means that, holding other variables constant, if household had access to credit and input supply of seed, its direct impact on intensity of input use will be an increase by about 0.2kg and the probability seed use will also increase 0.2 percent increase)

Test of hypotheses:

The hypotheses in this study were stated in the null form. The first hypothesis stated that, access to institutional support services have no significant effect on the intensity of input use. Table 3 to 5 stated the significant levels of these explanatory variables. Access to credit and input supply for fertilizer, agro-chemicals and improved seeds were all significant at 5 per cent level respectively. Therefore the hypothesis that access to institutional support services has no significant effect on the intensity of input use was rejected

Conclusions and Recommendations

Improving access to institutional support service of credit and input supply for fertilizers, agro-chemicals and improve seeds has a significant impact on crop productivity. Ultimately, this study strengthens the existing notion that smallholders' simultaneous access to well integrated institutional support services of credit, input supply of fertilizers and agrochemicals and extension services is crucial in getting farmers to participate both in input and output markets for a better income through intensified and market oriented agriculture.

Government and nongovernment strategies working towards the betterment of smallholder farmers, therefore, should aim at increasing both the availability and accessibility of agricultural support services. The results show that more than about 90% of the credit and input supply services for fertilizer and improved seeds are provided by the farmer cooperatives.

Oyo State Agricultural Development Programme (OYSADEP) and Oyo State Agricultural Input Supply Company (no more active) which are two principal agricultural agencies in inputs and credit disbursement should be made active and allowed to perform their roles. Credit and inputs should be made

available to the farmers by Oyo State Agricultural Input Supply Company. This will guarantee simultaneous access.

Smallholder farmers need to organize themselves into groups for easy access to formal sources of credit for the purchase of needed input of fertilizers, seeds, and agrochemicals.

More extension agents should be recruited to bridge the gap between the low Extension Agent - to – Farmers ratio

The good programme of the Federal Government Fertilizer Policy. Fertilizer Supply and Distribution in Nigeria, should include financial assistance to aid effective use of all these inputs.

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