

Original Research Article**ADOPTION OF FERTILIZER BY URBAN CROP FARMERS IN
NIGER DELTA REGION, NIGERIA****ABSTRACT**

This study was conducted in Uyo, the capital of Akwa Ibom State, Nigeria to empirically identify factors affecting the rate of adoption of chemical fertilizer by urban crop farmers. Through the multistage sampling procedure, 60 urban crop farmers were selected with the aid of questionnaire. Data were analysed using Tobit regression analysis. Results show that the rate of chemical fertilizer adoption increases where household heads advance in age, have higher literacy, larger farms and access to credit facilities but decreases where farms were located farther from homes and soils have good fertility status. Findings underscore the need to embark on market oriented interventions which will encourage urban farmers to invest in improved farming techniques is a suitable policy decision. Enhancing human capital and availability of credit at lower cost are policy options that should be vigorously pursued.

Keywords: Adoption, fertilizer, farmers, Nigeria.

1. INTRODUCTION

Economists have provided considerable evidence about agricultural technology adoption and diffusion among farmers in developing countries [1] [2]. A substantial body of literature analyzes farmers' adoption behaviour and these studies reveal considerable variation in such behaviour for agricultural technologies over time and across socioeconomic groups [3] [4]. Empirical models of technology typically include socioeconomic, physical and agro ecological variables as regressors [5] [5] [6]. Decisions to use a technology depends partly on how farmer receive, process and evaluate information about innovations. In environments where information acquisition and transfer are fraught with difficulties, the educational level of the farmer is critical [7] [8]. Moreover, the incentives to adopt a technology depend on the expected benefits, and education facilitates the sourcing, the processing and its successful application. As a result exposure to formal education is expected to increase technology adoption [7] [3] [9].

In the technology adoption literature, land is often used as a proxy for wealth. However, this variable can have an ambiguous effect on adoption. [3] suggest that small farms may be willing to adopt a technology to increase short-run profits, but financial constraints may impede such adoption. Households with larger farms are assumed to have easier access to credit and farm inputs and thus be more likely to be adopters. Moreover, extension services and agribusiness firms tend to target larger farms for trials of new agricultural technologies [10] [11]. Nevertheless, [12] argue that smaller farms may be more likely to cooperate in trials and to accept the risks and cost associated with experimentation. Hence, small-scale producers would be more inclined to adopt improved practices and to intensify their operation.

Soil health is fundamental asset for agricultural sustainability and is the most important part of any agricultural system [13]. According to [13], many agricultural systems are under threat because soils have been damaged, unproductive, eroded or simply ignored

during the process of agricultural intensification. One of the effective means of supplementing the natural soil nutrient supply, maintaining good soil conditions and restoring the health of poor soils for cropping is by use of fertilizer. [14] and [15] reported that fertilizers are substances that supply plant nutrients or amend soil fertility and are the most effective means of increasing crop production and improving the quality of food and fodder. As Nigeria is facing twin challenges of reforming the economy and reducing poverty, [16] and [15] the pressure of the increasing population in Nigeria does not only limit land resource availability for agricultural production but causes a reduction in food availability through a decline in food supply. According to [17], [15] pressure on population does not only increase food demand but affect resource use and indirectly decreases food supply. For decades, poverty, food insecurity and malnutrition were viewed as rural problems. But with the populations of many African, Caribbean and Pacific countries becoming more urban, poverty and poor nutrition are emerging as growing challenges for city dwellers [18]. With the growth in urban poverty now rapidly outstripping that of rural poverty, the use of organic wastes in urban farming can be viewed as an essential service offered to the city in providing an environmentally safe, cheap (income – generating) disposal opportunity [19]. But, recycling of organic wastes also comes with a cost, and often cause the spread of disease. Although waste recycling in urban farming may not offer an optimal solution for safe disposal of the material, an alternative approach which will alleviate the problems associated with waste recycling in farming is the use of chemical fertilizer. Despite these challenges in the use of organic waste in farming, many farmers are yet to adopt and utilize chemical fertilizer in farming. Since poor soil health and low use of inorganic fertilizers have been identified as two major factors limiting productivity growth of Agriculture in Africa (Nigeria inclusive) [20], [21], [22] and [15], incorporating chemical fertilizer as a major component in urban farming system therefore becomes imperative. This however requires an understanding of the factors responsible for the slow adoption of fertilizer and use by urban crop farmers. This study therefore attempts to identify the determinants of fertilizer use by urban crop farmers in Uyo, Nigeria.

2. METHODOLOGY

2.1 Study Area, Sampling and Data Collection Technique

This study was conducted in Akwa Ibom State, Niger Delta, Nigeria. The state is located at latitude 4°33' and 5°53' and longitude 7°25' and 8°25' East and occupies a total land areas of 7,246km². With an estimated population of about 3 million [23], the state is bounded to the North by Abia State, to the East by Cross River State, to the West by Rivers State and to the South by the Atlantic Ocean. Administratively, the state is divided into 31 Local government Areas and has 6 Agricultural Development Project (ADP) Zones viz: Oron, Abak, Ikot Ekpene, Etinan, Eket and Uyo. The study area is in the rainforest zone and has two distinct seasons viz: the rainy and the short dry season. The annual precipitation ranges from 2000 – 3000mm per annum. Most of the inhabitants of rural communities in the study area are farmers and the crops commonly cultivated include cassava, oil palm, yam, cocoyam, fluted pumpkin, okra, waterleaf, bitter-leaf etc. In addition, some micro livestock are usually raised at backyards of most homesteads [24].

The study employed multistage sampling procedure. The first stage involved the random selection of 3 out of 6 agricultural development zones (which are typically urban). The second stage involved the random selection of 20 farmers from each zone to make a total of 60 farming households. With the aid of questionnaire, data on farm size, gender, age, soil fertility status, quantity of fertilizer applied, educational level and labour employed were obtained.

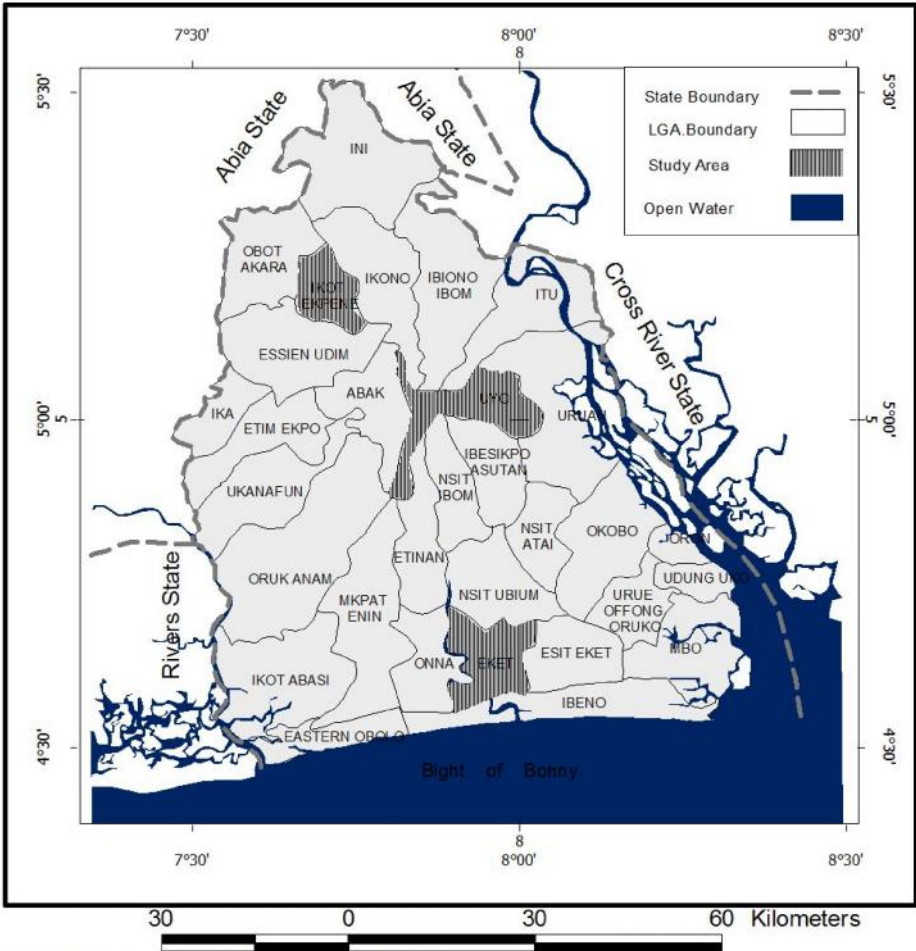


FIGURE 1: AKWA IBOM STATE SHOWING AGRIC. DEVT. PROJECT SAMPLED LOCAL GOVT. AREAS

2.2 Analytical Technique

Tobit model was used to model the effect of adoption decisions. This model, according to [25] and [26] has found several empirical applications in the adoption literature [27], [28], [29], [30], [31] and [22]. The dependent variable is level of use of inorganic fertilizer, which is censored at zero. To avoid the censoring bias that ordinary least squares could generate, a Tobit censored at zero was used because level of fertilizer use less than zero was not observed and most respondents reported zero application. As reported by [30] and [22], a bias to the parameter estimates is also imparted even when a Tobit procedure is incorrectly used assuming that the true point of censoring in the sample is zero. Other estimation approaches, such as the Heckman's model also generate unbiased results [31]. But the Tobit approach conserves degrees of freedom and is relevant in this case where the explanatory variables have a continuous effect on the dependent variable.

Since the level of fertilizer use cannot be negative (the threshold is zero), the dependent variable can be written using an index function approach as:

$I_i^* = \beta^T X_i + e_i$ (1)

$Y_i = 0 \text{ if } I_i^* \leq T$ (2)

$Y_i = 1 \text{ if } I_i^* > T$ (3)

Where Y_i represents a limited dependent variable, which simultaneously measures the decision to use fertilizer and the use intensity. I_i^* is an underlying latent variable that

indexes adoption. T is an observed threshold level. X is the vector of independent variables affecting adoption and intensity of use. β^T is a vector of parameters to be estimated e_i is the error term. If the non-observed value of I^* is greater than T , the observed variable T , becomes a continuous function of the independent variables and O otherwise. For the generalized case, the value of the log likelihood function is given as

2.3 Empirical Model

The model is presented as

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, e)$$

Where Y = Total quantity of fertilizer used on urban crop farm (kg/ha)

X_1 = Gender of the farmer ($D = 1$ if male, O if otherwise)

X_2 = Age of the farmer in years

X_3 = Education of the farmer in years

X_4 = Land size in hectares

X_5 = Average walking time to nearest farm in minutes

X_6 = Average walking time to nearest market in minutes

X_7 = Tenancy status of the farmer ($D = 1$ if tenant, O if otherwise)

X_8 = Soil fertility status of the land ($D = 1$ if yes, O if otherwise)

X_9 = Access to credit ($D = 1$ if yes, O if otherwise)

X_{10} = Family labor in mandays

X_{11} = Population pressure on available land (number of persons per hectare)

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistics

The summary statistics of the dependent and independent variables are presented in Table 1. The mean land size utilized for urban crop farming was 0.9 hectares. This result suggests that urban crop production was on subsistence level. Result conforms with recent empirical findings by [32] and [15]. The smallness in land sizes may be attributable to the prevalent tenure arrangement in southern Nigeria which encourages fragmentation of holdings. Finding is synonymous with earlier result of [16] who documented that the prevalent land tenure system has a number of demerits for moving agriculture from subsistence level to market oriented production and the system of inheritance tends to perpetuate fragmentation of holding among the male heirs of land owning families. The high mean value of family labour suggest that urban crop cultivation require substantial amount of labour as most labour employed in various farming operations were provided by members of the family. The high availability of labour is an indication of larger family size. Result on age and education suggest that urban crop farmers are within an active and productive age and have acquired considerable level of formal schooling. [15] obtained similar result. The average walking time of 30 minutes to the nearest market imply that most of the farm outputs were readily disposed and thus the quantity of stale products were reduced as most of the urban farming products were fresh and highly perishable. The average walking time of 60 minutes to the nearest farm suggest that urban farms were located farer from homes and therefore were less intensively cultivated.

Table 1: Summary Statistics of Variables

Variables	Unit	Mean Value	Range
Farm size	Hectare	0.9	0.4 – 1.2
Age	Years	23	16 – 49
Family labour	Manday	140.68	89.20 – 171.08
Education	Years	10	5 – 14
Walking time to nearest market	Minutes	30	45 – 60
	Minutes	60	30 – 90
Walking time to nearest farm			
Population pressure	Person/ha	7	4 – 16

Fertilizer use by urban crop farmers	Kilogram	128.84	50 – 200
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3.2 Test Result for Collinearity among Specified Variables in the Model

The VIF test result for multicollinearity between the dependent variable and the explanatory variables used in the Tobit model is presented in Table 2. The result showed that there was no significant collinearity between the explanatory variables and the dependent variables in the model. Result implies that the estimates of the Tobit model have minimum variance, consistence and probably unbiasedness.

Table 2: The variance inflation factors (VIF) test result for multicollinearity of variables used in the analysis

Variable	VIF Estimates
Age	2.152
Education	1.921
Land size	3.210
Average walking time to nearest farm	1.430
Average walking time to nearest market	2.122
Family labour	2.434
Population pressure	3.235

3.3 Tobit Model Estimate Results

In this study, land size in hectares is taken as a proxy for wealth. The variable, is positively significant ($p < .01$). This implies that increasing the size of land for farming will lead to increased adoption and intensity of chemical fertilizer use. [33]; [34]; [28]; [22]; [15] variously and empirically documented the positive effect of farm size on adoption in similar studies. The cost of adoption, risk perceptions and large fixed costs in small farms are affected by farm size and are constraints to technology adoption. Earlier findings by [33] and [15] agree with this study.

The variable age could positively or negatively affect adoption. Younger farmers are more likely to adopt agricultural innovations and vice versa. In this study, however, as shown in table 3, age has a positive sign and significantly impacts on adoption. Age indexes experience and services as evidence for human capital revealing that urban farmers with more years of farming experience acquired from accumulated years of observation and experimentation with various agricultural technologies are more likely to adopt innovations faster than urban farmers with less experience in farming. Similar and empirical studies by [35]; [36]; [32] and [37] found that increased experience in cultivation may also enhance critical evaluation of the relevance of better production decisions, including efficient utilization of productive resources.

The variable education has a coefficient of 0.711 and significant ($p < 0.10$). This means that urban farmers that have acquired some form of formal education are more likely to adopt improved farming techniques earlier and faster than the uneducated ones. Similar empirical findings were reported by [38]; [39]; [40]; [41] and [42]. This result supports the hypothesis that human capital plays a positive role in the acquisition and evaluation of new ideas. Moreover, programs and materials promoting technological change typically favor literate farmers. This result is also consistent with other findings in Africa, including, [43] in Cameroon, [10] and [5] in Ethiopia [44] in Malawi and [45] in Nigeria

The elasticity of the average walking time to the farm is negatively significant at ($p < .01$). This implies that urban farms located farer from homes are less intensively cultivated and thus lesser fertilizer use and adoption than farms located nearer to homes. This result agrees with recent and empirical findings by [15].

The variable soil fertility status is negatively significant ($p < 0.01$). This implies that urban farmers whose soil fertility status are poor would be more likely to increase their rate

of adoption and use intensity of fertilizer. Finding is consistent with recent empirical result of [22] and [15]. This result is however contrary to earlier findings of [46] who observed that regions with better soil quality and higher water availability are more likely to adopt and intensify fertilizer use.

The variable credit is positive as expected and is significant ($P < 0.01$). Result implies that accessibility to and availability of credit to urban farmers eliminates the production constraints and thus makes it easier for timely purchase of improved farming inputs. Result is synonymous with findings of [47]; [36]; [37] and [41].

Table 3: Estimates of the Determinants of Adoption

Variable	Coefficient	Standard Error	t-ratio
Intercept	-0.572	0.266	-2.150**
Sex X_1	-0.812	0.622	1.305
Age X_2	-0.308	0.108	-2.852***
Education X_3	0.711	0.424	1.677*
Land size X_4	0.055	0.027	2.037**
Average walking time to nearest farm X_5	-0.026	0.011	-2.364**
Average walking time to nearest market X_6	0.194	0.963	0.2015
Tenancy status X_7	0.011	0.014	0.786
Soil fertility status X_8	-1.044	0.422	2.474**
Access to credit X_9	0.668	0.195	3.426***
Family labor X_{10}	-1.284	0.958	-1.340
Population pressure X_{11}	0.375	0.089	4.213***

4. Conclusion

In this study, factors affecting the rate of adoption of chemical fertilizer by urban crop farming households were estimated using the Tobit model. The analysis reveals that the most critical factors affecting the rate of adoption and use intensity of chemical fertilizer are age and educational level of the farmer, land size under cultivation, average walking time to the nearest farm, soil fertility status of the land and accessibility to credit facilities. Findings suggest the need to formulate policies aimed at encouraging human capital development, training, increased urban cultivable areas. The provision of credit facilities and capital at lower cost is a rational policy decision.

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