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ANALYSIS OF THE EFFECT OF SOCIO-ECONOMIC CHARACTERISTICS OF NIGERIAN FARMERS' ON ACCESS AND USE OF TRACTOR FOR FARM MECHANIZATION: AN APPLICATION OF LOGISTIC ANALYSIS

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ABSTRACT

This study aims to identify various socio-economic variables that affect the farmers' decisions to Access and use farm tractors in Kaduna State. The study area was divided into five Local Government Areas and using Local Government Secretariat as sampling units, 40 Persons were selected per Local Government Area using the simple random sampling technique. A total of 300 respondents were interviewed using structured questionnaires. A logistic function model was employed to identify the main Characteristics influencing farm tractors access and usage by Persons on farms surveyed in the district. The SAS computer package was used to derive the maximum likelihood estimates of the access and usage process and to calculate the chi-square. The results of the logit analysis showed that education, age and land size were significant at 0.05 level of significance. Formal education is vital and farmers should be educated about the need to promote farm tractors. Attention should be focused on older farmers who are mainly the decision-makers in most Persons. The role of extension in promoting farm tractors should not be played down especially as concerns providing technical advice. Small-scale farmers should be encouraged to commercialise farm tractors so as to diversify their source of income.

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INTRODUCTION

Nigeria is one of the countries in the World that is blessed with both human and material resources (USAID, 2012). In terms of human resources, Nigeria has an estimated population of about 165 million people (NBS, 2012) that are engaged in agricultural and non-agricultural activities. It occupies an estimated land mass of 92.6 million hectare that has tremendous potentials for crop production. Out of the total land mass, the arable land area was 79 million hectares (Federal Ministry of Agriculture and Natural Resources (FMANR, 2010) and out of the 79 million hectares, only about 52 million hectares is usually cultivated (FMANR, 2010) living an excess of about 67 million hectares uncultivated. This implies that land availability is not a major limiting factor in agricultural development but despite the available land and human resources. In fact, Nigeria is one of the major importers of food items in the Sub-Saharan Africa. Report by FAO (2015) indicated that Nigeria was the highest importer of rice in the Sub-African region.

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In order to improve food production, Nigerian farmers have to Access and use farm mechanization because it is a means of enhancing human productivity and often with the intention to achieve results beyond the capacity for human labour (FAO, 2008). Advanced countries in the World that have made remarkable and enviable progress in food production Access and use farm mechanization through the use of modern technologies like tractors and its implements. (Ajah,2016).For instance, in America 95 percent of her agriculture is mechanized with only 26 percent of her population engaged in agriculture yet they produce enough to the extent that they export their outputs to other countries of the World. This is at variance to what is obtained in Nigeria where less than 2 percent of the agricultural production is mechanized (Faborode, 2001). This portrays the importance of farm mechanization hence it has been globally virtualized as the pivot to agricultural transformation. Because of the importance of farm mechanization, food experts have argued that Nigerian farmers are unable to produce enough food for her growing population and raw materials for agro-industries due to the use of local or crude implements that are manually operated (Dauda, Agidi and Shotunde, 2010). Hence, for Nigeria to

develop her agricultural sector and be relatively self-sufficient in food production, agricultural mechanization remains one of the best options if not the only option. To embrace agricultural mechanization, one of the most important agricultural technologies that Nigerian farmers must have access to is tractor and its implements. Although farm mechanization according to Maharjah and Cheltin (2006) encompasses, in its widest sense, hand tools, draught animals and mechanical technologies, tractor is one of the most important mechanical power because it is a major element in farm mechanization (Ishola and Adeoti, 2006). To emphasize the importance of tractor, agricultural mechanization is synonymous with tractorization. It is a critical input for agricultural mechanization and a major indicator for assessing level of agricultural development in any country (NAERLS and In a survey conducted by Naerls and Npfs (2011), it was revealed that about 28 states including Kaduna had a total of 1,579 functional tractors in 2011. Kaduna, where the study was conducted had 77 public-owned tractors. Although information on private-owned tractors could not be accessed, it is clear that the number of tractors available was insignificant when compared to the farming population and available land resource in Nigeria.

Since Nigerian farmers have been advised to embrace agricultural mechanization as a way of increasing food production and report by Naerls and Npfs (2011) indicated that most states in Nigeria including Kaduna had some functional tractors, there is every need to identify the Characteristics limiting small-scale farmers access and use of tractors for farm mechanization for farm mechanization in Kaduna, Nigeria. This is very important because if tractors are not affordable to farmers or available in public and private offices but not accessible, it makes no meaning to a farmer who needs it for production purposes. Again, it is necessary because documented evidence revealed that tractors were introduced in Nigeria in the 1950's (Dauda *et al* 2010) implying that this is not a new technology in Nigeria. Since 1950s till date, the level of Access and use and diffusion of farm mechanization should be very high enough for the Nigerian farmers to operate mechanized farms. The broad objective of the study is to analyse the effects of the socio-economic characteristics of the farmers as Characteristics small-scale farmers' access and use of tractors for farm mechanization in Kaduna, Nigeria.

MATERIALS AND METHODS

Secondary and primary data was collected and used in the analysis. Secondary data was collected from existing and relevant literature and publications. Vital information was also collected from the Ministry of Agriculture and forestry, Northern Kaduna State Local Government Authority and Kaduna Agricultural Development Programme (KADP). The study area was divided into 5 Local Government Areas. Using Persons as sampling units, 60 Persons were selected per Local Government Area using the simple random sampling technique. This was to give each household an equal likely chance of being selected and avoid any bias that may arise otherwise. Both accessors (farmers currently managing farm tractors) and non- accessors (farmers who have interacted with accessors but decided not to Access and use farm tractors, dropped it after trying or never tried at all) were interviewed, using a structured questionnaire that had lead and open-ended questions. Two analytical approaches were used. The chi-square and logit model.

Chi-square Analysis

The status of the respondents' level of access and usage (accessors or non-accessors) of farm tractors was classified in groups and with respect to each socio-economic variable, a contingency table was drawn up. The chi-square statistic was used to analyse the contingency table data. The formula is given below;

$$c2 = S\ (fe\text{-}fo)\ 2/fe \quad (1)$$

Where;
c_2 = Chi-square
f_e = Expected frequency
f_o = Observed frequency

The use of chi-square helps to decide whether two variables independent or dependent are related in a population. The test also determines if a conspicuous discrepancy exists between the observed and expected counts. It was employed in the analysis to test whether the explanatory variables were related among the accessors and non-accessors.

Logit Model

For this study in Northern Region of Kaduna State, the logit model was used because it reflected the empirically observed status of farm tractors on any particular farm. Such observations reflect a dichotomous variable, access and usage or non-access and usage. This 'access and usage behavioural model' with dichotomous (or binary) dependent variables can be used as a conceptual framework to examine variables associated with the access and usage of technology. Although least square estimates can be computed binary models, the error terms are likely to be heteroscedastic leading to inefficient parameter estimates; thus, classical hypothesis tests, such as the t-ratios are inappropriate (Pindyck and Rubinfeld, 1981). The application of the conventional OLS techniques result in bias by over estimation and inconsistency (Maddala, 1985, p.2) and it has been shown both theoretically and empirically that a logit analysis is more appropriate in such cases (Maddala, 1985, p169-196). The use of logit, which gives the maximum likelihood estimates, overcome most of the problems associated with linear probability models and provides estimators that are asymptotically consistent, efficient and gaussian so that the analogue of the regression t-test can be applied. The logit model based on the cumulative logistic probability function, is computationally easier to use and testified in (Pindyck and Rubinfeld, 1981, p.511 and p.287).
Conceptually, the following is the general access and usage behavioural model used to examine the Characteristics influencing the farmer's decision to Access and use farm tractors;

$$P_i = F\ (Z_i) \quad (2)$$

$$Z_i = \beta_o + \sum^{n}_{j=}1\beta jX_{ji} \quad (3)$$

Where:
Pi = The probability that an individual will Access and use a given resource base

(the binary variable, Pi = 1 for an Accessor and Pi = 0 for an non-Accessor)

Z_i = Estimated variable or index for the ith observation
F = The functional relationship between Pi and Zi
i = 1,2 ..., m are observations on variables for the access and usage model.

They are defined in Table 1 for this analysis, m being the sample size 300

X_{ji} = The jth explanatory variable for the ith observation, j = 1,2 ... n

b_j = A parameter, j = 0,1 .....n
j = 0,1....., n where n is the total number of explanatory variables.

The logit model assumes the underlying index, Z_i is a random variable that predicts the probability of the farmer's decision to Access and use farm tractors;

$$P_i = \frac{1}{1+e-Zi}$$

$$P_i = \frac{1}{1+e^{-Z_i}} \quad (4)$$

(The probability that an individual will Access and use a given tractor)

$$1-P_i = \frac{1}{1+e^{Zi}} \quad (5)$$

(Probability that an individual will not Access and use a given tractor)

Therefore:

$$\frac{P_i}{1-P_i} = \frac{1+e^{Zi}}{1+e^{Z_i}} \quad (6)$$

$$Li = Ln\frac{P_i}{1-P_i} = Ln\frac{1+e^{Zi}}{1+e^{-Z_i}} = Lne^{Zi} = Zi = \beta_0 + \sum_{j=1}^{n}\beta_j X_{ji} \quad (7)$$

This is the logit model (Engelman, 1981 and Gujarati, 1988)

RESULTS

For this study, the stimulus index Zi was determined as a linear function of the explanatory variable summarized in the Table 1. The age of the member of the household who manages the farm indicates their capacity to work. It also affects one's ability to Access and use innovations and changes. The maximum likelihood analysis results (Table 2) showed a positive relationship between age and the decision to Access and use farm tractors. This indicates that age influences the farmers' decision to Access and use. The age of the farmer affected the farmer's knowledge and the awareness of the activities in the surrounding environment among other farmers. Analysis of the data using chi- square showed that c2 = 17.610, which was statistically significant at 0.05 level of significance.

Table 1. Explanatory and Corresponding Binary Variables for Access and usage of Farm Tractors in Northern Kaduna State Local Government 2017

Explanatory Dummy Variable (Xi)	Binary Variable Value	Descriptor of Farmer
Age (X1)	0	Less than 21 Years
	1	21 - 55 Years
	2	Over 55 Years
Sex (X2)	0	Female
	1	Male
Education (X3)	0	No Formal Education
	1	Has Formal Education
Land Size (X4)	0	0 - 5 acres
	1	5-10 acres
	2	Over 10 acres
Disposable Income (X5)	0	Less than $1 p.a
	1	N60000 - 120000 Pa.
	2	More than N120000 Pa.
Off Farm Income (X6)	0	No Source of off Farm Income
	1	Has Source of off Farm Income

Table 2. Analysis of Maximum Likelihood Estimates for Access and use

Independent Variable	Estimates	Standard Error	Chi-square	Probability
Intercept	1.5650	0.8680	6.8500	0.0628
Sex	0.0687	0.5666	0.0280	0.7656
Education	0.6728	0.0166	6.0800	0.0065*
Age	1.9695	0.6102	17.6100	0.0007*

*Significant at 0.05 level of significance

Table 3. Analysis of Maximum Likelihood Estimates for Access and usage

Independent Variables	Estimates	Standard Error	Chi-square	Probability
Intercept	1.5650	0.8680	6.8500	0.0628
Land Size	1.1595	0.2829	25.192	0.0006*
Non-farm Income	0.0125	0.6006	0.6600	0.2100
Disposable	0.0596	0.0705	0.2900	0.6110

* Significant at 0.05 level of significance

The logit model in Table 3 showed a significant relationship between land size and the farmer's decision to Access and use farm tractors. Chi-square c2= 25.192. Land size is an indicator of the available economic resources and the willingness to Access and use a new technology. It revolves around Characteristics such as the risk, preference, capital constraints, labour requirement and the tenurial arrangements (Arnold, 1990). In agricultural zones, tree crops compete with cash crops with the latter being preferred. Farmers is high potential areas are therefore unwilling to divert land available for food and cash crops to trees which do not generate an equally lucrative product.

DISCUSSION

Social Characteristics that influence the Decision to Access and use Farm Tractors in Kaduna State

The results of the maximum likelihood analysis in Table 2 showed that there was a non-significant positive relationship between sex and the decision to Access and use farm tractors showing that males are not necessarily better accessors than females. Analysis using chi-square gave c2= 0.028, which was statistically non-significant at 0.05 level of significance. Sex is thus not a critical issue in a farmer's decision to Access and

use farm tractors. A significant difference was found between the level of literacy among accessors and non-accessors at 0.05 level of significance. The logit model indicated a positive significant relationship between access and usage of farm tractors and education. This accords with Oram (1988) who showed formal education as a vital aspect in the farmer's decision to Access and use farm tractors and the fact that literate farmers would be accessors. Formal education would therefore be a critical factor in influencing the effectiveness of the farmer's participation in farm tractors. Chi-square c2= 6.05 indicating education is statistically significant at 0.05 level of significance. An educated farmer can readily access information on the value of farm tractors and how it can be effectively implemented.

Economic Characteristics that influence the Decision to Access and use Farm Tractors in Kaduna State

Non-farm income incorporates income earned by the household from different sources other than the farm. It was apparent that non-farm income sources varied greatly. This included trade, employment, casual work, credit, relatives, friends and miscellaneous sources. The logit model showed that non-farm income was non-significant at 0.05 level of significance. Chi-square c2 = 0.66. Thus, the off-farm income earned by the household did not affect the farmers ability to Access and use farm tractors. This is because its investment is low cost. Disposable income is the income that is left to the household to spend after taxation.

It encompasses money accrued from different sources and used as expenditure for the household and savings. Judging from the logit coefficient, the household's level of income is a pre-disposable factor. It is not critical in the decision-making framework. Statistically, the decision to Access and use is not based on the income level. This is attributed to the fact that tree seedlings are cheap and in other instances the farmers are given the seedlings free by organizations trying to promote farm tractors in the area. Since majority (70%) of the Persons in Northern Kaduna State fall in the low-income category of less than $1per annum then, for farm tractors to be Access and use, this is the income group that needs to be targeted. This is also the threshold disposable income that can trigger the access and usage of farm tractors in the district. This is arrived at by the fact that farm tractorsare a low-cost investment. The low price of seedlings and readily available family labour makes the low-income group (less than $1 per annum) the target group. This low-income group comprises the impoverished lot and their meagre earnings cannot support expensive technologies. They are resource poor farmers most of them having less than three acres of land thus justifying the income level of less than $1 per annum the threshold income of the respondents interviewed, 77.5% of them were accessors and 22.5% were not.

The government working hand in hand with interested Non-Governmental Organizations should put in place a clear policy that emphasizes on the need to promote farm tractors within a view of alleviating general poverty. Each of the socio-economic variables studied should be addressed at levels in which it affects the farmer's decision to Access and use farm tractors. The policy implementation should be concentrated at the district level to bring it closer to the people. Promotion of farm tractors will help to reduce the imbalance in the market of timber and poles and make the marketing of the product efficient. Formal education is vital in promoting farm tractors in the area through educating farmers on its importance and the risk of deforestation. Attention should be focused on older farmers who are mainly the decision-makers in most Persons and conservatives in technology access and usage. Small-scale farmers should be encouraged to grow more trees and to commercialise this investment so as to diversify on their source of income.

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