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EFFECTS OF THE ADOPTION OF EXTENSION TECHNOLOGIES ON THE TECHNICAL EFFICIENCY OF MAIZE FARMERS IN OYO STATE

Olapade-Ogunwole F Adedeji I.A and Ogunniyi L.T

Ladoke Akintola University Of Technology Ogbomoso Oyo State Nigeria

ABSTRACT

This research work broadly examined the effects of adoption of extension technologies on the technical efficiency of maize farmers in Oyo state, Nigeria. The study is specific objectives are to examine the socio economic characteristic of the maize farmers, investigate the different maize extension technologies adopted by the respondents, determine the technical efficiency of the maize farmers and identify the constraints faced by the maize farmers during the adoption of maize extension technologies in the study area. The study employed the use of cross -sectional data from farm business survey conducted on a sample of 260 farmers from different local government areas of the study. The data were collected with the aid of structured questionnaire and were later analyzed.

The study employed the following analytical tools in order to analyze the data collected from the field. Descriptive statistics such as frequency distribution, percentages were used to describe the socio economic characteristics of maize farmers while econometric analytical tools involved such as regression analyses used to test for the first hypothesis; logit model was the used to test the second hypothesis while stochastic frontier production function analysis was used to analyses the technical efficiencies of maize farmers as well as the determinant of their technical efficiencies.

Among the maize farmers, the variable that were significant includes labour (at 5%) fertilizer quantity used (10%) seed quantity used (1%) and herbicides quantity used (1%). By implication the above findings revealed that the major productive inputs that greatly impacted on the maize roping of the maize farmers' enterprise were the aforementioned significant variables while the herbicides quantity used existed as the most important input that impact on maize output of the respondents

Regressions analysis also shows that there is significant relationship between the socio-economics characteristics of the respondents and the maize output, therefore the formulated first hypothesis was also rejected and the alternative hypothesis was accepted.

The mean technical efficiency of the maize farmers showed that the maize farmers were technically efficiency based on the stochastic frontier results, therefore the formulated second hypothesis was also rejected.

KEYWORD; Effect, Adoption, Extension Technologies, Maize Farmers.

INTRODUCTION

Many researchers and policymakers have focused on the impact of adoption of new technologies in increasing farm productivity and income (Hayami and Ruttan, 1985). However, during the last two decades, major technological gains stemming from the green revolution seem to have been largely exhausted across the developing world. This suggests that attention to productivity gains arising from a more efficient use of existing technology is justified (Bravo-Ureta and Pinheiro, 1997). Inefficiency in production means that output can be increased without additional conventional inputs and new technology. Therefore, empirical measures are necessary to determine the gains that could be obtained by improving efficiency in agricultural production with a given technology. An important policy implication stemming from significant levels of inefficiency is that it might be cost effective to achieve short-run increases in farm output, and thus income, by concentrating on improving efficiency rather than on the introduction of new technologies (Shapiro and Müller, 1977).

Agriculture is the mainstay of the Nigeria economy and is characterized by mixed farming system. Expected increases in agriculture requires increase in agricultural productivity. Agricultural productivity very much depends on the efficiency of the production process. Policies designed to educate people through proper agricultural extension services could have a great impact in increasing the level of efficiency and hence agricultural productivity.

Agricultural growth in Nigeria is increasingly recognized as central to sustained improvement in economic development of the nation and food security of the population. Agriculture has many ascribed roles to perform in the course of the country's economic development. Critical among these roles are those of providing adequate food for an increasing population, supply of adequate raw materials to a growing industrial sector and foreign exchange earnings.

Technical efficiency measurement has been the concern of researchers with an aim to investigate the technical efficiency levels of farmers engaged in agricultural activities. Empirical studies in developing countries suggest that farmers are unable to utilize maximum potentiality of technology due to their management capacity.

The government uses extension as a support service as well as a policy instrument for influencing farmer's behaviour to achieve its policy goals. In designing an extension system, contact with farmers, their active participation and the determination of farmers' need for technology are critical (Basnyat, 1995).

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Improved Agricultural Technology

The Nigerian policy makers generally agreed that development of agricultural system depends on the rate at which we achieve the intensification of agricultural activities, Falusi (1973), Falusi and Adubifa (1975), Umeh (1990, 1997) Antle (2003). One way of doing this is through the adoption of improved technologies. Olayide (1980) defined technology as the systematic application of collective human rationality to the solution of problems by asserting control over nature and human processes of all kinds. Technological development has also been defined as the technological change or progress that culminates in an increase in productivity or efficiency. Technological development occurs in step-by-step direction, starting with invention or applied research, testing of the feasibility using small-scale models innovation or actual use of the model and the diffusion of the change.

The term "agricultural technology" connotes different things depending on the inclination of the contributor. It can be defined to suit individual and or organization's aims and objectives. Nelson and Phelps (2006) defined technology as all improved methods, techniques, materials, tools etc. aimed at agricultural modernization. It includes such things as new implements, improved tools, improved seeds, fertilizer, insecticides, pesticides, storage facilities, irrigation facilities etc. Tweeten (2007), also defined technology as those forces that increase farm output with a given dollar volume of production inputs (farmland, labour, and purchased inputs including new and improved inputs and changes in farm management practices, specialization, and institutions serving agriculture.

The current novel thing in the developing countries is to indulge in technological package recommendation. By this, an innovation consists of a set of specific packages. Here, technical recommendations are presented as a set of interdependent prescriptions to be adopted in conjunction with each other or along a particular scenario. When a new hybrid seed is being recommended to the farmers, there are specific recommendations on such activities as land selection, preparation, sowing, agronomic practices including weeding, fertilization etc. to complement. This is largely the approach adopted in the Agricultural Development Programme in Nigeria and is based on the premise that the effectiveness of one factor or practice frequently would be enhanced because of its use in conjunction with a complex of other improved practices. For example, a study of United States agriculture revealed that the hybrid corn when first introduced in the south eastern United States caused relatively small yield increase per acre, and therefore, hybrid varieties did not add much to farm incomes. However when improved hybrid corn was combined with more fertilizer, closer spacing of plants and good tillage practices, the hybrids yielded highly satisfactory results. In essence at technological package is a combination of biological, chemical and mechanical technologies.

Available technologies can be broadly classified based on the sources, type and their characteristics. Technology can take two forms. First new products can be introduced, second new processes can be developed which give more output per unit of resource employed. Benefits from technology arise principally in two forms; either the new state of art saves resources or it provides a larger output from a given resource commitment. Stoneman (2003) further classified technology as either embodied or disembodied. It defined disembodied technological change as a state where "independent of may changes in the factor inputs, the isoquant contours of the production functions shift towards the origin as time passes, while embodied technological change comprises improvements that are only associated with investment in new equipment and skills, with old equipment left unenhanced. The new technology is built into or embodied in new capital equipment or newly trained or retrained labour.

Statement of the Problems

Extension has diverse definitions but can be summarized as a field where agricultural professionals play a role in identifying, adapting and sharing technology that is appropriate to the needs of individual farmers within diverse agro-ecological and socioeconomic contexts (Landon and Powell, 1996). Many factors contribute towards the development of agriculture, including extension as an institutional input. According to a worldwide survey conducted by the FAO in 1988–9, about 81% of extension work around the world is carried out through a ministry or department of agriculture (Umali and Schwartz, 1994).

Agricultural extension service in Nigeria is said to be ineffective and inefficient in transferring the technologies to the farmers. Sacay (1987) stated that the level of adoption of technology by the Nigeria farmers was low. For one reason or another, they have not taken advantage of modern technology. The force of non extension variables could be far greater than the so-called extension variables affecting food production and income in the agricultural rural sector. Implementation of more than one extension approach in the same district and village, lack of clear and timely policy guidelines, ignorance of non awareness to the policies laid down in the development plan of the country and no commitment to implement the strategies and directives given in the development plan are examples of the lack of national policy guidelines in Nigeria (Basnyat, 1995).

In addition, there is growing uncertainty about what role extension is supposed to play in the development process. There is now a much-reduced emphasis on uniform messages (such as those provided by the T&V system). The need to involve farmers more in the extension process itself has been recognized for some time and a number of participatory and facilitation approaches have been developed (Roling, 1995; Coldevin, 2000). Now, however, serious reservations are being expressed about the performance and capability of this sector, placing the future of the public extension system in doubt. Furthermore, large numbers of farmers remain outside the ambit of extension providers (Prinsley et al., 1994).

Khairo and Battese (2005) found that agricultural extension advice, formal schooling, off-farm income and the ages of maize farmers were important factors affecting the technical inefficiencies of maize farmers within the new agriculture extension program in the Harari Region of Ethiopia. Therefore, they concluded that agricultural policy makers need to look for alternative means of strengthening the social and economic basis of maize farmers in order to address resource constraints and low productivity in maize production.

Extension for sustainable agriculture systems must therefore emphasize helping individual farmers critically assess their situations and promote local cooperation and coordination of common resources. In order to move from a teaching paradigm towards a learning paradigm, highly participatory interaction and knowledge sharing among all actors is critical for extension institutions both in applied extension programs and at teaching institutions (Roling and Pretty, 1997). This is attributed to a number of factors including poorly motivated staff, a preponderance of non extension duties, inadequate operational funds, lack of relevant technology, topdown planning, centralized management, and a general absence of accountability in the public sector (Antholt, 1994). Overall, public extension services have consistently failed to deal with the site-specific needs and problems of the farmers (Ahmad, 1999). Production efficiency has two components: technical and allocative efficiency. Technical efficiency is the extent to which the maximum possible output is achieved from a given combination of inputs. On the other hand, a producer is said to be allocatively efficient if production occurs in a subset of economic region of the production possibilities set that satisfies the producer's behavioral objective (Ellis, 1988). Farrell (1957) distinguishes between technical and allocative efficiency in production through the use of a 'frontier' production function. Technical Efficiency is the ability to produce a given level of output with a minimum quantity of inputs under certain technology. Allocative efficiency refers to the ability of choosing optimal input levels for given factor prices. Overall productive efficiency is the product of technical and allocative efficiency.

Thus, if a farmer has achieved both technically and allocatively efficient levels of production, then the farmer is economically efficient. In this case, new investment streams may be critical for any new development.

In view of the antecedents, this study will provide answer to the following research questions.

i. What are the socio-economic characteristics of the maize farmers in the study area?
ii. What are the different maize extension technologies available and adopted by the respondents in the study area?
iii. Whatare the technical efficiency of the maize farmers in the study area?
iv. What are the constraints faced by the respondents when adopting maize extension technologies in the study area?

Hypotheses of the study

H_o1: There is no significant relationship between the socio-economic characteristics of the respondents and their maize output.

H_o2: Maize farmers are not technically efficient.

Materials and Method

The Study Area

This study was carried out in Oyo State, Nigeria. The state is predominantly agrarian. It lies in the equatorial rainforest belt and the rainfall around this area varies from 1500mm to 1800mm per annum. There is distinct wet season from April to late October and dry season from November to March; the areas have a mean annual temperature of 26.2 degree Celsius, the humidity is high between July and December and low between December and February.

The main occupation of the people is farming and farms are semi commercial units, which largely rely on rainfall as the chief source of water supply. In addition, farming household structure is basically of two types; the nuclear type called farm family and the extended type called the-farming household.

Majority of these farming households rely basically on the use of manual labour and simple tools such as hoe, cutlasses and matchets, and make insignificant use of capital intensive operation such as mechanization for ploughing, harrowing and ridging on their individual farms. The principal stages of production in the farming cycle are land preparation, planting, weeding and harvesting which require inputs of labour (man-days). The shortage of family or household labour during the production season often necessitates the introduction of hired labour to complement household labour on the farm. This often forces the farm owner to obtain credit in order to pay wages as well as purchase farm inputs (fertilizer, chemical and seed).

Source and Type of Data

The data that were used for this study are mainly primary data, which were obtained through the use of a structured questionnaire and interview schedule for the literate and non-literate respondents.

A multi-stage stratified random sampling technique was adopted in this study. Oyo state ADP has been stratified into four administrative zones (Ibadan/Ibarapa, Oyo, Oke-Ogun/Shaki and Ogbomoso). These zones were sub-divided into blocks and circles. Comprehensive lists of farm families in all the zones were obtained from OYSADEP Headquarters. Out of the total of 265,000 farm families listed under the ADP, Ibadan/Ibarapa had 81,507, Oyo, 49,483, Oke-Ogun/Shaki 37,826 and Ogbomoso 96,229. To ensure representativeness, two hundred and sixty copies of questionnaires were divided in proportion to the number of circle in each zone.

The copies of questionnaire that were administered in each zone were further divided in proportion to the number of farm families in each circle. Simple random sampling technique was employed to select the farm families that were sampled in each circle.

Analytical Technique and Procedure

Descriptive Statistics

Descriptive statistics used includes the mean, standard deviation, frequency distribution and coefficient of variation. They were used as tools to present the socio-economic and demographic information of the respondents selected for the survey.

Inferential Statistics

Inferential Statistics such as Production function, Maximum Likelihood Estimates (MLE) were employed to fit the stochastic frontier production function from which the technical efficiency indexes of the farmers were derived,Battese and Coelli, (1995) and Yao and Liu (1998),while regression analysis were also used to test the formulated hypotheses.

Model Specification ofStochastic Frontier Model

With the aim of addressing the research questions raised in the introductory part of this study and in light of the designed analytical framework, the appropriate model specifications are made in the following two sections.

Empirical Stochastic Frontier Model

The choice of functional form in an empirical study is of prime importance, since the functional form can significantly affect the results. In congruent with several works already done in the area of technical efficiency and productivity measurement, such as Battese and Coelli, (1995) and Yao and Liu (1998). Cobb-Douglas production function is fitted in this study, because it doesn't impose general restrictions on the parameters nor on the technical relationships among inputs and allows for easy measurement of the elasticity of factors of production as well as the return to scale. The analyses involved two steps.

As a first stage in the productivity analysis, Ordinary Least Square (OLS) estimation was made on the Cobb-Douglas production function. Based on the significance of the parameter estimates, information was gained on which variables should be included in the stochastic frontier analysis. In the production function five inputs of production, farm size (ha), herbicide quantity (litre), seed quantity (Kg), labour (man-day), and fertilizer quantity (kg) were included. The choice of the variables was made because these inputs are the conventional inputs used in maize production in the study area.

The model of the stochastic frontier production for the estimation of the TE was specified as:

$$\ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + V_i - U_i \quad \text{...............} \quad 4)$$

Where subscript i refers to the observation of the ith farmer, and

Y = Maize output (kg)
X_1 = Farm size under maize cultivation (ha)
X_2 = Herbicide quantity (litre)
X_3 = Seed quantity (Kg)
X_4 = labour (man-days)
X_5 = Fertilizer Quantity (kg)

β_i's = the parameters estimated
ln's = natural logarithms
V_i = the two-sided, normally distributed random error
U_i = the one-sided inefficiency component with a half-normal distribution.

The Inefficiency Model

In this study, the technical inefficiency was measured by the mode of the truncated normal distribution (i.e. U_i) as a function of socio-economic factors (Yao and Liu, 1998). Thus, the technical efficiency was simultaneously estimated. The determinant of the technical efficiency was defined by:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 \quad \text{...................................} \quad (5)$$

Where:

U_i = technical inefficiency of the ith farmer
Z_1 = Age of farmer (yrs)
Z_2 = Family Size (number)
Z_3 = Year of farming experience (yrs)
Z_4 = Year of Education (yrs)
Z_5 = Extension Contact (Yes = 1, No =0)

The above equation was used to examine the influence of some of the maize farmers' socio-economic variables on their technical efficiency. Therefore, the socio-economic variables in equation above were included in the model to indicate their possible influence on the technical efficiencies of the maize farmers.

In the presentation of estimates for the parameters of the above frontier production, two basic models were considered. Model 1 is the traditional response function in which the inefficiency effects (U_i) are not present. It is a special case of the stochastic frontier production function model in which the parameter $\gamma = 0$. Model 2 is the general frontier model where there is no restriction in which γ, $\sigma^2 s$ are present. The estimates of the stochastic frontier production function were appraised using the generalized likelihood ratio test, and the T-ratio for significant econometric relevance.

Technical Efficiency

The technical efficiency of production of the i-th farmer in the appropriate data set, given the levels of his inputs, is defined by:

$$TE_i = \exp(-U_i) \quad \text{...} (6)$$

From equations (3) and (4), the two components V_i and U_i are assumed to be independent of each other, where V_i is the two-sided, normally distributed random error ($V_i \sim N(0, \sigma_v^2)$, and U_i is the one-sided inefficiency component with a half normal distribution ($U_i \sim / N(0, \sigma_u^2)$. Y_i and X_i are as defined earlier. The β's are unknown parameters to be estimated together with the variance parameters.

The variances of the parameters, symmetric V_i and one-sided U_i, are σ_v^2 *and* σ_u^2 respectively and the overall model variance given as σ^2 are related thus:

$$\sigma^2 = \sigma_v^2 + \sigma_u^2 \quad \text{...} \quad (7)$$

The measures of total variation of output from the frontier, which can be attributed to technical efficiency, are lambda (λ) and gamma (γ) (Battese&Corra, 1977) while the variability measures derived by Jondrow*et al.*, (1982) are presented by equations (6) and (7):

$$\lambda = \frac{\sigma_u}{\sigma_v} \quad \text{……………………………….. ……………………….} (8)$$

$$\gamma = \frac{\sigma_u^2}{\sigma^2} \quad \text{…………………………………………………..….} (9)$$

On the assumption that V_i and $U_i$are independent and normally distributed, the parametersβ, $\sigma^2, \sigma_u^2, \sigma_v^2$, λ *and* γ were estimated by method of Maximum Likelihood Estimates (MLE), using the computer program FRONTIER Version 4.1 (Coelli, 1996a). This computer program also computed estimates of technical and allocative efficiencies.

The farm specific technical efficiency (TE) of the i-th farmer was estimated using the expectation of U_i conditional on the random variable (ε_i) as shown by Battese and Coelli (1988). The TE of an individual farmer is defined in terms of the ratio of the observed output to the corresponding frontier output given the available technology, that is:

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{\exp(X_i\beta + V_i - U_i)}{\exp(X_i\beta + V_i)} = \exp(-U_i) \quad \text{.................................} \quad (10)$$

(Tadesse and Krishnamoorthy, 1997)
So that:

O ≤ TE ≤ 1

RESULTS AND DISCUSSION

The section discuses the socio-economic characteristics of the respondents. The socio economic characteristics examined are with special reference to age, gender, marital status, educational level, family size and farm size etc.

Social economic characteristic of the respondent

Table 1:

Table 1 below showed that the mean ages of the respondents was 45.6 years. Most of the respondents (60.3%)fallow within age range of 31 and 50 years. This indicates that most of the respondents were still in their active age and this aids their maize production. It has been shown that the farmers' production and rate of adoption of maize extension technologies decline with age after about 50 years (Kebede, 2001), which is supported by Khairo and Battese(2005) who concluded that majority of farmers who adopted new extension technologies were mainlyyouth.Majority(69.2%) of the respondents were male while 30.3% of them were female. This implies that male were found to be more involved in maize production than their female counterparts and the involvement of male in maize production could be due to energy requirement of the farm enterprise in question.76% of the respondents were married, 13% were widowed while only 10.1% of the respondents were single. The results of marital status of the respondents suggest a high degree of level of responsibility and a great capability for sound rational decision among the farmers. This is in conformity with Landon *et al,* (1996) which concluded that marital status is a tutor, which is likely to encourage the sustainability of adoption decisions. 35.7% of the respondents had no formal education while 53.8% acquired primary school education, 7.7% also acquired secondary school education, 2.7% also acquired tertiary school education. This may be due to the individuals' farmers' background and this is expected to have some influence on their level of receptivity to the extension training and services provided. This is in line with a study by Roling and Pretty (1997), that farmers with more years of schooling tended to be more technically sound than the farmers with no formal education. 35.7% of the respondents had no formal education while 53.8% acquired primary school education, 7.7% also acquired secondary school education, 2.7% also acquired tertiary school education. This may be due to the individuals' farmers' background and this is expected to have some influence on their level of receptivity to the extension training and services provided. This is in line with a study by Roling and Pretty (1997), that farmers with more years of schooling tended to be more technically sound than the farmers with no formal education.Agriculture in Nigeria is characterized by substantial use of family labour. Table 9 revealed that the average family size was found to be 5 members, only about 16.1% of the respondents had between 1 and 3 members in their family while 71.5% (majority) were having between 7 and above members in their family. This is supported by Awudu and Richard (2001) that large families appeared to be more efficient in adopting extension technologies than small families although larger family members consumed more of farm produce than small family which usually reduce the quantity of the produce made available for sale and the propensities to make more income.

Years of farming experience of a farmer contribute to his ability to manage his holding efficiently through trial and error. Thus, the higher the experience of a farmer, the higher the adoption rate will be. Table 10 showed that above 68.9% of the farmers have been in farming for more than 10 years. The mean farming year is 21.26, it is therefore expected that this groups of farmers will be able to manage their farm efficiently. Less than 30% have farming experience that is lesser than 10 years. This in line with the findings of Awudu and Richard (2001) which concluded than farming experience contributes positively to production.

Age Range (Years)	Frequency	Percentage
21-30	36	13.8
31-40	73	28.1
41-50	81	31.2
51-60	50	19.2
61-70	20	7.7
$\overline{X}$ = **47**		
Sex		
Male	180	69.2
Female	80	30.8
Marital Status		
Single	27	10.1
Widowed	34	13
Married	199	76
EducationalLevel		
No formal Education	93	35.7
Primary Education	140	53.8
Secondary Education	20	7.7
Tertiary Education	7	2.7
Family Size		
1-3	42	16.1
4-7	33	12.6
7-10	185	71.5
$\overline{X}$ **= 5**		
Years of Farming Experience		
1-5	19	7.30
6-10	62	27.9
11-15	105	40.5
16-20	28	10.7
> 21	46	12.7
Total	**260**	**100.0**

$\overline{X}$ **= 21.26, SD = 0.567.**
Source: Field Survey, 2011.

Table 2:

The knowledge of the farmer's farm size is to give the idea of their scale of operation. This helps to determine the number of work force to be employed given family labour force hence the lost implication for farm operations which also determines farmer's potential income.

Table 12 showed that 28.5% cultivated between 1 and 5 hectares while only 10% also cultivated 20 hectares and above. Majority (53.8%) of the respondents cultivated between 6 and 10 hectares of land. The minimum farm size of the respondents in the study area is 1 hectare while the maximum is 22 hectares. A priori expectation showed that the greater the land area of land cultivated, the higher will be the propensity to make more income.69.3% claimed that they have contact with Extension Agents while 30.7% (minority) of the respondents claimed that, they have no contact with the Extension Agents. the multiple responses of the respondents on extension technologies adopted, 65.4% of them adopted improved seed technology, 61.5% of the sampled respondents adopted spacing technology as a means of boosting their maize production while 28.4%, 66.9% and 55.4% adopted thinning maize, weed control and seed protection respectively. The table further revealed that 3.8%, 24.6% and 9.2% also adopted the use of chemical, fertilizer application and harvesting as their own means of boosting maize production. Only 9.2% of the sampled respondents adopted seed rate extension technology.the mean maize output is 2097kg with standard deviation of 709 which indicate a large variability of output among the farmers. The minimum maize output was 900kg while the maximum maize output was 4000kg. It further shows that 19.2% of the respondents had maize output of between 1 and 1000kg, 26.5% had been between 1001 and 2000 while 30.80%, 23.5% of the sample respondents had between 2001 and 3000kgs and 3001 – 4000kg of maize respectively. The variation in their output implies that some maize farmers had access to some certain technology which aided their maize production.

Farm Size	**Frequency**	**Percentage**
1-5	74	28.5
6-10	140	53.8
11-5	20	7.7
>20	26	10.0
Extension Contact		
Contact	180	69.3
Non-contact	80	30.7
Extension Technologies Adopted		
Improved seed	170	65.4
Spacing	160	61.5
Thinning	74	28.4
Weed control	174	66.9
Seed protection	144	55.4
Use of Chemical	40	15.4
Fertilizer application	10	3.8
Harvesting	64	24.6
Seed rate	24	9.2
***Multiple Responses**		
Maize Output (kg)		
1-1000	50	19.2
1001-2000	69	26.5
2001-3000	89	30.8
3001-4000	61	23.5
Total	**260**	**100.0**

$\overline{X}$ =2092kg SD = 709
Source: Field Survey, 2011.

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Test of First Hypothesis

The hypothesis is stated in null form.

HO1: There is no significant relationship between the socio-economic characteristics of the respondents and their maize output.

Table 22 shows that age, sex, years of education, farm size, religion, marital status, primary occupation, other occupation, extension contact, years of farming experience and household size were considered to be the socio economic variables. The result showed that age, years of education were statistically significant at 10% level while sex, religion and farm size were statistically significant at 5% level of significance. Years of education has the coefficient out of the two socio-economic variable that is statistically significant at 10% with a value of 34.960 which implies that years of education is the most important variable that has a great influence on the output of maize farmers, although all the statistically significant variable had a significant influence on their output but years of education appear to be the most. Out of the socio economicvariables that were significant at 5%, sex appear to be the most socio-economic variable that has a great impact on the output of maize farmers in the study area. Therefore the null hypothesis is hereby rejected and the alternative hypothesis is accepted i.e. H_A: There is significant relationship between the socio-economic characteristics of the respondents and their maize output.

Regression Model Equation

$Y = b_0 + b_1 x_1 + b_2 x_2 + \ldots\ldots\ldots\ldots b_n X_n$

$Y = 1527.473+24.327+390.777+34.960+34.969 + 58.973 + 28.546 – 55.633$

(681.323) (14.158) (168.163) (21.682) (106.398) (157.571) (63.122) (158.924)

(2.242) (1.718) (2.324) (1.614) (-0.329)(0.374) (0.452) (-0.350)

-5.642-67.813 – 254.85 - 22.422

(13.345) (26.419) (122.114) (57.035)

(-0.430) (-2.567) (-2.104) (-0.393)

Y = Maize output

X_1= Age

X_2= Sex

X_3= years of education

X_4= Marital status

X_5= Primary occupation

X_6 = Other occupation

X_7=Extension contact

X_8= Years of farming experience

X_9= Farm size

X_{10}= Religion

X_{11} = Household size

Table 22: Parameter Estimates of the Regression Analysis of the Maize farmer in Oyo State

Variable	Coefficient	Standard Error	T-value

Constant	1527.473	681.323	2.242**
Age	24.327	14.158	1.718*
Sex	390.777	168.163	2.324**
Years of Education	34.960	21.682	1.674*
Marital Status	-34.969	106.3988	-0.329
Primary Occupation	58.973	157.571	0.374
Other Occupation	28.546	63.122	0.452
Extension Contact	-55.633	158.924	-0.350
Years of Farming Experience	-5.642	13.345	-0.430
Farm Size	-67.813	26.419	-2.567**
Religion	-254.851	121.114	-2.104**
Household Size	-22.422	57.035	-0.393
F	2.872		
R^2	0.622		

Notes: * = 1% level, ** = 5% * = 10%**

Source: Computed from field survey, 2011

F-cal = 2.87 while F-tab = 2.34, therefore F-cal < F-tab, Ho is rejected hence alternative hypothesis is accepted which says that there is significant relationship between the socio-economic characteristics of the respondents and their maize output.

Therefore, the r^2 shows that there is 62.2% variation in output of the respondents which is accounted for by the independent variables (socio economic characteristics) while the remaining 23.6% is caused by the exogenous variables (Error term).

Teat of second hypothesis

The hypothesis states that maize farmers are not technically efficient. This section discusses the results of technical efficiency of the maize farmers in Oyo-State. Two functional forms of the stochastic production frontier model were fitted (Linear and Cobb Douglas functional forms) but only the Cobb Douglas type provided the best fit based on the explicit details of the technical efficiency of the maize farmers as well as the number of significant variables in the model, more so Dawson and Lingard (1989) alluded to the fact that the Cobb Douglas type has certain advantages over the other functional forms.

Sign and Significance of Estimates of Stochastic Frontier Production Function (i.e. Cobb Douglas Frontier Function Type)

The coefficients of the variables are very important on discussing the resultsof the analysis of data. These coefficients represent percentage changes in the dependent variables as a result of percentage change in the independent variables.

Among the maize farmers in the study area, the variables that were significant included labour (significant at 5%), fertilizer quantity used (significant at 1%), seed quantity (significant at 1%), herbicides quantity used (significant at 1%) and adoption index of the respondent (significant at 1%), while farm size are not significant at all known of significance. By implication, the above finding revealed that the major productive inputs that have great impact on the maize output among maize farmers were labour, fertilizer quantity used, seed quantity used, herbicide quantity used and their adoption level towards extension maize technologies. Herbicide quantity has the highest coefficient with avalue of 0.7746 in the preferred model and by implication the herbicide quantity used existed as the most important input that has a great impact on maize output of the maize farmers. However, for every unit increase in herbicides quantity used there is less than proportionate increase in maize output. It is also shown that farmers' adoption level towards extension maize technologies has a great influence on the technical efficiency of maize farmers in the study

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area. All the significant variables carried positive sign; the economic implication of the sign is that any increases in the quantities of such variables would lead to an increase in maize output of the maize farmers.

Negative coefficient of a variable might indicate an excessive utilization of such a variable. In economic terms, any attempt to increase the quantities of significant variable will be tantamount to raising the level of the maize output of maize farmers in the study area.

The estimated parameters of the inefficiency model in the stochastic frontier models of the maize farmers in Oyo States presented in Table 23. The analysis of the inefficiency model shown in the Table 23 showed that the signs and significance of the estimated coefficients in the model have important policy implications on the technical efficiency of the maize farmers.

Among the efficient variables only age is statistically significant at 5% level which has negative coefficient (-0.2722). The above findings revealed that years of farming expenditure and family size tend to increase the level of technical inefficiency of the maize farmer while age of the farmers tend to reduce the level of technical inefficiency of the respondents.

Technical Efficiency Analysis of Maize Farmers in Oyo State

The predicted technical efficiency estimates obtained using the estimated stochastic frontier models for the individual maize farmers in the study is presented in Table 24.

It showed the predicted maize farmers specific technical efficiency (TE) indices ranged from a minimum 42% to a maximum of 99% with a mean of 81%.

The mean technical efficiency of maize farmers (i.e. 81%) shows that maize farmers weretechnical efficient, therefore the formulated hypothesis is rejected and alternative hypothesis of accepted which started that maize farmers are technically efficient in the study area.

Maximum Likelihood Estimates for the parameter of the stochastic frontier production function for maize farmers in Oyo State.

Variable	Parameter	Coefficient	T-value
Efficiency model			
Constant	β_0	0.3205	48.7277
Farm size	β_1	-0.1240	-02586
Labour	β_2	0.1569	2.5346**
Fertilizer quantity	β_3	0.1405	35579***
Seed Quantity	β_4	0.1376	3.6881***
Herbicides Quantity	β_5	0.7746	3.5774***
Inefficiency Mode			
Constant	δ_0	0.8502	2.0754
Age	δ_1	-0.2722	-2.5303**
Years of Education	δ_2	-0.1710	-1.4342
Years of farming Exp	δ_3	0.8048	0.6918
Family size	δ_4	0.5723	1.1796
Extension contact	δ_5	-0.1044	-09628
Adoption Index	δ_5	0.2159	9.4741***
Variance Parameter			
Sigma Squared	δ^2	0.1021	5.1675***
Gamma	δ	0.9999	52.3087
Log likehood function		67.1752	

Notes: * =1% level, ** =5%, * = 10%**
Source: Computed from field survey, 2011.

Range of frequency distribution of Technical efficiencies of the maize farmers in Oyo State

Efficiency score %	Technical Efficiency	
	Frequency	**Percentage**
0.40 – 0.60	72	27.7
0.61 – 0.80	68	26.2
0.81 – 1.0	120	46.1
Total	260	100.0
Mean %	0.8136	81%
Minimum %	0.4264	42%
Maximum %	0.9932	99%

Source: Field Survey, 2011

Conclusions and Recommendation

Based on the findings of this study, the following conclusions were drawn.

The larger percentage of the sampled maize farmers were at their productive age, male were more involved in maize production compared with female. Larger percent of farmers adopted maize extension technologies. Extension contact appeared to have a serious influenced on their adoption rate on maize extension technologies (Logit model). Maize farmers were technically efficient in the study area (Mean technical efficiency of the stochastic frontier).

The following recommendations are therefore suggested.

1. There is need to create more awareness about the roles of extension service among the farmers in the study area.
2. The authorities concerned with organizing extension delivery should improve on the frequency of extension contact in order to encourage farmers' participation in extension technologies when the need arises in the study area, and by extensionin the state at large.
3. The aforementioned recommendations can be combined with provision of inputs so as to mobilize farmers to always participate in extension programme in the study area.
4. More information about maize extension technologies should be disseminated through mass media with adequate training instead of total reliance on the extension agent in the dissemination of agricultural information.

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