

ADOPTION EFFECT OF CROP MANAGEMENT PRACTICES ON THE TECHNICAL EFFICIENCY OF MAIZE FARMERS IN SOUTH WESTERN NIGERIA

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ABSTRACT

Adoption of improved maize production technologies and management practices has received much attention in recent years because of increase in the demand for maize. Over the years however, the recorded maize yield of an average Nigeria farmer has not been able to match the efforts put into effectively make use of modern production technologies and management practices. The need therefore the examine improved maize production technologies is-a-vis some management practices becomes pertinent in order to identify th factors responsible for the inefficiency of maize farmers. This research therefore focused on the adoption effects of crop management practices on the technical efficiency of maize farmers in Oyo and Osun States Nigeria.

A multistage sampling technique was used in collecting data from a cross-sectional sample of 300 maize farming households in Oyo and Osun States. Descriptive statistics (means, frequency counts, percentages, etc.) Data Envelopment Analysis (DEA) Tobit regression analysis were employed in analyzing the data. Results from the Tobit analysis showed that adoption is determined by gender ($p < 0.05$), years spend in school ($p < 0.1$) marital status ($p < 0.05$) and access to extension training ($p < 0.1$).

The average overall technical efficiencies for farmers in Oyo State were 41.6 and 69.5 respectively for Constant Returns to Scale, Variable Returns to Scales and Scale Efficiency while for Osun State; these were 39,66.6 and 61.5 for CRS, VRS and scale efficiency respectively. These results revealed that substantial inefficiencies exist in the farming operations of the two states. The return to scale, where the sub-optimal (VRS), optimal (CRS) and super optimal (DRS) are considered for Oyo State respondents were 88%, 8.7% and 3.3% of the farmers were respectively. For Osun State respondents, 89.3%, 2.7% and 8% of the farmers were sub-optimal, optimal and super-optimal respectively.

Keywords: Adoption, maize DEA, Tobit, South-western.

1. INTRODUCTION

Maize has been cultivated in Nigeria for hundreds of years. According to Morris et. al. (1999) since the introduction of maize in the 16th century, it has established itself as an important food

crop in the country. In no time, maize also attracted the attention of commercial farmers, even though it never achieved economic importance as compared with traditional plantation crops, such as oil palm and cocoa. Over time, the Roding profitability of many plantation crops (attributable many to increasing disease problem in cocoa, deforestation and natural resource degradation, and falling world commodity prices) served to strengthen interest in commercial food crops, including maize (Morris et al., 1999). According to Al-Hassan and Jatoe (2002) maize is currently Nigeria's most important cereal crop. It is grow by the vast majority of rural households in almost all parts of the country except for the Sudan Savanna Zone of the North, it is grown exclusively as a food crop (Akinwumi, 1970).

Nigeria is currently the tenth largest producer of maize in the world, and the largest maize produce in Africa (IITA, 2012). Also it is estimated that over seventy percent of farmers are smallholders accounting for 90 percent of total farm output (Cadini, P and Angelucci F, 2013).

2. MATERIAL AND METHODS

The study was carried out in Southwestern part of Nigeria precisely Oyo and Osun states. The population of the study comprises all registered maize producing farmers in all agricultural zones under Oyo and Osun States Agricultural Development Projects (OYSADEP) and (OSSADEP) respectively. For administrative convenience four agricultural zones and thirty three (33) blocks were found in OYSADEP while three agricultural zones and thirty (30) blocks are in OSSADEP.

The Agricultural zones in Oyo states are Ibadan /Ibarapa (14blocks), Ogbomoso (5 blocks) Oyo (5 blocks) and Saki (9 blocks) and those of Osun state include Osogbo (13 blocks/Ife/Ijesha (10 blocks) and Iwo (7blocks). Three agricultural zones were purposively selected from each state making six (6) zones in total, based on the type of crops grown. These were Ogbomoso, Oyo and Saki zone from Oyo state and Ife /Ijesha, Iwo and Osogbo zones from Osun state.

Multistage random sampling technique was employed to sample three hundred (300) maize farmers. In the first stage, 30 percent of the blocks were randomly selected from each of the six agricultural zones. A total of sixteen blocks were sampled and each block comprises eight cells. Second stage involves random selection of 30 percent of the cells, two (2) in each block making a total of 32 cells for the study. Finally, 20 percent of the maize farmers in each cell were randomly selected for the study.

Empirical DEA Model

Given that there is an underlying production technology, technical as well as scale efficiencies can be estimated empirically. For a sample of n observations of farm households using k input to produce m outputs the input and output vectors for the i th household can be represented as (X_{ki}) and (Y_{mi}) respectively. For a household using (X_{ki}) to produce (Y_{mi}) the input-oriented technical efficiency estimate is defined by:

$$TE(X_{ki}, Y_{mi}) = \underset{\theta, z}{\text{Min}} \theta (\theta, X_{ki}, Y_{mi})$$

$$\text{Subject to } \left\{ \begin{array}{l} y_{mi} \leq \sum_{j=1}^I y_{mj}, m = 1, 2, \dots, M \\ \sum_{j=1}^I Z_j x_{ki} \leq k = 1, 2, \dots, K \\ z_i \geq 0, i = 1, 2, \dots, I \end{array} \right\}$$

where θ_i = technical efficiency estimate to be calculated for each farm household i , y_{mi} = quantity of output m produced by farm household i , x_{ki} = quantity of input k used by farm household i , z_i = intensity variable from household i , A household is considered to be technically efficient if $\theta = 1$, while a household with $\theta < 1$ is considered to be technically inefficient. The model above assumes constant returns to scale (CRS), which holds that all firms (farm households) operate at the optimum scale (Mugera and Featherstone, 2008). However, because of imperfections in agricultural markets (input/output markets) farms seldom operate under CRS, imposes variable returns to scale (VRS).

$$\sum_{j=1}^I Z_j = 1$$

$$\sum_{j=1}^I Z_j < 1$$

3. RESULT AND DISCUSSION

Technical and scale efficiency Indices of Farmers in both States (pooled)

The technical and scale efficiency distribution and frequency level for the pooled data collected from both states (Osun and Oyo State) are shown.

The efficiencies means were 33.3 percent, 65.7 percent and 61 percent for CRS, VRS and scale efficiency respectively. The fully technically efficient farmers were 3.7 percent, 14.3 percent and 3.7 percent for CRS, VRS and scale respectively. While, the minimum and maximum for CRS, VRS and scale were 100 1,100 and 20 and 100 and 1 respectively. Observing their means, it was deduced that there is still more rooms for adjustment by improving on the use of the improved technologies at appropriate time and level.

Frequency Distribution of Oyo Technical and Scale Efficiency Indices of Farmer

Efficiency Score	Technical Efficiency at CRS	Percentage	Technical Efficiency at VRS	Percentage	Scale Efficiency	Percentage
0 – 9	10	3.3	0	0	8	2.7
10 – 19	48	16	0	0	17	5.7
20 – 29	94	31.3	22	7.3	19	6.3
30 – 39	63	21	78	26	26	8.7
40 – 49	29	9.7	45	15	26	8.7
50 – 59	22	7.3	56	18.7	35	11.7
60 – 69	6	2	23	7.7	47	15.7
70 – 79	5	1.7	8	2.7	47	11.7

80 – 89	5	1.7	11	3.7	31	10.3
90 – 99	7	2.3	14	4.7	33	11
100	11	3.7	43	14.3	11	3.7
Total	300	100	300	100	300	100
Mean	33.3		56.0		61	
Maximum	100		100		100	
Minimum	1		20		1	

Source: Field Survey: 2017.

Characteristics of Farmers with Respect to Returns to Scale

Observing the scale efficiency for the pooled data which was 61 percent, it shows the efficiency is still considerable. From the overall 300 farms pooled together, 275 farms were suboptimal (IRS), 11 farms were optimal (CRS) and 14 farms were super optimal (DRS). This shows that we still have little percentage of farms which still use their resources optimally and larger percentages did not use the resources optimally.

Characteristics of Farmers with Respect to Return to Scale

Scale	Number of farmers	Percentage
Sub optimal (IRS)	275	91.7
Optimal (CRS)	11	3.7
Super-optimal (DRS)	14	4.6
Total	300	100

Source: Field Survey, 2017.

IRS – Increasing Returns to Scales

CRS – Constant Returns to Scale

DRS – Decreasing Returns to Scale

Summary of Output and Input Slacks of Farmers

From the pooled results, the pooled farmers can increase their maize output by 17.6kg given all available operation and technologies with the resources. Also they can reduce on average, the input usage of 0.052ha of land size, 1.53kg of maize seeds, 3.09Manday of family labour, ₦9079.53 of hired labour, ₦9,082.63 of quantity of fertilizer used and ₦18,162.16 of chemical and still produce maximally the output of maize.

Summary of Output and Input Slacks of Farmers

Input-Output	Number of farmers	Mean Slacks
x_1 (maize seed)	40	1.530
x_2 (farm size)	7	0.052
x_3 Manday (family labour)	99	3.093
x_4 (hired labour)	171	9079.53
x_5 (Quantity of fertilizer)	203	9082.63

x_6 (Quantity of chemical)	205	18162.16
y (maize output)	20	17.599

Source: Computed From Field Survey: 2017.

TOBIT ESTIMATES OF DETERMINANT OF EFFICIENCY OF ALL FARMERS

Estimated Tobit Model for Oyo State

From the analyzed Tobit using the following variables, Age, Gender, Years of Schooling, Household Size, Frequency of extension visit, years of experience farm size, Access to extension training using a binary mode either 1 or 0 and actual for ages, years of experience, household size etc. out of the nine variables analyzed, five were significant at various levels.

Gender was significant at 5 percent and positive which showed that male which is 1 is more active and dominate the farming system and it could be due to the strenuous work and this helps in adopting the various improved technologies.

Marital status was significant at 5 percent but negative. From the analysis married was 1, unmarried -0. This results showed that the unmarried were involved more in the adoption of the technologies compared to their counterparts. And this can be that they have less marital responsibility than their counterpart. Years of experience were significant at 1 percent and negative. This reveals that the more experienced the farmers are the more they believe and adopt their primitive and ancient methods of production. Farm size was significant at 5 percent and positive, this encourages farmers to procure enough land spaces to improve their technologies. Access to extension training was significant at 5 percent and positive. This revealed that the extension training given to the farmers in adopting the improved technologies have positive effect on their production. The sigma shows a significant level and this shows the result has a good fit.

Tobit Marginal Effect

The marginal effect was presented in the table, gender, years spent in school, marital status and access to extension training all have positive relationship with adoption index and are significant at 5%, 10%, 5% and 1% levels respectively. The coefficient of 0.944 in the table for access to extension training means that, holding other variables constant, if farmers are aware of the improved technologies, and have access to extension training, the level of improvement or the direct change on the adoption of the technology will at 94.4%.

The coefficients of frequency of extension visit. Household size, years of farming experience and farm size were positive but not statistically significant. Therefore, the frequency of extension visit, household size, years of farming experience and farm size increases as the adoption index for the improved technologies increases. However, the coefficient of age was negative and not statistically significant.

Tobit Regression Results (Marginal Effects)

Adoption Index as dependent variable

	Coeff.	Std. Err.	p-values	Marginal Effects
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Age	- 0.00469	0.00407	0.252	0.251
Gender	0.201	0.0686	0.004	0.003**
Years spent in School	0.0104	0.006	0.095	0.094*
Marital Status	0.1103	0.0545	0.044	0.043**
Household Size	0.00673	0.122	0.581	0.580
Frequency of Extension Visit	0.0121	0.026	0.645	0.644
Years of Farming Experience	0.000415	0.00369	0.910	0.910
Farm Size	- 0.0212	0.0129	0.271	0.270
Access to Extension Training	0.9444	0.146	0.000	0.000***
Constant	- 0.127	0.250	0.612	
Number of Observation	300			
LRCh ²	66.63			
Pseudo R ²	0.6570			

*** 1% level of significance, ** 5% level of significance and * 10% level of significance

Source: Computed From Field Survey: 2017.

4. CONCLUSION

They study concluded that awareness of and access to extension training have positive impact on the adoption of the improved maize technologies and crop management practices. In addition gender, years spent in school, marital status and access to extension training all have positive relationships with adoption index. Generally, the adoption of and compliance to one or more crop management practices improves farmers' technical efficiency, encouraging farmers to strictly adhere to these practices is a way forward in the bid by stakeholder to ensure increase in agricultural productivity.

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