Land Holding Pattern And Technical Efficiency Of Maize Production In Ogbomoso Agricultural Zone Of Oyo State

Ajao, A.O.

Agricultural Economics Department, Ladoke Akintola Univeristy Of Technology, Ogbomoso
oaajao57@lautech.edu.ng

Abstract: The major objective of this study is to analyze the farmland acquisition pattern and technical efficiency in maize production in the study area using a stochastic production frontier. The finding showed some level of inefficiency irrespective of the land holding pattern but more pronounced in the community holding land. The study further examined the determinant of inefficiency in these categories and found out that household size and experience are the major determinant of inefficiency.
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Introduction

The land tenure system defines the relationship among men in the use and control of land resources. A lot of work has been done on land tenure by several researchers and authors, each exclusively deriving a definition about the concept based on the study pattern, personal abilities and philosophy. The word "Tenure" means holding of property, especially real estate or by reference to a superior. When land is "held" it stands to exclude others from its use. Another most important dimension of land tenure is the period of time for which the property is held (Thapa, 1996).

Traditional land tenure systems have proved to be flexible in allowing for differences in the needs of families and for changing circumstances. It has generally been possible for the more energetic and capable farmers to acquire extra land, either from that controlled by the community, pledge. The owner of land has become unsecured due to a growing shortage of land and insecurity of expectations generated by the land policies of the government. Traditional system of land tenure presupposes an abundance of land. However, the existing pattern of land tenure may not evolve quickly enough to avoid acting as a constraint upon agricultural changes, which are urgently required in view of the rising population where it is no longer possible to leave land to fallow and continuous cultivation is now the rule (Fabiyi, 1990). Traditional system of land tenure encourages low productivity due to lack of incentives to develop the land, retards agriculture and effective utilization of land.

A substantial amount of agricultural investment is crucial to provide an acceptable standard of living to maize farmers; of all the factors which could be responsible for poor performance of agriculture in Nigeria, land tenure is one. Thus, for the reasons highlighted above, the Nigerian land tenure system has been under serious problem and pressure. This was exposed by Udoh (2000), when he said with land owners are becoming numerous and land becoming more complex and diversified.

David (1995) further explained that customary land tenure has rendered individual land holder trouble in getting credit as he cannot pledge land which he does not own as security for a loan. In a similar way, Adedipe et al, (1997) explained that such land cannot be used as collateral for securing credit. Credit availability to small holder farmers has been found to be significantly related to the type of land tenure.

Another disadvantage of customary land tenure is that it may be managed by relatives in the village (Adedipe et al, 1997). While the practice of land leasing is advantageous in giving employment opportunities to landless migrant farmers and gives absentee land owners the chance to earn some extra income from rent, it generally does not lead to the best farm management practices. (Ondiege, 1976).

Nigeria's situations on tenure systems need an urgent step which will provide security to farmers and land owners, hence the call for enactment of the Land Use Decree. The above, thus make people especially farmers call for accelerating land tenure arrangement as a pre-requisite for rapid economic and social development.

Before the promulgation of Land Use Decree now Land Use Act (LUA) human merely have the use of land. Under the customary law in most communities in western Nigeria, a well stratified hierarchy of authority and control over land developed, at the apex is the Oba or Baale, followed by the traditional chiefs, and the family heads. (Adedipe et al., 1997).

Although the agricultural policy for Nigeria of 1989 recognizes land as a major factor in crop production, it is evident that land is not readily available, given the magnitude of the requirement, both for agriculture and for industrial development (Adedipe, 1997). Subsequently, the government issued a policy statement which recommended that ownership of all land in the country should be vested collectively in all Nigerians, through the allocation of certificate of occupancy at the local government and state level for rural communal tenure and privately owned land (Adedipe et al., 1997). According to Adedipe et al., (1997), the Land Use Decree (Act) vests all land in the state through the office of the (military) governor of each state. Land is held in trust and administered for the use and common benefit of all Nigerians according to the provision of the Act. By this legal instrument, the state replaced the traditional institutions of Obaship and chieftaincy in their roles as keepers of communal land.

The Land Use Act of 1978 is made up of eight parts of fifty one sections. It addresses four important issues arising from the former land tenure systems in Nigeria: the problem of lack of uniformity in the laws governing land use and ownership: the issues of uncontrolled speculation in urban land; the questions of access to land rights by Nigerians on equal legal basis; and the issue of fragmentation of rural land arising from either the application of tradition principle of inheritance and / or population growth and consequent pressure on land. It approaches these issues via three related strategies; the vesting of proprietary rights in land in the state; the granting of infrastructural rights in land to individuals; and the use of an administrative system rather than market forces in the allocation of rights in land (Thapa, 1996). The solution to the problem of inadequate food production, especially in the face of mounting population pressure and declining soil fertility, rest with increased productivity through intensive use of land and other resources. therefore, this study examined productivity of maize in line with land ownership pattern in Oyo state.

2. Materials and method:

Agricultural productivity can be defined as the index of the ratio of the value of total farm output to the value of the total input used in farm production, (Olayemi, 1980). This index can be measured by using many methods, some of which include: the linear programming method, budgetary analysis, and so on.

The theoretical basis for this study hinges on the production theory and the production function approach. The farmer is identified with his given level of technical efficiency, Price / allocative efficiency and the overall (economic) efficiency. Since the production process involve an input – output relationship, the production and factor markets play a significant role. Farmers operate in the two markets as price takers.

Resource productivity is definable in terms of individual resource inputs or a combination of them. Optimal productivity of resources implies an efficient synonym in this context.

Farell (1958) has defined efficiency measures in three forms:

(i) Technical efficiency which measures a firm's success in producing maximum output from a given set of inputs.
(ii) Price efficiency which measures a firm's success in choosing the optimal set of inputs.
(iii) Overall efficiency which is the product of these two types of efficiencies i.e. technical and price efficiencies.

2.1 Measurement of Resource Use Efficiency

Farrel (1957) discovered a methodology to measure economic, technical and allocative efficiencies is associated with the ability to produce on the frontier isoquant while technical efficiency refers to the ability to produce at a given level of output using cost minimizing input ratio and economic efficiency simply means the capacity of a firm to produce a pre-determined quantity of output at minimum cost for a giving level of technology.

Bravo-ureta and Pinheiro (1997) using production frontier and second step analysis performed on two-limit to derive equations for technical efficiency and economic efficiency and allocative efficiency were not only able to provide empirical measure of different efficiency indices but also indicated some key variables that are not correlated with these indices. This is going beyond much of the published literature concerning efficiency, because most of the researches in the area of productivity analysis focuses exclusively on the measurement of technical efficiency.

Earlier, Olayide (1982), claimed that the simplest methodology of resource productivity is in terms of individual input-output ratios. For instance, labour productivity can be calculated by multiplying this ratio of the total output to the total input of labour and the indices of productivity can be calculated by multiplying this ratio by 100, in terms of aggregate output-input framework, resource productivity in crop production process.

Bravo-ureta and Pinheiro (1993), tried to identify the sources of inefficiencies in maize farming by investigating the relationship between farm/farmer characteristics and the computed indices of efficiency which include allocative efficiency, economic efficiency and technical efficiency.

Indices using the model by Bravo-ureta and Pinheiro (1993), based on what the literature called "second step" estimation, they were farm level technical efficiency, allocative efficiency and economic, efficiency with variable like; contract farming, agrarian reform, size of farm, years of schooling, age, and number of people in the household. Contract farming was found to be positively related to the indices of efficiency and this is consistent with Kalirajan (1981) who argued that contract farming can be very valuable for small scale operation, because it has access to the market and increases income and employment opportunities. Furthermore, contract farming may improve allocative or price efficiency by reducing risk. Reform was found to be positively connected to the indices of efficiency, Bravo-ureta and Evenson, (1994), found positive connection between farm-level efficiency and the availability of the extension services and access to information between extension and efficiency appears to be findings in the farm efficiency literature focusing on developing country agriculture. (Bravo-ureta and Pinheiro, 1993).

Farm size and indices of efficiency was found to have a positive relationship supporting the notion that medium size farm have an efficiency advantage as compared with small farms and very large farms.

Various studies have found a positive correlation between formal education measured in years of schooling and indices of efficiency (Belbase and Grabowski, 1985) while several others have reported no statistically significant relationship between these two variables (Bravo-Ureta and Evenson, 1994).

Age is positively related with indices of efficiency, which shows that those farmers who are under twenty five years have higher level of technical efficiency, allocative efficiency and economic efficiency. These results are consistent with the findings of Belbase and Grabowski (1985) and Bravo-Ureta and Evenson (1994).

The number of people in the household was found to be negatively significant with allocative efficiency and economic efficiency but positively significant with technical efficiency. The result indicates that larger household might utilize family labour beyond the point where the marginal value product of labour is equal to the wage rate (Bravo-Ureta and Pinheiro, 1997).

In addition, according to Hussain (1989), older farmers are less likely to have contact with extension agent and are less willing to adopt new practices and modern inputs.

Furthermore, younger farmers are likely to have some formal education and therefore might be more successful in gathering information and understanding new practices which in turn will improve their efficiency through higher level of technical and allocative efficiency.

2.2 Sampling Procedure, data collection and analytical technique

The study area has five local government areas, namely Ogbomoso North, and South, Orire, Surulere and Ogo-Oluwa. The multistage random sampling technique was employed. The first stage involved purposive selection of three Local Government areas in Ogbomoso agricultural zone namely; Ogo-Oluwa, Surulere and Orire Local Government areas because of their rural nature. The second stage involves random selection of four villages from each local government area, making a total of 12 villages in all. The third stage involves random sampling of ten maize farmers from each of the twelve villages, making a total of 120 farmers.

2.3 Method of Data Analysis

The data collected were analyzed with the use of three methods (i) Descriptive statistics involving the use of simple percentages and proportions. These were used to examine the socio-economic characteristics of the maize farmers and the Stochastic Frontier Production Function: This was use to estimate the technical efficiency in maize farming. It is given by:

$\text{In } Y_1 = \text{InBo} + \sum B_j \text{ In}X_{1j} + vi - ų_1;\ldots\ldots i$

Where Yi=Farm output (kg), Xi=vectors of farm inputs use, X_1=farm size (ha), X_2=seed (kg), X_3=Fertilizer (kg), X_4=Labour (Manday), X_5=Chemical (litre), V=Random variability in the production, μ =Deviation from maximum potential output attributable to technical inefficiency, β_0=Intercept, β=Vectors of production function parameters to be estimated; i=1, 2, 3, n farms; j=1, 2, 3, m inputs.

2.4 Model Specification

In this study, the focus is on maize production, which is one of the main food crops in the study area and Oyo State as a whole. With the work of several scholars like that of Seyoum et al., (1998) where the Cobb-Douglas stochastic frontiers was used in estimating the technical efficiency of maize farmers. Therefore, for the sake of this study, the stochastic frontier production functions in which Cobb-Douglas as proposed by Battese and Coelli (1995) represents the best functional form of the production frontier and also as confirmed by Yao and

Liu (1998) was applied in the data analysis in order to better estimate technical efficiency of maize farmers.

The model of the stochastic frontier production for the estimation of the TE in a way consistent with the theory of production function can be specified as follow:

$In\ Y_i = \beta_o + \beta_1\ In\ X_{1i} + \beta_2\ In\ X_{2i} + \beta_3\ In\ X_{3i} + \beta_4\ In\ X_{4i} + \beta_5\ In\ X_{5i} + V_i - U_i$…………………ii

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

Y = Output of maize Grain (Kg)
X_1 = Farm size (ha)
X_2 = Seed (Kg)
X_3 = Fertilizer (Kg)
X_4 = Labour (Manday)
X_5 = Chemical (litre)
β_0 = Intercept
β_1's = Parameters to be estimated
In's = Natural logarithm
V_i = Random variability in the production
U_i = Deviation from maximum potential output attributable to technical inefficiency.

The inefficiency model

$U_i = \delta_o + \delta_1 \mathbf{Z}_{1i} + \delta_2 \mathbf{Z}_{2i} + \delta_3 \mathbf{Z}_{3i} + \delta_4 \mathbf{Z}_{4i} + \delta_5 \mathbf{Z}_{5i}$ …iii

Where:

U_i = Technical inefficiency of the ith farmer
Z_1 = Age of farmer (years)
Z_2 = Sex of farmer (dummy; 1 = male, 0 = female)
Z_3 = Marital status
Z_4 = Year of farming experience
Z_5 = Household size

The technical efficiency in equation was simultaneously estimated with the determinant of technical efficiency defined by equation iii to examine the influence of maize farmer's socio-economic characteristics on their technical efficiency. It assumes that the technical inefficiency measured by the mode of normal distribution where Ui is a function of socio-economic factors (Yao and Liu, 1998). In the presentation of estimate for the parameters of the above frontier production, the β and δ coefficients are un-known parameters to be estimated along with the variance parameters δ^2 and γ. The δ^2, and γ, coefficients are present. The estimates of the stochastic frontier production function were appraised using the generalized likelihood ratio test, and the t-ratio for significant economic relevance.

3. Result and discussion

Socio- economic characteristics of the farmers, farmland acquisition pattern and technical efficiency in maize production in the study area are presented in Table 1. From the table it was revealed that 47% of the respondents fall between the ages of 36 – 45 years and acquire their farmland by inheritance while only 7.5% of the respondents fall below 25 years which enable them to have community right to acquire their farmland. The mean age was 37.9 years which implies that most of the maize farmers are in their active age; hence, productivity is expected to be high. About 83% of the respondents were male while 17% are female, this implies that male have right to inherit farmland and had a community right to hold a farmland than female, also, about 53% of the respondents are married while only 28% are single, 73.2%, of the respondents had a farm size of less than 1 hectare, 11.2% had between 1 – 3 hectare of farmland, while 8.5% of the respondents had 3 – 5 hectare of farm size and acquire their farmland by inheritance, 13% had their farm size greater than 5 and acquire their farmland by community holding. The findings with respect farm size in this study are in congruent with the findings of Olayide, (1980). Table 1 also reveals the distribution of educational levels of the respondents. The level of education attained by a farmer is known to influence the adoption of innovation, better farming decision making including efficient use of inputs. The study showed that 81% acquired their farmland by inheritance while 12% had access to community holding to acquire their farmland for cultivation. This means that the more educated people acquire their farmland more than respondents with no education which could lead to better management of the enterprise, farming experience as a factor is supposed to have a positive relationship with the productivity of farmers. Approximately 26% of the respondents had between 6-10 years of experience on inherited farmland while 18% of the respondents that acquired their farmland by community holding had 11 -15 years of experience, also 3.4% of the respondents that acquired their farmland had less than 20 years of experience.

The table further revealed that about 57.1% acquired their farmland through inheritance which provide property right to the farmer and permit the farmland to be used for perennial and annual crop cultivation while 28.5% had community right to hold farmland for their cultivation, while 13.3% had privilege to purchase their farmland for cultivation. Also, the showed the distribution of respondents by farm related factors. It shows that only 59% were migrants who serve as labourer to farmer who inherited farmland, while 29% were settlers who settled in their various villages and serve as labourer to farmer who had community right to holding farmland for cultivation. The survey found that head poterage served as the most popular 62% mean of evacuating farm produce among the farmers while 30.2% evacuate their farm produce by mean of motorcycle among the farmers that had community right to holding farmland.

Table 4.1: Distribution of respondents by socio-economic characteristics.

Year of Experience	Frequency	%	Frequency	%	Frequency	%
≤ 5	36	62.0	18	40.9	6	33.3
6-10	15	25.8	13	29.5	6	33.3
11-15	5	8.6	8	18.1	4	22.2
≥ 20	2	3.4	5	11.3	2	11.1
Total	**58**	**100.0**	**44**	**100.0**	**18**	**100.0**
Labour (man day)						
Migrant	34	58.6	27	48.2	8	50.0
Settlers	14	24.1	16	28.5	4	25.0
Others	10	17.2	13	28.2	4	25.0
Total	**58**	**100.0**	**56**	**100.0**	**16**	**100.0**
Mode of Transport						
Foot	40	61.5	16	37.2	5	41.6
Motorcycle	12	18.4	13	30.2	3	25.0
Bicycle	8	12.3	10	23.2	2	16.6
More than one	5	7.6	4	9.3	2	16.6
Total	**65**	**100.0**	**43**	**100.0**	**12**	**100.0**

***Source:Author's computation*.**

3.1 The stochastic frontier production function analysis for farmland acquisition pattern and technical efficiency in maize production in study area

This section discusses the results of technical efficiency estimates for the analysis of farmland acquisition patterns (Inherited, community holding, and direct purchase) and technical efficiency in maize production in study area. The Cobb Douglas functional form of the stochastic frontier function provided the best fit based on the explicit analysis of farmland acquisition pattern and technical efficiency in maize production as well as the number of significant variables in the model.

Among maize farmers on inherited land, the only significant variable was seed and these was significant at 1% while the other variables like farm size, fertilizer, labour and chemical were all not significant at all known levels of significance. Seed had the highest coefficient with a value of 0.8666 in preferred models (model 2). Farm size, seed and labour all carried positive signs while fertilizer and chemical both carried negative signs in preferred model. Among the maize farmers on lands acquired by direct purchase, none of the variables like farm size, seed, fertilizer, labour and chemical was significant at all known levels of significance. Fertilizer had the highest coefficient with a value of 0.5536 in the preferred models (model 2). Farm size, fertilizer, labour and chemical all carried positive signs while seed alone carried negative sign in the preferred model.

Among the maize farmers on community holding, the only significant variable was labour and this was significant at 1% while the other variables like farm size, seed, fertilizer and chemical were all not significant at all known levels of significance. Labour had the highest coefficient with a value of 1.080 in the preferred models (model 2). Farm size, fertilizer and labour all carried positive signs while seed and chemical both carried negative signs in the preferred model. The variables with positive coefficient imply that any increase in such a variable would lead to an increase in maize output of the maize farms, while an increase in the value of the variables with a negative coefficient would lead to a decrease in output of maize. Negative coefficient on a variable might indicate an excessive utilization of such a variable.

The estimated sigma squares (σ^2) of the maize farmers on land obtained by inheritance, direct purchase and community holding were 0.9881, 0.9656 and 0.9313 respectively in the preferred model (model 2). The values are large and significantly different from zero (Table 2). They indicate better goodness of fit of the model and the correctness of specified distributional assumptions.

The estimated gamma (γ) parameters of the maize farmers on inherited, direct purchase and community holding were 0.9881, 0.9466 and 0.8444 and were highly significant at 1% level of significance. This means that 98.8%, 94.66% and 84.44% of the variations in the maize output among the farmers on inherited, direct purchase and community holding in the study area are due to the differences in their technical efficiencies.

3.2 Inefficiency Model

The estimated parameters of the inefficiency model in the stochastic frontier models of the analysis of farmland acquisition pattern and technical efficiency in maize production in study area are presented in Table 2a-2c. Among the farmers on inherited lands, the coefficients of marital status, experience, and household size were negative while those of age and sex were positive. Those variables with positive coefficients lead to increase in technical inefficiency or decrease in the technical efficiency of maize farmers on inherited lands while variables with negative coefficients lead to decrease in technical inefficiency or increase in their technical efficiency.

Among the farmers on direct purchased lands, the coefficients of age, marital status, experience, and household size were negative while that of sex was positive. Those variables with positive coefficients lead to increase in technical inefficiency or decrease in the technical efficiency of maize farmers on direct purchased lands while variables with negative coefficients could lead to decrease or increase in technical inefficiency or efficiency. Among the farmers on community holding, the coefficients of marital status, experience, and were negative while those of age, sex and household size were positive. Those variables with positive coefficients could lead to increase or decrease in technical inefficiency or efficiency of maize farmers on leased lands while variables with negative coefficients could lead to decrease or increase in technical inefficiency or efficiency.

The estimated productivity parameters such as elasticities of production and returns to scale are discussed in this section.

Table 2: Maximum likelihood estimates for the parameters of the stochastic frontier Production function for maize farmers on inherited lands in the study area.

Variable	Parameter	Model 2	T-ratio
General Model (Production Function)			
Constant	β_0	45.0778	7.2063
Farm Size	β_1	0.5573	0.3883
Seed	β_2	0.8666*	4.3568
Fertilizer	β_3	-0.2365	-1.2413
Labour	β_4	0.8098	0.5920
Chemical	β_5	-0.8552	-1.2667
Inefficiency Model			
Constant	δ_0	-1.8136	-1.1097
Age	δ_1	5.5530*	2.8323
Sex	δ_2	1.4271	0.7847
Marital Status	δ_3	-4.5115	-1.3655
Experience	δ_4	-11.5470	-1.9785
Household Size	δ5	-0.2707	-1.0757
Sigma Squared	σ^2	233.683*	215.836
Gamma	γ	0.9881*	109.928
Log Likelihood Function	-130.87		
X^2	301.56		
$X^2_{(0.05, 8)}$	14.07		

Notes: ** = 5% level (Figures in parentheses are t- values).
Source: author's computation.

Table 2b: Maximum likelihood estimates for the parameters of the stochastic frontier production function for maize farmers on land directly purchased in the study area

Variable	Parameter	Model 2	T-ratio
General Model (Production Function)			
Constant	β_0	5.4392	1.621
Farm Size	β_1	0.0780	0.376
Seed	β_2	-0.1991	-0.433
Fertilizer	β_3	0.5536	0.645
Labour	β_4	0.1986	0.596
Chemical	β_5	0.1778	0.792
Inefficiency Model			
Constant	δ_0	0.7538	1.935
Age	δ_1	-0.0154	-0.449
Sex	δ_2	0.0363	0.192
Marital Status	δ_3	-0.0111	-0.220
Experience	δ_4	-0.0158	-0.682
Household Size	$\delta 5$	-0.000049	-0.276
Sigma Squared	σ^2	0.9656	6.004
Gamma	γ	0.9466	1.000
Log Likelihood Function	-6.2533		
X^2	23.62		
$X^2_{(0.05,8)}$	14.07		

Notes:** = 5% level (Figures in parentheses are t- values).
Source: author's computation

Table 2c: Maximum likelihood estimates for the parameters of the stochastic frontier production function for maize farmers on community holding in the study area.

Variable	Parameter	Model 2	T-ratio
General Model (Production Function)			
Constant	β_0	0.2975	1.963
Farm Size	β_1	0.3159	1.588
Seed	β_2	-0.1400	-1.314
Fertilizer	β_3	0.0902	0.545
Labour	β_4	1.080	8.494
Chemical	β_5	-0.0583	-0.644
Inefficiency Model			
Constant	δ_0	0.6957	3.422
Age	δ_1	0.0047	0.261

Sex	δ_2	0.1198	1.341
Marital Status	δ_3	-0.0245	-0.953
Experience	δ_4	-0.0439	-3.085
Household Size	δ5	0.00216	2.803
Sigma Squared	σ^2	0.9313	9.391
Gamma	γ	0.8444	0.854
Log Likelihood Function	16.2929		
X^2	21.80		
$X^2_{(0.05,8)}$	14.07		

Notes: ** = 5% level (Figures in parentheses are t- values).
Source: author's computation

3.3 Elasticities (εP) and returns to scale (RTS) of the analysis of land acquisition pattern and technical efficiency in maize production in study area.

Among the farmers on inherited lands, the estimated elasticities of the explanatory variables of the preferred model (Model 2) show that farm size, seed and labour were positive functions to the factors. This indicates a good use of such variables and they exist in stage I of the production function while Chemicals and fertilizer were negative decreasing functions to the factors which indicate that the use and allocation of those variables were in stage II of the production function – a preferred stage of production.

Among the farmers on direct purchased lands, the estimated elasticities of the explanatory variables of the preferred model (Model 2) show that farm size, fertilizer, labour and chemical were positive functions to the factors. This indicates a good use of such variables and they exist in stage I of the production function while seed was negative decreasing function to the factors which indicate that the use and allocation of those variables were in stage II of the production function – a preferred stage of production.

Among the farmers on community holding, the estimated elasticities of the explanatory variables of the preferred model (Model 2) show that farm size, fertilizer and labour were positive functions to the factors. This indicates a good use of such variables and they exist in stage I of the production function while seed and chemicals were negative decreasing functions to the factors which indicate that the use and allocation of those variables were in stage II of the production function – a preferred stage of production.

Table 3a: Elasticities (εP) and Returns-to-Scale (RTS) of the Maize Farmers on inherited lands in study area.

EP	Coefficient
Farm Size	0.5573
Seed	0.8666
Fertilizer	-0.2365
Labour	0.8098
Chemical	-0.8552
RTS	1.142

Source: author's computation.

Table 3b: Elasticities (εP) and Returns-to-Scale (RTS) of the Maize Farmers on direct purchased lands in study area.

EP	Coefficient
Farm Size	0.0780
Seed	-0.1991
Fertilizer	0.5536
Labour	0.1986
Chemical	0.1778
RTS	0.8089

Source: author's computation.

Table 3c: Elasticities (εP) and Returns-to-Scale (RTS) of the Maize Farmers on community holding in study area.

EP	Coefficient
Farm Size	0.3159
Seed	-0.1400
Fertilizer	0.0902
Labour	1.080
Chemical	-0.0583
RTS	1.2878

Source: author's computation

3.4 Returns to scale (RTS)

The analysis of results in Table 3a-3c shows that the RTS for the analysis of farmland acquisition pattern and technical efficiency in maize production in study area. The RTS for farmers on inherited, direct purchased and community holding types are 1.142, 0.8089 and 1.2878 respectively in the study areas. This indicates that farmers on inherited and community holding are in the increasing return to scale stage of the production system while those on direct purchased lands are in the decreasing return toscale of the production system.

3.5 Technical Efficiency Analysis of Maize Farms in the Study Area

The predicted technical efficiency estimates obtained using the estimated stochastic frontier models for the individual maize farms in the study area presented in Tables 4a to 4c.

Tables 4a and 4c shows the predicted technical efficiency estimates for the maize farmers on inherited, direct purchase and community holding in the study area. The predicted maize farm specific technical efficiency (TE) for the maize farmers' indices on community holding ranged from a minimum of 10.12% to a maximum of 98.55% for the farms, with a mean of 14.42% .Thus, in the short run, an average maize farmer has the scope of increasing maize production by about 85.58% by adopting the technology and techniques used by the best practiced (most efficient) maize farmers. Such maize farmer could also realize 85.36% cost savings (i.e.1 – [14.42/ 98.55] in order to achieve the TE level of his most efficient counterpart. (Bravo-Ureta &Evenson, 1994)

The predicted maize farm specific technical efficiency (TE) for the maize farmers' indices on inherited lands ranged from a minimum of 12.46% to a maximum of 99.99% for the farms, with a mean of 54.84% .Thus, in the short run, an average maize farmer has the scope of increasing maize production by about 45.16% by adopting the technology and techniques used by the best practiced (most efficient) maize farmers. Such maize farmer could also realize 45.15% cost savings (i.e.1 – [54.84/ 99.99] in order to achieve the TE level of his most efficient counterpart. (Bravo-Ureta and Evenson, 1994)

The predicted maize farm specific technical efficiency (TE) for the maize farmers' indices on direct purchase ranged from a minimum of 58.63% to a maximum of 89.71% for the farms, with a mean of 55.54% .Thus, in the short run, an average maize farmer has the scope of increasing maize production by about 44.46% by adopting the technology and techniques used by the best practiced (most efficient) maize farmers. Such maize farmer could also realize 38.15% cost savings (i.e.1 – [55.54/ 89.81] in order to achieve the TE level of his most efficient counterpart. (Bravo-Ureta &Evenson,1994)

A similar calculation for the most technically inefficient maize farmer on community holding land reveals cost saving of about 87.73% (i.e., 1 – [10.12/98.55] shown in table 4.15. The decile range of the frequency distribution of the TE indicates that about 9.09 % of the maize farmers had TE of over 70 % and about 6.06% had TE ranging between 51 % and 70 % respectively.

A similar calculation for the most technically inefficient maize farmer on inherited land reveals cost saving of about 87.54% (i.e., 1 – [12.46/99.99] as shown in table 4.16. The decile range of the frequency distribution of the TE indicates that about 24.32 % of the maize farmers had TE of over 70 % and about 18.91% had TE ranging between 51 % and 70 % respectively.

A similar calculation for the most technically inefficient maize farmer on direct purchase reveals cost saving of about 34.72% (i.e. 1 – [58.63/89.81] as shown in table 4.17. The decile range of the frequency distribution of the TE indicates that about 25.49% of the maize farmers had TE of over 70 % and about 33.33% had TE ranging between 51 % and 70 % respectively.

3.6 Test of hypotheses

The results from the test conducted on the specified null hypotheses are discussed in tables below.

Test of hypothesis for the absence of inefficiency effects

The null hypothesis specifies that the maize farmers on inherited, direct purchased and community holding were technically efficient in their production and that the variation in their output was only due to random effects, which are beyond the control of the decision maker and as such the average response function (OLS) was adequate to estimate the production function parameters. The hypothesis is defined thus: H_{02}: $\gamma = 0$

The generalized likelihood ratio test was conducted and the Chi-square (X^2) distribution was computed. Table 5 shows the results of the generalized likelihood ratio test for the absence of technical inefficiency effects. The results showed that the null hypothesis, $\gamma = 0$, was rejected for the maize farmers on inherited, direct purchased and community holding respectively in the study area. This indicates that the technical inefficiency effects were strong in the production of maize by the farmers having different land ownership statuses in the study area and that variation in their production processes were not only due to random effects but also inefficiency effects.

Table 4a: Decile range of frequency distribution of technical efficiencies of the maize farmers on community holding in the study area.

Decile Range (%)	Technical Efficiency	
	Frequency	%
≤ 30	38	54.54
31 – 40	6	18.18
41 – 50	4	12.12
51 – 60	2	6.06
61 – 70	-	-
71 – 80	1	3.03
81 – 90	1	3.03
>90	1	3.03
Mean %	14.45%	
Minimum%	10.12%	
Maximum %	98.55%	

Source: author's computation.

Table 4b: Decile Range of Frequency Distribution of Technical Efficiencies of the Maize Farmers on inherited land in the study area.

Decile Range (%)	Technical Efficiency	
	Frequency	%
≤ 30	30	2.70
31 – 40	5	13.51
41 – 50	6	16.21
51 – 60	2	5.40
61 – 70	5	15.51
71 – 80	1	2.70
81 – 90	1	2.70
>90	7	18.92
Mean %	54.84%	
Minimum%	12.46%	
Maximum %	99.99%	

Source: author's computation

Table 4c: Decile range of frequency distribution of technical efficiencies of the maize farmers on direct purchase in the study area.

Decile Range (%)	Technical Efficiency	
	Frequency	%
≤ 30	4	5.88
31 – 40	5	9.8
41 – 50	9	17.65
51 – 60	7	13.73
61 – 70	10	19.60
71 – 80	7	13.73
81 – 90	6	11.76
>90	-	-
Mean %	55.54%	
Minimum%	58.63%	
Maximum %	89.81%	

Source: author's computation

Table 5: Test of hypotheses on technical efficiency

H_{02}: Maize farmers are fully technically efficient ($\gamma = 0$)

Farmers' land status	L (H_0)	L (H_a)	$X^2_{Computed}$	d.f	$X^2_{7, 0.05}$	Decision
Inherited	-121.46	-106.39	301.56	8	14.07	Reject Ho
Direct purchase	**-48.94**	**31.65**	**23.62**	**8**	**14.07**	Reject Ho
Community holding	-65.57	16.2929	21.80	8	14.07	Reject Ho

Source: author's computation

Conclusion:

This study examined the productivity of maize farmers with respect to the pattern of land holding using a stochastic production frontier. The findings of the study have implications for increased food production in the study area. Attainment of 70% efficiency means that farmers still have room to increase their efficiency to the optimum (100%). This will require addressing those factors which are constraints to efficiency. In conclusion, there is a significant positive relationship between farm size, fertilizer, seed and labour in the maize output in the study area and also access to good quality seed have positive impact on output, and increase in size of production brings better output to the farmers. To make farmers more efficient technically, adult education should be encouraged to introduce modern techniques of farming to improve productivity. Hence, maize production in the study area is profitable.

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