Linking Socio-economic and Policy Variables to Technical Efficiency of Traditional Agricultural Production: Empirical Evidence from Nigeria [1]

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Abstract

The major objective of this study was to analyze and link the level of technical efficiency of Nigerian small-scale farmers to specific farmers' socio-economic and policy variables. Data were collected on 461 food crop farmers selected from five states of Southwestern Nigeria. The selection of respondent farmers was multi-stage and involved random sampling method, stratification as well as purposive sampling. The collected data were analyzed with the use of stochastic frontier production modeling technique. The results show that while farmers socio-economic and policy variables significantly influenced the level of technical efficiency, education has the highest marginal effect on technical efficiency while gender has the least marginal effect. The highest mean technical efficiency of 0.77 occurs among group of farmers within 7-12 years of schooling (secondary school education group) while the least mean technical efficiency (0.54) occurs within the category of farmers with years of schooling within 1-6 years. The findings of the study has a number of policy implications, including the need to formulate and implement agricultural policies that will enable farmers acquire basic education necessary to read, write and understand instructions on application and adoption of new farming innovations.

Keywords: Traditional agriculture; socio-economic variables; policy variables; Technical efficiency; Nigeria.

1. Introduction

Agriculture plays a basic role in the economic development of Nigeria. It provides food for the growing population, employment for over 65% of the population, raw materials and foreign exchange earnings for the development of the industrial sector. Since the period of Nigeria's independence in 1960 and up to the present period, the Nigerian small-scale farmers have been in central focus in agricultural policy formulation. This is because the nation's agriculture has always been dominated by small scale farmers who represent substantial proportion of the total population and produce over 90% of Nigeria's food requirements (Okuneye, 1989). Idachaba (2000) has however identified inconsistent policies as the major sources of poor performance of Nigerian agriculture. Efficiency of production is central to raising production and productivity in the African agriculture.

While several studies have been carried out on estimation of efficiency in African agriculture (e.g. Adesina and Djato 1997; Obwona 2000, Ajibefun and Abdulkadri, 1999; Seyoum *et al* 1998), none of these studies has linked variation in technical efficiency to socio-economic and policy variables, by measuring the marginal effects of these variables. Those studies that attempted to link these variables to technical performance of the farmers (e.g. Weir and Knight 2000; Obwona 2000; Weir 1999) merely indicated the direction of the influence and not the marginal effects or magnitude of the effects of such variables on efficiency. These are the issues this study was set to address.

The impact of socio economic characteristics of farmers on performance has generated a lot of interest among researchers and policy makers. There are empirical evidences to suggest that education could improve performance of the farmers. Obwona (2000) showed that education contributes positively to the improvement of efficiency of tobacco farmers in Uganda. Seyoum *et al* (1998) found that farmers that participate in program of technology demonstration are more technically efficient than farmers that do not participate. Weir (1999) indicated that a substantial benefit of schooling for farmer's productivity in terms of efficiency gains in Ethiopia, but with a threshold of at least four years of schooling before any significant effects on farm level technical efficiency. Weir and Knight (2000) study the impact of education externalities on production and technical efficiency of farmers in rural Ethiopia. The findings indicate that the source of externalities to schooling is in the adoption and spread of innovations, which shift out the production frontier. Adesina and Djato applied the stochastic frontier model to measure the relative efficiency of women as farm managers using the profit function. Their results show that the relative degree of efficiency of women is similar to that of men. Obwona (2000) applied the Cobb-Douglas frontier model in analysis of the determinants of technical efficiency differentials among small and medium scale tobacco farmers in Uganda. The results of the study show that education, credit accessibility and extension services contribute positively to the improvement of efficiency. While these studies merely indicate positive or negative effect of farmers socio-economic variables on technical efficiency, it is necessary to measure the relative contributions (marginal effects) of these variables to the level of technical efficiency, by measuring the magnitude and hence the importance of the variables on farmers technical efficiency.

2. Study area, data and analytical approach

This study covered Southwestern part of Nigeria, consisting of Ekiti, Ogun, Ondo, Osun, and Oyo states. Within this area, there are three distinct ecological zones: the mangrove forest to the south, the rain forest to the middle belt and the derived savanna to the north. The zone is well suited for production of arable crops such as maize, cassava, rice, yam and plantain as well as tree crops such as cocoa, oil pal and rubber. The bulk of agricultural products come from small-scale farmers who practice manually cultivated rain-fed crops. For this study, the selection of respondent farmers was multi-stage and involved random sampling method, as well as purposive sampling. In the first stage, the communities in each state were divided into two strata (urban and rural). The rural stratum was purposively selected, as agricultural production is more common in the rural settings than the urban areas. Within the rural stratum, two villages were randomly selected from each state, making a total of 10 villages. From each selected village, three main sole crops were considered: maize, cassava and rice. Multiple crop farms (consisting of a mixture of two or more of these crops) were also sampled. Information was collected on output as well as inputs of each category of farms. Data were also collected on socio-economic and policy variables. Such variables include farmers' age, level of education, household size, farming experience, gender, land ownership and membership of cooperative society. For all the input variables and output variable, the monetary values were also obtained.

This study made use of the methodology of stochastic frontier production function. The production frontier can be viewed as composed of those parts of the firm's production functions that yield maximum output for a given set of inputs. Hence, it is possible that a firm with its scale of operation may not be able to reach the frontier, which is the production function for the industry. On the other hand, there may be firms whose outputs are closer to frontier, given their levels of inputs. The notion of how close the individual production plans are to the maximum levels, as defined by the frontier, given inputs levels, is the measure of technical efficiency for each firm. Following Farrell's (1957) efficiency idea, a measure of technical efficiency for any given household *i* is given by the following ratio:

$$TE_i = \left\{ \frac{E(z_i / u_{i,} x)}{E(z_i / u_i = 0, x_i)} \right. \tag{1}$$

where z_i, x_i, and u_i are the output, input and inefficiency effect vectors, respectively. Therefore, the stochastic frontier production function is defined by the ratio of observed output to frontier output as represented in equation (2)

$$TE_i = \frac{z_i}{z_i*} = \frac{F(x_i;\beta)e^{(v_i-u_i)}}{F(x_i;\beta)e^{v_i}} = e^{-u_i} \quad \text{so that } 0 \leq TE_i \leq 1 \qquad (2)$$

where z_i* represents the frontier output and Z_i the observed output. β_{is} are the coefficients to be estimated; v_{is} are assumed to be independently and identically distributed normal random errors, having zero means and unknown variance σ^2_v;. The u_s are the technical efficiency effects, which are assumed to be independent of v_{is}. In this study, we use the maximum likelihood method, in line with Battese and Coelli (1995), using Battese and Corra (1977) parameterization. The maximum likelihood (ML) estimates of the production function in equations (2) and (4) is obtained from the following log likelihood function,

$$\ln L = \frac{N}{2}\ln\frac{\Pi}{2} - \frac{N}{2}\ln\sigma^2 + \sum_{j=1}^{N}\ln\left[1 - F\left(\frac{\varepsilon_j\sqrt{\gamma}}{\sigma\sqrt{(1-\gamma)}}\right)\right] - \frac{1}{2\sigma^2}\sum_{j=1}^{N}\varepsilon^2{}_j \qquad (3)$$

where ε_j are residuals based on maximum likelihood estimates, N is the number of observations, F() is the standard normal distribution function, $\sigma^2 = \sigma^2_u + \sigma^2_v$ and $\gamma = \sigma^2_u/\sigma^2$. The maximum likelihood estimates of the production function were estimated using the computer program, FRONTIER Version 4.1, Coelli (1996). FRONTIER provides estimates of β, $\sigma^2_u+\sigma^2_v$, $\gamma = \sigma^2_u/\sigma^2$ as well as individual and average farm-level efficiencies.

For this study, the production technology of small-scale food crop farmers was assumed to be specified by the translog frontier production function defined by

$$LnY_i = \beta_0 + \sum_j \beta_j x_{ji} + \sum_k \beta_{1,6-k} x_{1i} x_{6-k,i} + \sum_h \beta_{2,6-h} x_{2i} x_{6-h,i} + \sum_m \beta_{3,6-m} x_{3i} x_{6-m,i} + \sum_n \beta_{4,6-n} x_{4i} x_{6-n,i} + \sum_p \beta_{5,6-p} x_{5i} x_{6-p,i} + \beta_{66} x_{6i} + v_i - u_i \qquad (4)$$

Where L_n represents the natural logarithm; The subscript i represents the i-th sample farmer; Y represents the output of farmer;x_1 represents the total area of land in hectares; x_2 represents the labour, in mandays used in production; x_3 stands for credit used in production; x_4 represents value of implements used in production; x_5 represented quantity of seeds planted in kilograms; x_6 represents quantity of fertilizer; *j, k, h, m, n* and *p* represent the interaction between the 6 inputs in the second order level of the translog frontier model. This is the main strength of the translog frontier model over the Cobb-Douglas frontier model, as it is possible to represent the interaction between various inputs in production. β_{is} are the coefficients to be estimated; v_{is} are assumed to be independently and identically distributed normal random errors, having zero means and unknown variance σ^2_v;. The u_s are the technical efficiency effects, which are assumed to be independent of v_{is}.

The inefficiency of production if farmers, μ,, was modeled in terms of the socio-economic variables of the farmers, which are assumed to affect their level of technical efficiency. Technical inefficiency of the farmers, (μ_i), is defined by

$$\mu_i = \delta_0 + \delta_i Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} + \delta_6 Z_{6i} + \delta_7 Z_{7i} \qquad (5)$$

Where Z_1, Z_2, Z_3, Z_4, Z_4, Z_5, Z_6 and Z_7 are farmers' socio-economic and policy variables which are the level of education, farming experience, extension visit, gender, age, type of land ownership, membership of cooperative respectively. These variables are assumed to influence technical efficiency of the farmers. The translog frontier model in equation (4) is simultaneously estimated with the inefficiency model in equation (5).

3. Empirical results

The maximum likelihood estimates of the parameters in the translog frontier model of equation (4) are presented in Table 1. The estimates for the γ–parameter in the stochastic frontier production function are quite large for all crops/cropping system, varying from 0.59

to 0.86, with all being highly significant. This means that inefficiency effects are highly significant in the analysis of the output of the farmers.

Table 1: Maximum likelihood estimates of the translog stochastic frontier production function

Variable	Parameter	Cassava		Maize		Rice		Multiple Crops	
		Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Constant	β_0	3.23	4.11	3.71	3.77	3.60	3.41	1.95	4.11
Land	β_1	0.30	2.94	0.19	2.14	0.55	3.06	0.19	2.46
Labour	β_2	0.13	2.41	0.21	1.33	-0.17	3.42	-0.20	2.81
Credit	β_3	0.24	2.17	0.33	2.28	0.16	2.55	0.13	2.93
Implements	β_4	-0.09	0.81	-0.21	1.77	-0.25	0.49	0.32	3.20
Seed	β_5	-0.41	3.24	0.46	2.77	0.18	2.16	-0.11	1.04
Fertilizer	β_6	-0.15	4.41	-0.22	3.04	-0.29	2.67	-0.25	2.15
$[\text{Land}]^2$	β_{11}	0.06	1.09	0.20	2.15	0.10	2.21	0.08	1.09
$[\text{Labour}]^2$	β_{22}	0.18	2.10	0.16	2.46	0.13	0.14	0.13	0.06
$[\text{Credit}]^2$	β_{33}	0.14	2.16	0.05	3.36	-0.16	2.35	-0.15	2.57
$[\text{Implements}]^2$	β_{44}	-0.01	1.23	-0.05	0.24	-0.03	2.98	0.14	0.26
$[\text{Seed}]^2$	β_{55}	0.12	3.40	0.06	0.12	0.10	0.04	0.11	3.14
$[\text{Fertilizer}]^2$	β_{66}	-0.20	1.33	0.09	2.56	0.21	1.85	0.09	1.06
[Land x Labour]	β_{12}	0.14	1.71	0.13	0.09	0.11	2.35	-0.09	0.17
[Land x Credit]	β_{13}	0.15	2.66	-0.14	4.21	-0.14	2.49	0.03	2.57
[Land x Implements]	β_{14}	-0.22	0.35	0.12	0.26	0.04	0.47	-0.03	0.19
[Land x Seed]	β_{15}	0.17	2.41	0.03	0.16	-0.13	2.98	0.05	0.15
[Land x Fertilizer]	β_{16}	-0.03	0.21	0.16	1.41	-0.19	0.16	0.09	2.34
[Labour x Credit]	β_{23}	0.13	1.28	-0.03	2.52	0.07	0.28	-0.07	3.17
[Labour x Implements]	β_{24}	0.14	0.35	-0.17	0.21	-0.06	0.33	-0.04	0.19
[Labour x Seed]	β_{25}	-0.11	4.62	0.19	0.35	0.05	0.64	0.02	2.88
[Labour x Fertilizer]	β_{26}	0.04	1.31	0.11	0.05	0.06	1.12	0.19	0.52
[Credit x Implements]	β_{34}	-0.04	0.71	-0.33	0.42	0.05	1.29	-0.01	2.63
[Credit x Seed]	β_{35}	0.14	2.44	-0.05	2.34	0.15	1.36	0.04	4.49
[Credit x Fertilizer]	β_{36}	0.57	0.23	-0.07	1.19	-0.17	0.12	0.11	0.13
[Implements x Seed]	β_{45}	0.06	0.17	0.10	0.39	-0.15	0.54	0.03	0.20
[Implements x Fertilizer]	β_{46}	0.08	0.23	0.15	2.76	0.15	0.26	0.04	0.16
[Seed x Fertilizer]	β_{56}	-0.08	2.11	-0.16	0.15	0.22	0.37	-0.08	1.33
Inefficiency Model									
Constant	δ_0	0.29	2.44	0.36	3.41	0.28	3.54	0.13	4.38
Education	δ_1	-0.44	3.62	-0.15	2.89	-0.15	5.08	0.15	5.14
Experience	δ_2	-0.11	2.75	-0.26	0.33	-0.29	3.37	-0.17	3.19
Extension Visit	δ_3	-0.15	2.77	-0.23	2.48	-0.37	2.95	0.14	1.22
Gender	δ_4	0.21	0.37	-0.21	0.19	-0.15	2.67	0.13	2.77
Age	δ_5	0.21	2.14	0.27	3.31	0.15	2.66	0.11	2.22
Land ownership	δ_6	-0.44	2.65	-0.11	2.62	-0.25	1.44	-0.21	2.55
Membership of coop society	δ_7	-0.17	2.31	-0.19	2.46	0.12	1.15	-0.19	0.21
Variance Parameter									
Gamma	γ	0.69	5.34	0.66	6.49	0.86	7.68	0.59	4.55
Log likelihood function		-31.22		-27.61		-45.41		-60.89	

Land variable is positive and highly significant for all cropping systems. Labour input is also highly significant for all cropping systems but with a negative coefficient for multiple cropping system. This negative value may be as a result of over-use of labour by multiple crop farmers. Credit is also positive and significant for all cropping systems. This explains the importance of credit in raising farm production. For implement, it has negative coefficients for all farming systems except for multiple cropping system. Seed has positive coefficient for all cropping systems, except for cassava and multiple crops. It is however significant for all the cropping systems, except multiple cropping system. Fertilizer is positive and significant for all the cropping systems.

Inefficiency Model

The estimated coefficients in the explanatory variables in the model for technical inefficiency model in Table 1 are of interest and have important implications. The coefficients represent the relative importance of the variables in influencing the level of observed technical efficiency of the farmers. The results show that coefficients of gender and age are positive for almost all the crops/cropping systems while the other variables are negative. The implication is that those variables with positive coefficients have positive effect on inefficiency (or reduce technical efficiency) and vice-versa for those variables with negative coefficients in the inefficiency model. However, the magnitude of the effect of the inefficiency variables is of paramount importance. Quantification of the marginal effects of these variables on technical efficiency is possible by partial differentiation of the technical efficiency predictor with respect to each of the inefficiency effects variables. Battese and Tessema (1993) show that for the i^{th} firm, the technical efficiency is predicted using the conditional expectation,

$$TE_i = E[\exp(-U_i)|E_i = e_i]$$

$$= \exp(-\mu_* + \tfrac{1}{2}\sigma_*^2(\frac{\phi[(\mu_*/\sigma_*) - \sigma_*]}{\phi(\mu_*/\sigma_*})) \qquad (6)$$

where

$$\mu_* = (1-\gamma)z_i\delta - \gamma e_i, \quad \sigma_*^2 = \gamma(1-\gamma)\sigma_s^2,$$

$$e_i = v_i - u_i$$

and ϕ represents the distribution function of the standard normal random variable. The marginal effects indicate the relative importance of the variables in determining the level of technical efficiency. Presented in Table 2 are the results of differentiating of equation 4 with respect to each of the inefficiency effects variables (which are evaluated at their mean values and e_i are calculated at the mean values of the dependent and independent variables in the stochastic frontier production function.

Table 3: Marginal effects of socioeconomic and policy variables

Variable	Coefficient	t-ratio
Education	-0.033	4.68
Experience	-0.0041	2.54
Extension visit	-0.0013	3.66
Gender	0.0011	1.09
Age	0.0024	3.02
Land ownership	-0.0015	1.77
Membership of cooperative society	-0.0021	2.79

While gender and age variables have positive marginal effects on technical efficiency, other variables have negative effects. It is important to state that education has the highest marginal effect on technical efficiency, with gender factor having the least marginal effect. All the marginal coefficients of all the variables are significant at 5% level, except the marginal coefficient of *gender* and land *ownership*.

Technical Efficiency and Confidence Interval Estimates

Given the fact that point estimates tend to over-estimate technical efficiency, we estimated confidence intervals following. Battese *et al*. 2000. Given a stochastic frontier production model defined by Log $Y_i = x_i\beta + V_i - U_i$, and the distributional specifications for U_i, Battese *et al*. 2000 shows that a (1-α)100% confidence predictor for U_i is defined by [U_i(lower), U_i(upper)], where U_i(lower)and U_i(upper) are defined by,

$$U_i(\text{lower}) = \mu_i + \sigma\Phi^{-1}[1-(1-\alpha/2)\Phi(\mu_i/\sigma)]$$

U_i(upper) = $\mu_i+\sigma\Phi^{-1}[1-(\alpha/2)\Phi(\mu_i/\sigma)]$

Where $\Phi(.)$ represents the standard normal distribution function. Hence, a (1-α)100% confidence predictor for exp(U_i)-1] is defined by

$$\{\exp[U_i(\text{lower})]-1,\exp[U_i(\text{upper})]-1\}. \quad (7)$$

Battese *et al*. 2000 provide the conditional distribution of U_i given $\varepsilon_i = V_i + U_i$, for the case of cost frontier function. Given that we estimate production frontier, we make use of Horrace and Schmidt (1996) who suggest that the confidence prediction of U_i should be based on the conditional distribution of U_i, given $\varepsilon_i = V_i - U_i$ for the case of production frontier.

The confidence intervals constructed for the estimated technical efficiency are provided in Table 4. The Table shows a wide confidence interval. The Table shows the dispersion of confidence intervals by the level of efficiency.

Table 4: Dispersion of Confidence Interval by Level of Efficiency

% Efficiency interval	Frequency	Mean Efficiency	Upper CI	Lower CI	Range
0.00-10.00	9 farms	07.00	09	06	07.00
10.00-20.00	12 farms	13.24	20	12	08.00
20.00-30.00	18 farms	28.55	30	21	09.00
30.00-40.00	27 farms	37.33	44	36	08.00
40.00-50.00	47 farms	48.21	55	44	11.00
50.00-60.00	86 farms	58.42	64	52	12.00
60.00-70.00	76 farms	67.60	77	62	15.00
70.00-80.00	71 farms	77.12	73	77	04.00
80.00-90.00	67 farms	86.66	96	85	11.00
90.00-100.00	48 farms	91.77	100	89	09.00

The dispersion of confidence intervals on efficiency basis shows highest range (15.00) among farms with efficiency between 60% and 70% of efficiency and least range of dispersion (04.00) among farmers with efficiency between 70% and 80% of efficiency. The implications of the results from the confidence intervals is that the farms might be less efficient than revealed by the point estimates alone. Farms originally identified to be on the frontier or very close to the frontier, may in fact lie well below it.

4. Discussion

It is important to highlight and discuss the policy relevance of this study in line with influence of socio-economic and policy variables on technical efficiency of the farmers. To do this, different classes of the farmers were made in relation to the variables and mean technical efficiency scores were computed according to the classes. The results of these classifications are provided in Table 5.

The results on variation of mean technical efficiency, based on different educational level show that the highest mean technical efficiency (0.77) occurs among the farmers with 7-12 years of formal education. These are the farmers that had at least primary education and at most secondary education. The least mean technical efficiency (0.54) occurs within the category of farmers with level of education of 1-6 years. This seems to be a surprising result, given that farmers with no education have higher mean technical efficiency than farmers with 1-6 years of education. It is also interesting to note that the highest mean technical efficiency did not come from the group of farmers with highest level of formal education (12 years and above). For age variable, the least mean technical efficiency of 0.47 occurs among the oldest category of farmers included in the study. These are the farmers with age greater than 60 years old. The mean technical efficiency for this group is far less than the pooled mean technical efficiency for all the farmers.

Table 5: Effects of policy variables on technical efficiency (pooled data)

Variables	Mean Technical Efficiency	Comparison to overall Mean TE (0.64)
Education		
0	0.55	Less than overall mean
1-6	0.54	Less than overall mean
7-12	0.77	Greater than overall mean
> 12	0.68	Greater than overall mean
Age		
< 20	0.57	Less than overall mean
20-40	0.68	Greater than overall mean
41-50	0.79	Greater than overall mean
51-60	0.70	Greater than overall mean
> 60	0.47	Less than overall mean
Experience		
< 5	0.60	Less than overall mean
5-15	0.62	Less than overall mean
16-25	0.69	Greater than overall mean
> 25	0.64	Equal to overall mean
Family size		
< 4	0.75	Greater than overall mean
4-6	0.76	Greater than overall mean
7-10	0.50	Less than overall mean
> 10	0.54	Less than overall mean
Gender		
Male	0.65	Greater than overall mean
Female	0.63	Less than overall mean
Fertilizer		
No Use	0.47	Less than overall mean
1-30	0.58	Less than overall mean
31-60	0.63	Less than overall mean
61-90	0.81	Greater than overall mean
>90	0.72	Greater than overall mean
Land ownership		
Owned	0.67	Greater than overall mean
Rented or leased	0.61	Less than overall mean
Membership of coop society		
Member	0.74	Greater than overall mean
Non-member	0.53	Less than overall mean

The implication of this result is that this category of farmers, though experienced in the business, is no longer strong enough to work on the farm or effectively supervise the farm workers, if relied on hired labour. However, the highest mean technical efficiency of 0.79 occurs within the 41-50 years age category. This category of farmers belongs to the middle age and fairly old farmers. This is an indication that the farmers in this group are still strong enough to work on the farm but have also gathered enough experience in the farming business.

Experience is expected to increase technical efficiency, all other things being equal. While the result in the inefficiency model confirms this assertion, it has been indicated in Table 6 that years of farming experience does not continuously lead to continuous increase in technical efficiency. The highest mean technical efficiency occurs among the farmers with 16-25 years of farming experience, while the least technical efficiency occurs among farmers with the least farming experience. On family size, the results show that only households in the category of family size between 1 and 6 members have mean technical efficiency greater than the pooled mean technical efficiency. For gender factor, the mean technical efficiency of male farmers (0.65) is slightly higher than the mean technical efficiency of their female counterpart (0.63). However, the result of hypothesis test indicates that there is no significant difference in technical efficiency of the two groups. On fertilizer use, the mean technical efficiency increased progressively with increase in the quantity of fertilizer. However, the highest mean technical efficiency did not occur among the group of farmers with the highest level of fertilizer. The highest mean technical efficiency occurs among farmers with fertilizer use of between 60kg and 90kg. While there is a higher mean technical efficiency among farmers who owned their land, the mean technical efficiency is higher for farmers who belong to farmers' cooperative societies than farmers who do not belong to any farmers' society group.

5. Conclusion

The major objective of this study was to analyze and discuss the links between socio-economic and policy variables and technical efficiency of traditional agriculture, with application to Nigerian small scale farmers. Results of analysis indicate that technical efficiency of the farmers varies across farms and farming systems. The results show that while education has the highest marginal effect on technical efficiency, the highest mean technical efficiency (0.77) does not occur among group of farmers with the highest years of schooling. The highest mean technical efficiency occurs among group of farmers within 7-12 years of schooling (secondary school education group), the least mean technical efficiency (0.54) occurs within the category of farmers with years of schooling within 1-6 years. The findings of the study has a number of policy implications, including the need to formulate and implement agricultural policies that will enable farmers acquire basic education necessary to read, write and understand instructions on application and adoption of new farming innovations.

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