DETERMINANTS OF PRODUCTIVITY EFFICIENCY OF SMALL SCALE MAIZE FARMERS IN SOUTHWEST, NIGERIA: A TRANSLOG FUNCTIONAL APPROACH

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Abstract

The study assessed the productivity of small-scale maize farmers in South-West, Nigeria. One hundred and eighty respondents were selected using a multistage sampling technique. Primary data were collected through the administration of a well-structured questionnaire and analyzed using a combination of descriptive statistics, stochastic frontier translog cost, and production function analyses and regression model. Maximum Likelihood Estimates of the Stochastic Frontier Translog Production Function results showed that the coefficients of labour, fertilizer, farm size and seed had significant effect on the technical efficiency of maize farmers in the study area. Among the second order coefficients, the results revealed that only the coefficient of agrochemicals had a significant positive effect on the technical efficiency. However, some interactive coefficients were significant, implying that, some specified variables combined to cause significant changes in the technical efficiency of maize farmers. Maximum Likelihood Estimates of the Stochastic Frontier Translog Cost showed that the price of seed, fertilizer, agrochemicals, implements and price of labour had a significant effect on the total cost of production. The returns-to-scale was 1.73, indicating that the maize farmers were operating at increasing returns-to-scale. The results of allocative efficiency measurement showed that the allocative efficiency varied widely across maize production, ranging between 0.41 and 1.00 with the mean of 68% implying that, in the short run, there is possibility of increasing allocative efficiency in maize production of farmers in the study area by 32% if they would adopt the technology and production techniques currently used by the most efficient farmer. These findings demonstrated the need to strengthen policies that expose farmers to adult literacy classes and training programmes to reduce the level of inefficiency in resource use in the study area.

Key words: Determinants, Farmers, Maize, Production, Small-scale, Southwest

Introduction

Agriculture continues to be a strategic sector in the development of most low-income nations like Nigeria, where smallholder farming is the dominant livelihood activity. The sector contributes around 28% to the Gross Domestic Product (GDP) and provides employment for about 70% of the total labour force of the country (NBS, 2014). In the financial year (2014), Nigeria earned US$899.0 million by exporting agricultural products which were 4.53% of total export earnings of the country (Abudulfatah, 2015). According to FAO (2015), agriculture is the single largest employer in the world, providing a livelihood for 40 percent of today's global population and it is the largest source of income and jobs for poor rural households.

Maize is one of the world's most important cereals along with wheat and rice. Maize is currently produced on nearly 100 million hectares in 125 developing countries and is among the three most widely grown crops in 75 of those countries (FAO, 2010). Although much of the world's maize production (approximately 78%) is utilized for animal feed, human consumption, in many developing and developed countries is steadily increasing. The growing demand for food in developing countries alone is predicted to increase by around 1.3% per annum until 2020 (Ortiz *et al*. 2010). By 2050, the demand for maize in the developing world will double, and by 2025, maize is likely to become the crop with the greatest production globally (Rosegrant *et al*. 2008). It shows that maize production is significant to the sustainable development of rural economy, food security, and poverty reduction in rural areas of Nigeria. Maize has now risen to a commercial crop on which many agro-based industries depend on as raw materials (Iken and Amusa, 2004).

Despite the various programmes launched and established by the government of Nigeria, the returns from the agricultural sector have been below the potential (Izuchukwu, 2011). Crop yields continue to decline and are substantially lower than the potential yields (Nwafor, 2011). Despite the economic importance of maize to the teeming populace in Nigeria, its production has not met the food and industrial needs of the country (Onuk *et al.,* 2010). The demand for maize sometimes outstrips the supply because of the various domestic uses (Akande, 1994) and this has negative consequences for household food security. This could be attributed to low productivity from farmers and non-adoption of improved technologies for maize production. The study of resource productivity is important because it is the first step in a process that might lead to substantial resource saving with its implication for food production among maize farmers in Southwest Nigeria. Efficiency measurement is very important for monitoring productivity growth. Therefore, efficiency studies benefit economies by ascertaining the extent to which it is possible to increase productivity using present resources base and available technologies. Such studies provide a foundation for the development and adoption of new technologies which could push the frontier of efficiency higher.

Methodology

The study was conducted in South Western Nigeria. The six states in South Western Nigeria are: Ogun, Osun, Ondo, Oyo, Lagos, and Ekiti. It is bounded in the North and East by Kwara and Kogi states, in the West by the Republic of Benin and in the South by the Atlantic Ocean. It has a land area of 76,852 square kilometres and a population of about 25.2 million (National Population Commission Census, 2006). All the states have an average annual rainfall and temperature of 1486 mm and 26.7^{0}C respectively (Omotosho, 2009). The climate of Southwest Nigeria is tropical in nature and it is characterized by the wet and dry seasons. The wet season is associated with the South-west monsoon wind from the Atlantic Ocean while the dry season is associated with the northeast trade wind from the Sahara desert.

Primary data were used for this study. The data were collected from the respondents with the aid of a well-structured questionnaire. A multi-stage sampling technique was used to select one hundred and eighty (180) respondents in the study area. In the first stage, two states were randomly selected. The second stage involved random selection of three Local Government Areas (LGAs). From the list obtained from Agricultural Development Project, in each of the LGAs, three communities were randomly selected. From each community, ten (10) maize farmers were purposively selected to make ninety (90) maize farmers per state. Thus, the total of one hundred and eighty respondents (180) was the sample size for the study. Data collected were analyzed using a combination of stochastic frontier translog production function, and translog cost production function Analyses. Stochastic frontier translog production function and translog cost production function Analyses were respectively employed to determine the technical and allocative efficiencies of the farmers in the use of major production inputs in maize production.

Economic efficiency: Cost efficiency was measured using Stochastic Frontier Translog Cost Function which is specified as follows:

$$LnC_i = \alpha_0 + \alpha_1 \ln P_1 + \alpha_2 \ln P_2 + \alpha 3 \ln P_3 + \alpha_4 \ln P_4 + \alpha_5 \ln P_5 + \alpha_6 \ln P_6 + ½ \alpha_7 \ln P_1^2 + ½\alpha_8 \ln P_2^2 + ½ \alpha_9 \ln P^2_3 + ½ \alpha_{10} \ln P^2_4 + ½\alpha_{11} \ln P^2_5 + ½\alpha_{12} \ln P^2_6 + \alpha_{13} \ln P_1 \ln P_2 + \alpha_{14} \ln P_1 \ln P_3 + \alpha_{15} \ln P_1 \ln P_4 + \alpha_{16} \ln P_1 \ln P_5 + \alpha_{17} \ln P_1 \ln P_6 + \alpha_{18} \ln P_2 \ln P_3 + \alpha_{19} \ln P_2 \ln P_4 + \alpha_{20} \ln P_2 \ln P_5 + \alpha_{21} \ln P_2 \ln P_6 + \alpha_{22} \ln P_3 \ln P_4 + \alpha_{23} \ln P_3 \ln P_5 + \alpha_{24} \ln P_3 \ln P_6 + \alpha_{25} \ln P_4 \ln P_5 + \alpha_{26} \ln P_4 \ln P_6 + \alpha_{27} \ln P_5 \ln P_6 + V_i + U_{i.}$$

Where; LnC_i = Total input cost of the i-th farm, P_1 = Output in kg, P_2 = Unit price of seed in naira per kg, P_3 = Price of fertilizer in naira per kg, P_4 = Price of agrochemicals in naira, P_5 = Unit price of implement in naira, P_6 = Price of labour in naira, $\alpha_{0,}$ $\alpha_{1,}$ α_2................ α_{27} are parameters to be estimated. V_i = Stochastic or random error (Errors that are not under the control of farmers) $U_{i.}$= Error due to inefficiency effect in the model (Errors term under the control of farmers).

Farm- level economic efficiency (EE) was obtained by the relationship:

$$EE = \frac{1}{CE} \qquad \text{Coelli } et\ al. \text{ (1998)}$$

Where EE = Economic Efficiency
CE = Cost Efficiency

Technical Efficiency: The technical efficiency was measured using a stochastic frontier translog production function specified as follows:

$$\ln Y_t = \beta_0 + \sum \beta_k \ln X_{ki} + \tfrac{1}{2} \sum\sum \beta_{kj} \ln X_{ki} \ln X_{ji} + (V_i - U_i) \ldots\ldots\ldots\ldots(1)$$

Where, ln = the natural logarithm; i = ith respondent, Y_t = Output of farmer in kilograms (kg), X_{ki}= Variable inputs, X_{ji} = Fixed inputs, β_0, β_k and β_{kj} are parameters to be estimated. V_is = Assumed to be independently and identically distributed normal, random errors, having zero means and unknown variance (δ^2v). U_is = Technical efficiency, which is assumed to be independent of V_is.

The translog production function is alternatively defined as follows:

$$\ln Yi = bo + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + ½ b_6 \ln X_1^2 + ½ b_7 \ln X_2^2 + ½ b_8 \ln X^2_3 + ½ b_9 \ln X^2_4 + ½ b_{10} \ln X^2_5 + b_{11} \ln X_1 \ln X_2 + b_{12} \ln X_1 \ln X_3 + b_{13} \ln X_1 \ln X_4 + b_{14} \ln X_1 \ln X_5 + b_{15} \ln X_2 \ln X_3 + b_{16} \ln X_2 \ln X_4 + b_{17} \ln X_2 \ln X_5 + b_{18} \ln X_3 \ln X_4 + b_{19} \ln X_3 \ln X_5 + b_{20} \ln X_4 \ln X_5 + e$$

Where; In = natural logarithm, Y_i = output (kg), X_1 = total labour used in man days, X_2 = farm size (ha), X_3 = quantity of seeds used (kilogrammes), X_4 = quantity of agro-chemicals used (litres), X_5 = quantity of fertilizer used (kilogrammes), bs = coefficients to be estimated.
e = error term (Vi – Ui)

Allocative Efficiency: This is measured as follows;

$AE = \frac{EE}{TE}$ where

AE = Allocative Efficiency
EE = Economic Efficiency; and
TE = Technical Efficiency.

Determinants of Allocative Efficiency:
Allocative Efficiency scores were then regressed against the set of farm-specific factors to obtain the determinants for allocative efficiency as done by (Kalirajan, 1991).

$$AE = b_0 + b_1M_1 + b_2M_2 + b_3M_3 + b_4M_4 + b_5M_5 + b_6M_6 + b_7M_7 + b_8 M_8 + b_9M_9 + b_{10}M_{10}$$

Where AE = Allocative efficiency of the i-th farmer; M_1 = Farmers age in years, M_2 = Household size, M_3 = Educational status (Formal educated =1 and No formal educated = 0), M_4 = Gender (1= Male, 0 = Female), M_5 = Farmer's farming experience (Years), M_6 = Quantity of Agrochemicals (Litres), M_7 = quantity of fertilizer used (kg), M_8 = Farm size (Ha), M_9 = Membership of farmers associations/cooperative societies (a dummy variable: 1= member, 0 = otherwise), M_{10} = Number of extension contacts made by the farmer in the year; and b_0, b_1, b_2......... b_{10} **=** Regression parameters to be estimated.

Results and Discussion

Estimates of the Stochastic Frontier Translog Cost Function

The Maximum Likelihood (ML) estimates of the stochastic frontier translog cost and parameters for maize are presented in Table 1. The significant value of the sigma square (δ^2) indicates the goodness of fit and the correctness of the specified assumption of the composite error terms distribution (Okoye and Onyenweaku, 2007). From the table, the output, the prices of seed, fertilizer, agrochemicals, implements and that of labour were significant at 1% and 5% levels respectively. It implies that increasing the price of these inputs (excluding the prices of seed and labour), would increase the total cost of production, while the prices of seed and labour would decrease the total cost. The results of the relationship that existed between the total cost and the price of labour contradicted the findings of Ogundari *et al*., (2006) which specified that there was a positive relationship between the cost of labour and maize production at 1% level of significance. The result of the relationship between the total cost of maize production and price of agrochemicals is in line with the outcome of Duniya, (2015) which stated that the price of chemicals was positive and significant in influencing the total cost of production. Also, the coefficients of the square term for the price of implements and interaction of the prices of fertilizer, and agrochemicals, i were positive and significant at 1% and 5% level of significance, showing a direct relationship with the total cost of maize production.

On the other hand, the coefficients of the square term for the prices of fertilizer and agrochemicals were negative but significant at 5% and 1% respectively, indicating an inverse relationship with the total cost of maize production.

Table 1: Maximum Likelihood Estimates of the Stochastic Translog Cost Function

Variables (Parameters)	Coefficients	Std. errors	T-values
Constant (α_0)	34.4807	1.6556	20.8265
LNOUTPUT (α_1)	0.0154**	0.0073	2.0949
LNFSEED (α_2)	-0.6139***	0.1962	-3.1276
LNFERT (α_3)	2.0235**	0.8783	2.3037
LNAGROCHEM (α_4)	0.0049***	0.0014	3.4411
LNIMPLEMT (α_5)	0.0773**	0.0359	2.1522
LNLAB (α_6)	-0.0875**	0.0413	-2.1166
(0.5 LNOUTPUT)^2 (α_7)	-0.0431	0.2303	-0.1871
(0.5 LNFSEED)^2 (α_8)	0.2802	0.7438	0.3767
(0.5 LNFERT)^2 (α_9)	-0.0157**	0.0074	-2.1055
(0.5LNAGROCHEM)^2 (α_{10})	-0.4932***	0.1192	-4.1346
(0.5 LNIMPLMT)^2 (α_{11})	0.5058**	0.2109	2.3976
(0.5 LNLAB)^2 (α_{12})	0.1052	0.1194	0.8805
LNOUTPUT*LNSEED (α_{13})	0.0232	0.0701	0.3306
LNOUTPUT*LNFERT (α_{14})	0.0012	0.0095	0.1254
LNOUTPT*LNAGROCH (α_{15})	-0.0254	0.1207	-0.2104
LNOUTPT*LNIMPLMT (α_{16})	0.0183	0.1472	0.1243
LNOUTPT*LNLAB (α_{17})	0.0601	0.1089	0.5514
LNFSEED*LNFERT (α_{18})	0.0189	0.4921	0.0384
LNSEED*LNAGROCHM (α_{19})	-0.2702	0.4689	-0.5762
LNFSEED*LNIMPLMNT (α_{20})	-0.1803	0.1897	-0.9503
LNSEED*LNLAB (α_{21})	0.3388	0.5589	0.6061
LNFERT*LNAGROCHE (α_{22})	0.0416**	0.0202	2.0531
LNFERT*LNIMPLEMNT (α_{23})	0.0018***	0.0005	3.3537
LNFERT*LNLAB (α_{24})	0.7147	0.8062	0.8864
LNAGRCHEM*LNIMPM (α_{25})	-0.0169	0.1133	-0.1491
LNAGROCHEM*LNLAB (α_{26})	-0.3172	0.7184	-0.4415
LNIMPLEMT *LNLAB (α_{27})	0.0173	0.0596	0.2902
Log-likelihood function	-635.8445		
Total Variance (δ^2)	0.8113***	0.2592	3.1292
Variance Ratio (γ)	0.9401**	0.4061	2.3147
LR Test	41.3369		

*Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level

Source: Computed from Field Survey Data, 2015

Estimates of the Stochastic Translog Production Function

The Maximum Likelihood (ML) estimates of the stochastic frontier translog production function and parameters for maize are presented in Table 2. The high and significant values of sigma square (δ^2) indicate the goodness of fit and correctness of the specified assumption of the composite error terms distribution (Idiong, 2005). Among the first order coefficients, the results revealed that, the coefficients of labour and fertilizer had a significant positive effect on the technical efficiency of maize farmers in the study area. It implies that, an increase in these variables would result to an increase in technical efficiency of maize farmers in the study area. On the other hand, the results revealed that the coefficients of farm size and seed had a negative effect on the technical efficiency of maize farmers in the study area.

Among the second order coefficients, the results revealed that only the coefficient of agrochemicals had a significant positive effect on the technical efficiency at 5% level of probability. Others had no significant relationship with technical efficiency of maize farmers. However, some interactive coefficients were significant at 1% and 5% level of significance, implying that, some specified variables combined to cause a significant change in the technical efficiency of maize farmers.

Table 2: Maximum Likelihood Estimates of the Stochastic Translog Production Function

Variables (Parameters)	**Coefficients**	**Std. errors**	**T-values**
Constant (β_0)	-20.4469	0.9918	20.6162
LNLAB (β_1)	2.9272***	0.8246	3.5497
LNFSIZE (β_2)	-6.5341***	0.9920	-6.5867
LNSEED (β_3)	-0.0331**	0.0163	-2.0365
LNAGROCHEM (β_4)	1.5873*	0.8724	1.8195
LNFERT (β_5)	3.7877***	0.8733	4.3375
(0.5 LNLAB)^2 (β_6)	-0.3397	0.7872	-0.4315
(0.5 LNFSIZE)^2 (β_7)	-0.7265	0.9945	-0.7305
(0.5 LNSEED)^2 (β_8)	-0.0837	0.8965	-0.0933
(0.5LNAGROCHEM)^2 (β_9)	0.1540**	0.0706	2.1825
(0.5 LNFERT)^2 (β_{10})	-0.3931	0.8506	-0.4621
LNLAB*LNFSIZE (β_{11})	0.3901	0.8195	0.4760
LNLAB*LNSEED (β_{12})	0.0890	0.7204	0.1235
LNLAB*LNAGROCHEM (β_{13})	-0.2656**	0.1112	-2.3884
LNLAB*LNFERT (β_{14})	0.1158	0.6878	0.1683
LNFSIZE*LNSEED (β_{15})	0.3157	0.8882	0.3554
LNFSIZE*LNAGROCHEM (β_{16})	0.2012	0.8632	0.2330
LNFSIZE*LNFERT (β_{17})	0.4850***	0.1063	4.5625
LNSEED*LNAGROCHEM (β_{18})	0.0771	0.7642	0.1008
LNFSEED*LNFERT (β_{19})	0.1677***	0.0397	4.2241
LNAGROCHEM*LNFERT (β_{20})	-0.1901**	0.0840	-2.2630
Log-likelihood function	-124.8790		
Total Variance (δ^2)	1.0571***	0.2835	3.7282
Variance Ratio (γ)	0.9375***	0.1828	5.1278
LR Test	68.1695		

*Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level
Source: Computed from Field Survey Data, 2015

Estimation of Factors Affecting Allocative Efficiency

Table 3 shows the results of the determinants of allocative efficiency in maize production. Results showed that the included explanatory variables explained 71% of the variation in the value of allocative efficiency. The coefficients of education, experience, membership of association and extension contact were positive and significant at 1% and 5% level of probability. It implies that an increase in any of these variables would lead to increase in the allocative efficiency of maize farmers. The direct relationship between allocative efficiency and educational status indicates that maize farmers that had formal education would efficiently allocate resources better than their counterparts that had no formal education (Ohajianya *et al*; 2010). Farming experience had a direct relationship with allocative efficiency. This implies that the more experienced the farmer, the more productive on the farm. This may be, because, experienced farmers have better knowledge of crop management practices (Hassan and Nhemachene, 2008). Membership of association also, had a direct relationship with allocative efficiency because of the fact that maize farmers who belonged to the farmers' association/cooperative societies tend to have opportunities to exchange ideas with members, thereby, making them have a higher advantage over others in allocating available resources efficiently. This supports the findings of Fleming *et al.* (2004). The age of the farmers and farm size had a negative but significant influence on the allocative efficiency of maize farmers in the study area. This indicates that allocative efficiency decreases as age and farm size of the farmers increase. For the age, it may be due to the fact that farmers tend to be more conservative as their age increases and had a negative or reserved attitude towards the adoption of innovations and technologies that may improve their productivity. On the other hand, the negative relationship of farm size with allocative efficiency implies that small farm holdings are allocatively efficient. This result is in agreement with Yotopoulos and Lau (1973) that smaller farms were more efficient in cost allocation, and corroborates the findings of Van-Zyl *et al.* (1995) that commercial farms could become significantly more efficient if they become smaller.

Table 3: Determinants of Allocative Efficiency in Maize Production

Variables	Coefficients	Std. errors	T-Values
Constant	0.0864	0.1013	0.8522
Age	-0.0552***	0.0152	-3.6315
Household Size	-0.0627	0.1560	-0.4017
Education	0.4973***	0.1635	3.0411
Gender	0.0072	0.0739	0.0974
Experience	0.0265**	0.0122	2.1567
Quantity of Agrochemicals	0.0082	0.1285	0.0638
Quantity of Fertilizer	-0.0726	0.9641	-0.0753
Farm Size	-0.0174***	0.0054	3.1906
Membership of Association	0.0041**	0.0017	2.3024
Extension Visits	0.0720**	0.0347	2.0696

Source: Computed from Field Survey Data, 2015

** Significant at 5% level; *** Significant at 1% level

R^2 = 0.710

Estimates of Allocative Efficiency

The summary of the calculated allocative efficiency of maize is presented in Table 4. The allocative efficiency ranged between 0.432 and 0.910. The mean allocative efficiency was 0.67. The results indicate that average maize farmer in the study area would enjoy cost saving of about 33% (1-0.67) if the farmer attains the level of the most inefficient maize farmer among the respondents. The most allocative inefficient maize farmer will have an efficiency gain of 57% (1-0.43) in maize production if the farmer is to attain the efficiency level of most allocative efficient maize farmer in the study area.

Table 4: Distribution of Allocative Efficiency Estimates

Efficiency Level	Frequency	Percentage
0.41-0.50	24	13.4
0.51-0.60	04	2.2
0.61-0.70	78	43.3
0.71-0.80	36	20.0
0.81-0.90	18	10.0
0.91-1.00	20	11.1
Total	180	100.0
Mean Value	0.678	
Minimum Value	0.432	
Maximum Value	0.9102	

Source: Computed from Field Survey Data, 2015

Elasticity of Production and Return-to-Scale Analysis

The input elasticity's of production and returns-to-scale (RTS) values are presented in Table 5. The production elasticity measures the proportional change in output resulting from a proportional change in the i-th input level, with all other input levels held constant (Ajibefun, 2002). The RTS is the summation of the estimated coefficient of variables used for the estimation of the Stochastic Translog Frontier Production Function. The RTS of 1.73 indicates that maize in the study area was in the increasing return to scale, meaning that the production is in the stage of inefficient production (stage I). Therefore, the implication of increasing returns-to-scale means that, maize farmers should intensify their efforts to expand the present scope of maize production to maximize output with the current level of resources.

Table 5: Elasticity of Production and Return-to-Scale of the Respondents.

Variables	Elasticity of Production
LNLAB	2.9272
LNFSIZE	-6.5341
LNSEED	-0.0331
LNAGROCHEM	1.5873
LNFERT	3.7877
$(0.5\ LNLAB)^2$	-0.3397
$(0.5\ LNFSIZE)^2$	-0.7265
$(0.5\ LNSEED)^2$	-0.0837
$(0.5LNAGROCHEM)^2$	0.1540
$(0.5\ LNFERT)^2$	-0.3931
LNLAB*LNFSIZE	0.3901
LNLAB*LNSEED	0.0890
LNLAB*LNAGROCHEM	-0.2656
LNLAB*LNFERT	0.1158
LNFSIZE*LNSEED	0.3157
LNFSIZE*LNAGROCHEM	0.2012
LNFSIZE*LNFERT	0.4850
LNSEED*LNAGROCHEM	0.0771
LNFSEED*LNFERT	0.1677
LNAGROCHEM*LNFERT	-0.1901
RTS	1.7319

Source: Computed from Field Survey Data, 2015

Conclusion and Recommendations

Based on the findings of the study, it can be concluded that maize farmers in the study area have not attained their best in terms of production. This has been confirmed by the presence of technical and allocative inefficiency effects in their operations. The results of the study clearly show that although the farmers are small-scale and resource-poor, they are fairly efficient in the use of their resources and that any expansion in the use of any resources would bring more than proportionate increase in their output, given the increase returns- to-scale value obtained. The mean allocative efficiency of maize was 0.67, suggesting that opportunities still exist for increasing the productivity and income of maize farmers in the study area by increasing the efficiency with which resources are used at the farm level.

Based on the findings of this study, the following recommendations are made**:**

i. Government and non-governmental organisations should help expose farmers to formal education such as adult literacy classes and training programmes as this would help reduce the level of inefficiency in resource use in the study area.

ii. The Government, NGOs and private individuals should focus on ways to attract and encourage young people, who are agile and aggressive to embark on maize production. This group of people would be able to put in a lot of effort at raising the current level of efficiency, given a conducive policy environment.

iii. Farmers should be encouraged through enlightenment programs to belong to farmers' association to enable them benefit from both the government and non-governmental agricultural intervention programmes.

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