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Technical, Allocative and Economic Efficiency of Maize Seeds Beneficiaries of SAA/KSADP in Kano State, Nigeria

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ABSTRACT

This study analyzed the technical, allocative and economic efficiency of maize seed producers who are beneficiaries of the KSADP/SAA initiative in Kano State, Nigeria. Data were collected from 156 randomly chosen beneficiaries using structured questionnaire. The analysis employed descriptive statistics and stochastic frontier analysis. Findings revealed that the average was 47.27 years with majority (98.72%, 98.08% and 84.72%) being male, married and possessing some form of formal education respectively. The mean score for technical, allocative and economic efficiencies of 0.92, 1.08 and 0.99 respectively. It was further found that age, gender and years of experience were significant predictors of technical inefficiency (all at P<0.01). While allocative efficiency was affected by age, gender, educational level and years of experience. The study concludes that the beneficiaries effectively allocate their resources. It is recommended that low-interest credit is required to enable them upscale their production to make seeds available at affordable price to farmers.

INTRODUCTION

Maize (*Zea mays*) is crucial global cereal crop, especially in Sub-Saharan African (SSA) nations, where it is grown alongside other arable crops for both consumption and trade (Santpoort, 2020). However, seed is widely considered as an essential ingredient for productive crop development. Farmers need enough high-quality seeds at the proper timing and cost to increase productivity. (Umar et al., 2014). High-quality seeds help farmers meet their goals of increasing crop output and other applications (Chijoke & Akaninyene, 2019) and should be made readily available and effectively utilized to raise the standard of living of rural people and their income as well (Sapkota et al., 2018).

Therefore, community-based informal seed production has become a popular alternative to formal seed systems for disseminating new crop varieties, primarily because farmer-produced seeds are more accessible and affordable for most farmers than certified ones (Katuingi et al, 2011). To ensure regular supply of quality seeds at affordable price and poverty free society, Kano Agro-pastoral development project (KSADP) trained selected farmers in Kano State as community-based seed multipliers. Besides, all these beneficiaries are small-scaled seed multipliers. Small-holder farmers utilize significant resources for relatively low output (Taphee, 2015). Since productivity is closely linked to efficiency, it is therefore imperative to evaluate the resource utilization and productivity of these maize seed multipliers. The efficiency and profitability of any agricultural enterprise depend heavily on inputs used in the production process (Sapkota et al., 2018). This study therefore, aims to determine the technical, allocative and economic efficiency of these farmers and identify the factors contributing to any inefficiencies.

METHODOLOGY

Study Area

The survey was conducted in Kano State, Nigeria, which span approximately 20,760 square kilometers. The state has a projected population of 13,969,085and features diverse agricultural land and forest vegetation (NPC, 2021). It experiences a temperature range from 14.2˚C to 40.3˚C and an annual rainfall of 617mm. The primary farming systems are rain-fed and irrigation agriculture. Kano State is bordered by the States of Jigawa to the north and east, Bauchi to the southeast, Kaduna to the southwest, and Katsina to the northwest (KNARDA, 2019).

Sampling Procedure

A multi stage sampling technique was employed to select the beneficiaries. In the first stage, 21 Local Government Areas of the State were purposively selected based on the intensity and preponderance of SAA/KSADP beneficiaries. The LGAs selected include: Kura, Garunmallam, Tudunwada, Kumbotso, Gwarzo, Rogo, Danbatta, Kunchi, Tsanyawa, Dawakin Tofa, Bagwai, Kabo, Rimin Gado, Tofa, Minjibir, Ungoggo, Wudil, Warawa, Gezawa, Takai and Sumaila. Secondly, the Raosoft sample size calculator was applied to list of 265 beneficiaries (maize seeds producers) obtained from SAA at 95% confidence level, 156 respondents were determined as a sample size for this study. In the third stage, simple Random Sampling was used to select the individual respondents.

Method of Data Collection

The data for this survey were obtained with the aid of structured questionnaire by well-trained enumerators in an android application kobocollect. Some of the information elicited include socioeconomic characteristics of the maize seeds producers (beneficiaries), quantity and costs of inputs used and output obtained.

Analytical Techniques

The study used both descriptive and inferential statistics. The stochastic frontier production function model by Battese and Coelli (1995) was adopted to estimate the technical efficiency, while a stochastic frontier cost function was used for allocative efficiency. Economic efficiency was calculated as the product of technical and allocative efficiency.

Technical Efficiency (TE) Function

The stochastic frontier production function was used to determine the technical efficiency of maize seeds multiplication among the beneficiaries of KSADP. It is specified implicitly as:

$$Y_i - f(X_i, \beta) \exp (V_i - U_i) \quad \text{......i}$$

Where:
y_i = Quantity of maize seeds output (kg) of the i^{th} farm
X_i = Vector of input by the i^{th} farm
β = Vector of parameters to be estimated
V_i = Random error outside the farmer's control and
U_i = Technical inefficiency effects

The Stochastic Frontier Production Function (SFPF) specifying the technical efficiency in maize seeds multiplication in the study area is expressed explicitly as:

$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + (V_i - U_i)$ ……i

Where:
In = Natural logarithm
Y = Output of maize (Kg /ha)
B_0 = Constant term
$\beta_1 - \beta_5$ = Regression coefficients
X_i = Quantity of seed used (kg)
X_2 = Farm size (hectares)
X_3 = Quantity of fertilizer used (kg)
X_4 = Quantity of herbicides used (litres)
X_5 = Quantity of pesticides used (litres)
X_5 = Total labour used in maize seeds production (man/days)
Vi = a random variable in production which accounts for the random variation in output by factors beyond the control of seeds multiplier.
Ui = deviation from maximum potential output due to technical inefficiency of the seeds multiplier.

Technical Efficiency (TE), which is defined as the ratio of observed output to maximum feasible output called frontier output. When TE = 1, it shows that a farmer obtains a maximum feasible output, while TE < 1 means a shortfall of the observed output to the frontier output. The higher the figure, the more efficient is the use of the resources.

Allocative Efficiency

Allocative efficiency is the extent, to which farmers make efficient decision by using inputs up to the level at which their marginal contribution to production value is equal to the factor cost (Kalinga, 2014). Therefore, stochastic frontier cost function was used to estimate the allocative efficiencies (AE) of maize seeds multipliers. It is specified as follows:

$LnCi=Ln\beta o+\beta_1 LnX_1+\beta_2 LnX_2+\beta_3 LnX_3+\beta_4 LnX_4+\beta_5 LnX_5+Vi-Ui$ ……………..ii

Where
Ln = natural logarithm
Ci = total cost of maize seeds multiplication (N/Ha/Season)
X_1 = Cost of seed (N/Kg/Ha)
X_2 = Cost of fertilizer (N//Kg/Ha)
X_3 = Cost of herbicides (N/L/Ha)
X_4 = Cost of pesticides (N/L/Ha)
X_5 = Cost of labour (N/man-day/Ha)
βo = intercept
$\beta_1 - \beta_5$ = vector of costs function of parameters to be estimated
Vi = a random variability in the cost of maize seeds multiplication that cannot be influenced by the producer
Ui = deviation from the cost frontier attributable to allocative inefficiency.

The Economic Efficiency

This is the product of technical efficiency (TE) and allocative efficiency (AE) of the individual maize seeds producer. Therefore, the economic efficiency is given as:

EE = TE x AE ……………………………………………………………iii

AE = EE / TE (0 < 1) ………………………………………………….iv

TE = EE / AE …………………………………………………………..v

The Technical Inefficiency Model

This study identified the determinants of seeds producer's technical inefficiency in terms of socio-economic variables of the multipliers to achieve objective 2. The model is specified as:

$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6$ vi

Where:
-Ui = Technical inefficiency of the i^{th} farmer
δ_0 = Constant
$\delta_1 - \delta_6$ = Parameters to be estimated
Z_1 = Age of the respondents (years)
Z_2 = Gender (1 = Male, 2 = Female)
Z_3 = Marital status (1 = Single, 2 = Married)
Z_4 = Household size (number of persons)
Z_5 = Level of education (Nil = 0, Primary = 1, Secondary = 2, Tertiary = 3)
Z_6 = Years of experience (years)
It should be noted that, a negative inefficiency coefficient signifies a positive relationship with technical efficiency and vice-versa.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of CBSM Beneficiaries

The results in Table 1 revealed an average age of 47.27 years. This implies that majority of the CBSM beneficiaries of SAA/KSADP intervention were relatively young, agile with physical and mental ability to undertake seed multiplication enterprise as a business. This result relatively move in tandem with the finding of Tasilla Kanja et al, 2019 reported a mean age of certified and conventional groundnut seeds producers in Northern Ghana as 42.32 and 40.61 years respectively. The vast majority of the beneficiaries were male (98.72%) and married (98.08%), suggesting a gender biased in the program. This move in line with Sakpota et al., 2018 who found that 74.2% of maize seeds producers in Palpa District of Nepal were male. The average household size was 12, larger than the national average of 6 persons, which can be the source of family labour. As a result, reduces cost of production and increase the net income of the business.

The results in Figure 1 revealed that 28.47% of them had diploma/NCE, 24.31% had attained SSCE certificate level, 15.28% each had a degree and non-formal education, 9.03% stopped only from primary school, 4.17% had certificate, 2.08% were vocational attendants and 0.69% each had junior secondary school and master's degree. This shows that majority (84.72%) of them had formal education which will assist them in reading instruction on chemical and fertilizer application and also in the adoption of innovation.

Table 1: Socioeconomic characteristics of Community-based seeds multiplication beneficiaries

Variables	Frequency	Percentage	Mean
Age of the CBSM beneficiaries			47.27
Gender			
Male	154	98.72	
Female	2	1.28	
Marital Status			
Single	3	1.92	
Married	153	98.08	
Household size			12
Years of experience in maize seeds multiplication			5.35
Total	**156**	**100**	

Source: Field survey, 2023

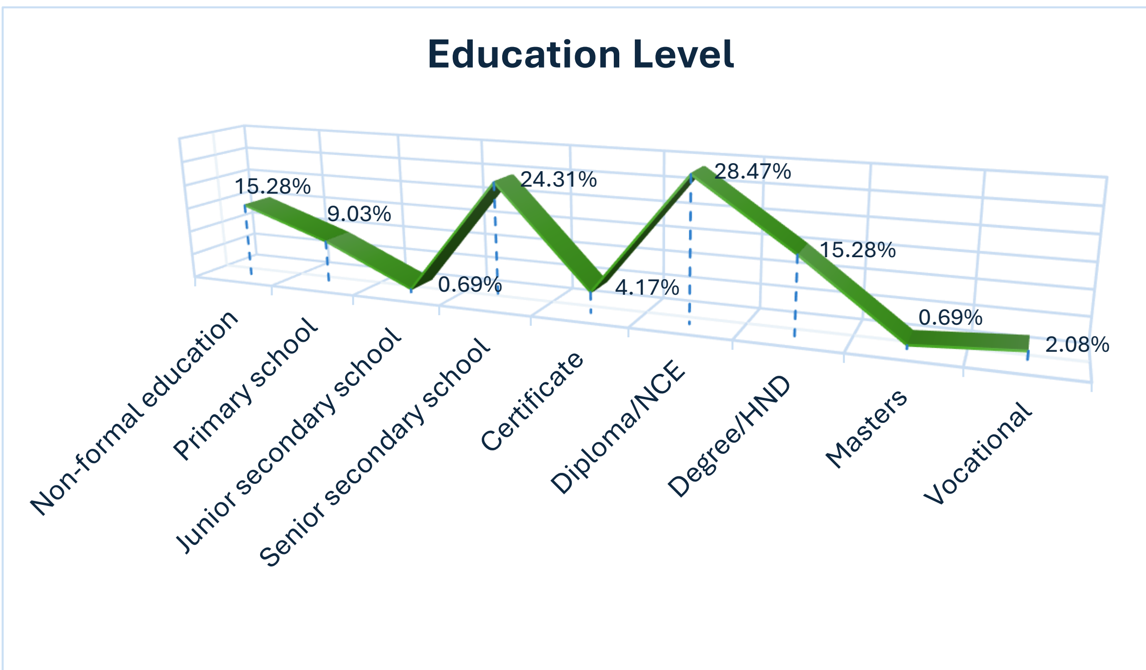

Figure 1: Educational level of the CBSM beneficiaries

Technical Efficiency

From the results in Table 2, the gamma value of 1.000, indicated that the variations in output were primarily due to differences in technical efficiency. The estimated value of sigma squared was 0.0324 and significant at 1% confidence level, which indicate a goodness of fit of the model. The results showed that Qty of fertilizer (0.7717), farm size (0.7002), Labour (0.3837) and Qty of seed (0.1853) were all positive and significant at 1%. If there is a 1% increase in Qty of fertilizer, farm size, labour and Qty of seed, it will result in a corresponding increase in maize seed multiplication by 0.7717%, 0.7002%, 0.3837% and 0.1853% respectively. In contrast, the coefficients of Qty of herbicides and Qty of pesticides are negative with a factor of -0.3454 and -0.0536 respectively, which are also significant at 1%, indicating over utilization of both herbicides and pesticides.

The results further showed that marital status, household size and educational level negatively influenced technical inefficiency (thus improving efficiency). This implies that increase in these negative coefficients' variables will significantly increase production efficiency. This is similar with findings of Nazifi et al (2024) where the magnitude of household size was negative and significant. While age, and years of experience had a positive relationship with inefficiency.

Table 2: Technical Efficiency of Maize Seed Producers (Beneficiaries of KSADP/SAA)

Variable	Coefficient	Standard-error	t-ratio
beta 0	1.5153	0.1252	12.0993***
Qty_Seeds (Kg)	0.1853	0.0097	19.0886***
Farm size(ha)	0.7002	0.0069	102.0102***
Qty_Fert. (Kg)	0.7717	0.0080	96.6714***
Qty_Herbicides (ltr)	-0.3454	0.0124	-27.8200***
Qty_Pesticides (ltr)	-0.0536	0.0059	-9.1103***
Labour (Man/Day	0.3837	0.0316	12.1229***
delta 0	-0.4125	0.8971	-0.4598
Age of the beneficiary (year)	0.0208	0.0040	5.1989***
Gender	0.8303	0.1270	6.5355***
Marital status	-0.8250	0.4682	-1.7621*
Household size	-0.0487	0.0069	-7.0611***
Educational level	-0.0499	0.0145	-3.4441***
Years of exp.(years)	0.0412	0.0055	7.5458***
sigma-squared	0.0647	0.0087	7.4425***
Gamma	1.0000	0.0000	107169.2600***
log likelihood function	240.9097		
LR test	138.6937		

Source: Field survey, 2023

Allocative Efficiency of the Maize Seed Producers (Cost Function)

The results in Table 3 showed that the gamma estimate for cost the cost function was 0.9716meaning that 97.16% of the production cost variation among the beneficiaries were due to allocative inefficiency. The results indicated that cost of seeds (0.0220), cost of fertilizer (0.4479), cost of pesticide (0.0256) and cost of labour (0.9911) were all positive and significantly influenced production cost. Therefore, any increase in 1 unit cost of any of these variables, all things being equal, there will be an increase in maize seed production cost by 0.022%, 0.4479%, 0.02565% and 0.9911% respectively. While cost of herbicides was found to be negative with coefficient value of -0.0509 and significant at 1% level of confidence.

The result for the inefficiency model, variables such as age, gender, marital status, educational level and years of experience negatively affected allocative inefficiency, thereby promoting efficiency. This shows that increase in these negative coefficients variables will significantly increase allocative efficiency of the maize seed producers. This contradicts the findings of Abdul et al., (2017) where gender was found positive and significant at 1%, implying that gender variation does not influence the inefficiency among the farmers.

Table 3: Allocative Efficiency of Maize Seed Producers (Cost Function)

Variable	Coefficient	Standard-error	t-ratio
beta 0	-3.0293	0.4505	-6.7249***
Cost_Seeds (Naira)	0.0220	0.0491	0.4489
Cost_Fert. (Naira)	0.4479	0.0350	12.8105***
Cost_Herb. (Naira)	-0.0509	0.0166	-3.0576***
Cost_Pest.(Naira)	0.0256	0.0088	2.9123***
Cost_Labour (Naira)	0.9911	0.0188	52.6068***
delta 0	0.4970	0.8979	0.5535
Age of the beneficiary (year)	-0.0516	0.0065	-7.8849***
Gender	-0.5815	0.2443	-2.3807***
Marital status	0.9940	0.4744	2.0953**
Household size	0.0479	0.0057	8.3720
Educational level	-0.0582	0.0100	-5.7964***
Years of exp.(years)	-0.0390	0.0025	-15.7896***
sigma-squared	0.0324	0.0042	7.7421***
Gamma	0.9716	0.0102	94.9774***
log likelihood function	219.6080		
LR test	146.0372		

Source: Field survey, 2023

Summary of TE, AE and EE

Table 4 revealed an average technical efficiency of 0.92, implying that maize seeds producers in the study area were technically efficient in maize seeds multiplication but had a shortfall of 8%% below perfection technically. The mean value of allocative efficiency was 1.08. This connotes that maize seeds multipliers utilized their resources at 100% optimal level. Therefore, they were perfectly efficient in allocating their available resources in the maize seeds multiplication. This might be attributed to the training obtained on good agronomic practices by SAA/KSADP. The mean economic efficiency was 0.99, indicating that seed producers could increase output by about 1% with more efficient resource use.

Table 4: Summary Reports on TE, AE and EE

Variable	Minimum	Maximum	Mean	Number of Obs
Technical Efficiency	0.54	0.99	0.92	156
Allocative Efficiency	1.01	2.01	1.08	156
Economic Efficiency	0.55	1.68	0.99	156

CONCLUSION AND RECOMMENDATIONS

The study, concludes that maize seeds multipliers are highly efficient in using their available resources. Educational level, household size and marital status were key determinants of technical efficiency, while age, gender, educational level and years of experience influenced allocative efficiency. It is recommended that financial institutions provide these maize seeds producers with credit to scale-up their operation, thereby increasing the supply of affordable seeds.

REFERENCES

Abdul, M., Tashikalma, A. K., Maurice/ D.C., & Shittu, F. M. (2017). Analysis of cost efficiency of rainfed maize production in Yola North and Yola South Local Government of Areas of Adamawa State, Nigeria. Global Journal of Agricultural Sciences, 16(1), 65-71.

Chijioke, N. and Akaninyene, U. (2019). Profitability of Improved Seed Adoption on Small Holders Maize Farmers in Abuja Nigeria. Business and Management Studies. 4 (4); 71 – 81. doi:10.11114/bms.v4i4.3922.

Kalinga, A. (2014). Input Use Efficiency in the Madibira Smallholder Farmers' Irrigation Scheme in Tanzania.Masters' Thesis, Sokoine University of Agriculture. Morogoro

Katungi, E., Karanja, D., Wozemba, D., Mutuoki, T. and Rubyogo, J. C. (2011). A Cost-Benefit Analysis of Farmer Based Seed Production for Common Bean in Kenya. *African Crop Science Journal*. 19(4); pp. 409 – 415.

Mohammed B. (2015). Analysis of resource use efficiency and profitability in chili pepper (Capsicum frutescens) production and its contribution to household farm income in Kaduna state. MSc Thesis Submitted to agricultural economics and rural sociology, faculty of agriculture, Ahmadu Bello University, Zaria.

Nazifi B., Abdullahi B.N., Suleiman S. (2024), Stochastic Frontier Analysis of Hot Pepper Production among Small-Scale Farmers in Dutsin-Ma Local Government Area of Katsina State, Nigeria. Research Journal of Agricultural Economics and Development 3(1), 1-13. DOI: 10.52589/RJAEDCFDZTHSR

Santpoort, R. (2020). The drivers of maize area expansion in sub-Saharan Africa. How policies to boost maize production overlook the interests of smallholder farmers. Land, 9(3), p.68.

Sapkota, M., Joshi, N. P., Kattel, R. R. and Bajracharya, M. (2018). Profitability and Resource Use Efficiency of Maize Seed Production in Palpa District of Nepal. *SAARC J. Agri.,* 16(1): 157 – 168.

Taphee, B. G. (2015). Resource Productivity and Efficiency of Small-Scale Groundnut Farmers in Taraba State, Nigeria. PhD Thesis, Department of Agricultural Economics, Faculty of Agriculture, University Of Nigeria, Nsukka. Pg 6,

Umar, S., Sanni, S.A., Usman, I. S. and Shuaibu, H. (2014). Community Maize Seed Production as An Income Generating Activity for Poverty Alleviation In Selected Communities of Zamfara State, Nigeria. Proceeding of the 1st International conference on Dryland, Bayero University, Kano 8th – 12th December, 2014. Pp. 164 – 168.