

Productivity Analysis of Maize Production Using Local and Improved Varieties in Selected Local Government Areas of Zamfara State, Nigeria

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Abstract

The study examined the productivity analysis of improved and local maize varieties in selected Local Government Areas of Zamfara State. Seven Local Government Areas were purposively selected for the study. Two Districts were randomly selected from each of the seven Local Government Areas. Two Villages were also randomly selected from each of the two districts in a Local Government Area. Through the use of simple random sampling ten farmers (five each for local and improved maize varieties) were selected from each of the villages and this gave a total of 280 farmers as the sample size. Data were collected by the use of structured questionnaire. Data were analyzed using regression. The result showed a positive and significant ($P < 0.05$) relationship between plot size, quantity of fertilizer applied and yield of improved maize. While increase in the quantity of seed (0.425) and fertilizer (0.374) led to significant increase in yield at 5% and 1% levels respectively for local maize production.

Keywords: Maize Varieties; Productivity Analysis; Regression; Input-Output Relationship

Introduction

Maize (*Zea mays*) is one of the oldest and widely cultivated cereals worldwide. It has a big impact in the economies of developed as well as developing countries. Improved Open Pollinated Varieties (OPVs) and hybrids maize varieties are termed as modern varieties (MVs) developed by any formal plant-breeding programme. Local varieties refer to the farmers' traditional varieties (also known as land races) that have never been worked on by a formal breeding programme, as well as older improved OPVs and hybrids (Morris *et al.*, 1999).

Maize has been in high demand for human consumption and used as poultry feed. In order to prevent importing maize and boost maize production, Nigerian Govt. has been making efforts through research Institutions/organizations in order to come up with improved/hybrid maize varieties that are high yielding, resistant to some stresses and requiring less period for maturity. Productivity is defined as the output of a particular good or service per unit of input. example the productivity of labour is output per man-hour (David, 1987). In order to achieve highest output per unit of input the resources must be made available and farmers technically efficient (Olukosi and Ogunbile, 2005). Even though a lot of research on maize production in other areas were carried out, a lot more research is needed on the productivity of improved and local maize varieties production particularly in the area of study. This is because some farmers still hold on to maize production using local varieties in the area despite the potential benefits of improved maize varieties. The study was to compare the productivity analysis of maize production using improved and local varieties. The finding could be

used by farmers to make adjustment in the use of farm resources to enhance increased maize production.

Methodology

The Study Area: The study was carried out in Zamfara State in the Northwestern part of Nigeria. Zamfara State is geographically located between latitudes $10^{\circ}50'N$ and $13^{\circ}38'N$ and longitudes $4^{\circ}16'E$ and the state covers a land area of 38,418sq. km. Climate is characterized by a long hot dry season usually lasting from September to May and a short warm, wet (rainy) season that usually starts in mid-May and ends in September. The mean annual rainfall is about 900mm. Mean annual temperature is about $30^{\circ}C$ with a maximum of $42^{\circ}C$ in April - May. Average relative humidity is 50% and annual mean evaporation 6%. Hamattan also lasts from November-March ZARDA, 2005 (as cited in Rabi'u *et al.*, 2006). The state is blessed with a vast area of land that is suitable for production of crops. Maize in Zamfara state is gradually replacing Guinea corn, that used to be the most staple food in the state. Maize is widely cultivated, marketed and consumed by the people in the state. Maize grain is consumed by human and the maize stalk consumed by livestock. The improved maize varieties cultivated by farmers in the area includes Quality Protein Maize (QPM), Extra Early White, Extra Early Yellow, Oba super I Oba super II and Oba 98. The local maize varieties cultivated in the area includes 'Yargara White and Yellow. Other food crops grown in the area are Millet, Maize, Rice, Guinea corn. Cassava. Groundnut, sweet potatoes and cowpea. The area has abundant grasses for animal grazing and characterized by scattered trees, mainly Baobab, Bean seed, Mango and Neem trees. The inhabitants of the area also engage in trading, rearing and fishing (ZSG, 2006).

Sampling Procedure and Sample Size: The survey was carried out in seven (7) purposively selected Local Government Areas of Zamfara State out of the fourteen (14) existing ones. These are Talata Mafara, Bungudu, Maru, Bukkuyum, Tsafe, Gusau and Anka Local Government Areas. This was done due to the abundance of maize production in the areas. Two (2) districts were randomly selected from each of the already chosen seven Local Government Areas. This gave a total of fourteen (14) districts. Two (2) villages in each of the 14 districts were randomly selected. This gave a total of twenty-eight (28) villages required for the research. Names of farmers using improved maize varieties were obtained from Zamfara Comprehensive Agricultural Revolution Programme (ZACAREP) while farmers using local maize varieties were identified by local leaders, in order to serve as sampling frame. Five (5) farmers who grew improved maize variety and 5 farmers who grew local maize variety from each of the twenty-eight villages were randomly selected. This gave a total of two hundred and eighty (280) maize farmers as sample size for the research.

Instrument for Data Collection: The researchers collected the data from the farmers through the use of structured questionnaire. The farmers were visited twice during the period. Questions were asked by the researcher and responses of the farmers were recorded. The data were collected ones for 2007 cropping season only. The

researchers collected input-output data from the farmers. The output data included yield of maize in kg. The input data included quantity and cost of labour, quantity and cost of fertilizer, quantity and cost of seeds, maize plot size, quantity and cost of manure and hours of animal traction.

Method of Data Analysis: The data obtained from the field survey of improved and local maize varieties production in the study area was analyzed by the use of regression analysis. In order to determine the productivity of input utilization in improved and local maize production in the study area, production function models were used. The production function stipulates the technical relationship existing between inputs and output in the production process (Adesimi, 1982). The functional forms of the model that were used in the analysis included linear and Cobb-Douglas production functions. The Cobb Douglas production function was chosen and reported because it gave the best fit based on magnitude, signs on the regression coefficient and level of significance of the parameter estimates of the independent variables. Several inputs were utilized in crop production system. In this survey, the yield realized by farmers was used as the dependent variable while the independent variables were the inputs used. The following multiple regression equations were run for both improved and local maize varieties.

i. The Linear Production Function Model.

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + u \dots\dots (1)$$

ii. The Cobb - Douglas Production Function Model

$$Y = ax_1^{b_1}x_2^{b_2}x_3^{b_3}x_4^{b_4}x_5^{b_5}x_6^{b_6}x_7^{b_7}u \dots\dots\dots (2)$$

Transformation of The Cobb - Douglas production function model into Logarithmic form gives.

$$\log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + b_6 \log x_6 + b_7 \log x_7 + u \dots\dots\dots (3)$$

Where

Result and Discussion

The production function estimates for local and improved maize varieties were analyzed using both linear and Cobb-Douglas models; the Cobb-Douglas function was selected and reported for both varieties as it provided the best fit based on the magnitude, signs of the regression coefficients, and the significance levels of the parameter estimates, with the results for improved and local maize varieties presented in Table 1 and Table 2, respectively. The result in Table 1 and 2 revealed that, the coefficient of determination R² for the estimated Cobb-Douglas production function is 0.685 (68.5%) and 0.530 (53%) for improved and local maize varieties respectively. This implied that 53 and 68.5 per cent of the variation in total yields of local and improved maize varieties production

Y = The total quantity of maize produced (kg) as the dependent variable.

- X₁= Maize plot size (ha).
- X₂= Family labour (Mandays).
- X₃= Hired labour (Mandays)
- X₄ = Quantity of maize seeds used (kg).
- X₅= Quantity of fertilizers used (kg)
- X₆= Quantity of manure applied (kg).
- X₇= Animal Traction (Hours).

a = Constant term
u = Error term
b₁, b₂, b₃, b₄, b₅, b₆ and b₇ are the coefficients.

x₁, x₂, x₃, x₄, x₅, x₆ and x₇, are the independent variables. respectively are explained by the independent variables included in the models. The F- ratios of local and improved maize varieties are significant at 1% level; this also confirmed the explanatory power of the independent variables. The regression coefficients of the respective independent variables showed the extent to which each variable explained variation in the dependent variable. Table 1 indicated that, the regression coefficients with respect to plot size was positive and significant at 5% level for improved maize varieties. For the improved maize variety (Table 1) for every one percent increase in plot size (xi) holding all other inputs constant, there was increase in yield by 0.286% and this was significant at five per cent level. Falusi (1989) also reported that land coefficient had significant relationship with the dependent

variable in the estimated regression equation for improved varieties of maize. In a related study in Uganda Nkonya *et al.*, (2003) reported that there was significant relationship between maize yield and plots planted with improved maize variety. The regression coefficient associated with quantity of seeds is 0.425 for local maize varieties. This showed a positive relationship between the quantity of seeds used and the yield obtained. This means that for every one period increase in the quantity of seeds, holding all other inputs constant, there was increase in yield by 0.425%, and this increment was statistically significant at 5% level.

The result in table 1 and 2 also indicates that the coefficient of the fertilizer used in the regression model revealed that-fertilizer had 0.239 and 0.374 for improved and local maize varieties respectively. This showed a positive relationship between the quantity of fertilizer used and yield obtained. This means that for every one percent increase in fertilizer, holding all other inputs, constant, there were increase in yield by 0.374% and

0.239% for local and improved maize varieties respectively and statistically significant at 1% and 5% level for local and improved maize varieties respectively. This showed the need to continue adding this input in maize production as it added significant increase in yield. The hypothesis that there is no relationship between inputs and output in the production of improved and local maize varieties is rejected. In a related finding, it was reported that farm size, fertilizer and purchased inputs such as seeds were significant inputs that accounted for variation in the output of food crop farmers (Babatunde and Boluwade, 2004). In another related research, it was reported that an average settler could improve profit substantially by increasing the amount of seeds, fertilizer, hired farm machinery and spray chemicals used per hectare for maize production (Adesimi, 1982). It was also earlier showed that maize yield is significantly higher on plots planted with improved seeds and on those where inorganic fertilizer, mulching and crop rotation are used (Nkonya *et al.*, 2003).

Table 1: Regression Results of the Cobb–Douglas Production Function for Improved Maize Varieties in Selected LGAs of Zamfara State

Variable	Regression Coefficient	Std. Error	T-Value	Sig.
LnX1 (Plot size)	0.286	0.132	2.166	0.034**
LnX2 (Family labour)	2.859E-03	0.045	0.063	0.950ns
LnX3 (Hired labour)	3.194E-02	0.060	0.533	0.596ns
LnX4 (Quantity of seed)	6.938E-02	0.079	0.876	0.384ns
LnX5 (Quantity of fertilizer)	0.239	0.094	2.531	0.014**
LnX6 (Quantity of manure)	-0.148	0.099	-1.488	0.142ns
LnX7 (Animal traction)	0.126	0.106	1.192	0.238ns
Constant	7.035	0.964	7.296	0.000*

Model Summary

- **F-value:** 19.562***
- **R²:** 0.685

Footnotes

- *** = Significant at 1%
- ** = Significant at 5%
- ns = Not significant**

Table 2: Regression Results of the Cobb–Douglas Production Function for Local Maize Varieties in Selected LGAs of Zamfara State

Variable	Regression Coefficient	Std. Error	T-Value	Sig.
LnX1 (Plot size)	9.930E-06	0.066	0.537	0.593ns
LnX2 (Family labour)	0.142	0.097	1.457	0.150ns
LnX3 (Hired labour)	1.804E-02	0.111	0.163	0.871ns
LnX4 (Quantity of seed)	0.425	0.162	2.624	0.011**
LnX5 (Quantity of fertilizer)	0.374	0.131	2.859	0.006***
LnX6 (Quantity of manure)	9.830E-02	0.151	0.650	0.518ns
LnX7 (Animal traction)	-3.024E-02	0.121	-0.249	0.804ns
Constant	3.043	1.251	2.432	0.018

Model Summary

- **F-value:** 12.388***
- **R²:** 0.530

Footnotes

- *** = Significant at 1%
- ** = Significant at 5%

ns = Not significant**

Conclusion

It was concluded that there was significant relationship between plot size, quantity of fertilizer applied and yield of improved maize. While increase in the quantity of seed and fertilizer led to significant increase in yield for local maize production. It is recommended that farmers should reduce the use of those inputs that had no significant

increase to yield obtained and increase the use of those inputs that had significant increase to yield in maize production. Also farmer should be guided more by extension agents on proper use of farm inputs in order to achieve the highest technical efficiency of farm inputs in maize production.

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