Resource Productivity of Maize Production in Numan Local Government Area of Adamawa State, Nigeria

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Abstract- This paper attempts to analyze the efficiency of maize (Zea mays L.) production in Numan Local Government of Adamawa State, Nigeria. Multistage sampling technique was employed to select Ninety seven (97) maize producing farmers for the study. Data for the study were collected using structured questionnaires. Multiple regression analysis was used to study the relationship between inputs and output. The result shows that there is a positive and significant relationship between farm sizes, quality of seed used, fertilizer, plough-cost, labour with maize output in the study area.

Index Terms- Resource productivity, multiple regression, Numan Local Government area

I. INTRODUCTION

Yield of 2.78 ton/ha, maize ranks first among cereals and is followed by Rice, Wheat and Millets, with average grain yield of 2.55, 1.63 and 0.66 ton/ha respectively (Indian council of Agricultural Research, 2004). Recently, the world average yield of 4.3 ton/ha over the last three years with equivalent values for rice and wheat are 3.8 and 2.7 tons respectively (Tony, 2013). Maize is one of the most important grains in Nigeria, not only on the basis of the number of farmers that engaged in its cultivation, but also in its economic value (Oladejo & Adetunji, 2012). Maize has evolved in Nigeria from the backyard crop in the 1970s to a commodity which is third in terms of output and area cultivated only to sorghum and Millet since the 1990s (NARP, 1994; as cited by Phillip, 2002). Maize is now widely accepted as a major source of food and cash income among it's predominantly smallholder producers in Nigeria. According to Phillip (2002), the factors which aided the rapid expansion and acceptance of maize cultivation in Nigeria are significant. First, was the development, through collaborative research, of fertilizer responsive and early maturing open pollinated and hybrid varieties. Second, was the emergence of maize as a major substitute industrial raw material, following the ban of most cereal grains import in the 1980s. Third, there was enhanced adoption of maize growing and maize-related technologies through the vigorous extension activities of the World Bank assisted by Agricultural Development Projects (ADPs). Fourth, there had been prolonged concessional pricing of fertilizers, the critical input class in maize production in most part of Nigeria. And, fifth, is the relative ease of transporting and storing maize grains.

This work therefore was prompted by the over dependence on other local governments to supply maize, in the study area, which is due to acute shortage and increase in the demand of maize in the area. The study therefore tries to measure the efficiency under different farms in Numan Local Government Area of Adamawa state of Nigeria.

II. METHODOLOGY

Study Area

The study area was Numan Local Government Area of Adamawa State. Numan is situated at latitude 9.47° North, longitude 12.03° East and 137 meters elevation above the sea level (Numan maps n.d).Numan local government area lies in the north-west of Adamawa state. It shares common boundaries with Guyuk Local Government Area to the north, Demsa Local Government Area to the north-east and Lamurde Local Government Area to the south-west.

The Local Government has a number of ethnic groups. Among them are the Bwatiye, Bille, Mbula, Hausa, Wurkumand Junju who live in segmented communities. Numan Local Government Area has a population of 77617 people and it covers a land area of 2,193 square kilometers (Numan maps n.d). The soils of the study area consist of well drained sandy loam, silt and silty loam.

The study area experience high temperature of about 38.4^0C in December which rises in April-May to 43^0C. There are two distinct seasons in the area, the rainy season and dry seasons. The beginning and end of rainy season followed the migration pattern of inter tropical convergence zone (TTCZ). The rainy season is from May-October with the heaviest downpour in August. The annual average rainfall of the area is about 960.3 mm. The dry season start from November and ends in April. This is the period of harmattan when the dust laden carried by North-Eastern trade winds (continental air masses) from the Sahara desert have a marked effect on the climate of the area. The driest month are January and February with relative humidity of 13%, short grasses interspersed by short trees, shrubs and mosaic of Savannah marks the vegetation of the area (Information unit Numan L.G.A, 2013).

The major occupations of the people in the study area are farming, fishing, hunting and civil service. Major crops grown in the area include maize, guinea corn, rice and beans. Also livestock like pigs, goats, cattle and sheep are reared in the area. Social amenities available in the study area are electricity, police station, schools, market, sporting centers, banks etc.

Source of Data

The data for this study were collected from primary source. The data were collected from maize farmers through the use of structured questionnaire that was administered to the producers in the study area.

Sample Size and Sampling Procedure

Multistage sampling techniques were used to select the respondents. Five wards were purposively selected from the ten (10) wards of the local government area. From each of the selected five wards, two villages were purposively sampled giving a total of ten villages. Under this arrangement, a total of 97 maize farmers were randomly selected from the ten villages according to the proportion of the maize farmers and to whom questionnaires were administered to, data were collected for the study from their responses. The information collected includes the socio-economic characteristics of farmers, production costs and returns, inputs used in the production, production constraints etc.

III. ANALYTICAL TOOL

Multiple regression analysis was used to study the relationship between inputs and output. This is generally given as;

$Y = f(x_1x_2.....x_n)$

Four functional forms have been used to determine the relationship between the variables inputs and the output and the best fit equation selected. The functional forms are:

i. Linear function:

$Y = b_o + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 ……..b_{10}X_{10} + U_i$

ii. Exponential function

$LnY = b_o + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 ……..b_{10}X_{10} + U_i$

iii. Semi-logarithm function

$Y = lnb_o + b_1lnX_1 + b_2lnX_2 + b_3lnX_3 + b_4lnX_4 ……..b_{10}lnX_{10} + U_i$

iv. Double logarithm function

$LnY = lnb_o + b_1lnX_1 + b_2lnX_2 + b_3lnX_3 + b_4lnX_4 ……..b_{10}lnX_{10} + U_i$

Where:

Y = Total output of maize (kg)
X_1 = Farm size in hectares (ha)
X_2 = Quantity of fertilizer (kg)
X_3 = ploughing cost (₦)
X_4 = Quantity of seeds (kg)
X_5 = Labour (mandays/hour)
X_6 = Quantity of herbicide (ltrs)
$b_1 – b_{10}$ = Coefficients of the variable inputs
U_i = Error term

IV. RESULTS AND DISCUSSIONS

The relationship between maize production input and the output can be explained based on the regression result as shown in table 4. 13.

Maize output was regressed with the quantity of farm size, fertilizer, plough-cost, quantity of seeds, labour, and herbicide to determine the relationship between the dependent variable (Y) and independent variables (X_1-----X_6). Four functional forms were tried in order to determine the best fit function. Economic and statistical criteria were employed to select linear function as the lead equation; thus the equation:

$$\mathbf{Y=-3483.686 + 917.9455X_1 +2.923218X_2 + 0.1259594X_3 + 64.42412X_4 + 65.43022X_5 - 7.555654X_6}$$

The importance of the production function analysis was to measure the contribution of each input to production when the input interacts with one another to produce output (Gidado, Adebayo, Daniel, and Alama, 2013).

The standard error of Y estimate = 0.03. The co-efficient of multiple regressions (R^2) was given to be (0.64), this implies that about 64% variation in the output is explained by the inputs captured in the regression. This indicates that an increase in each of the variables (except herbicide which is negative) will result to an increase in output of maize. This is in consonance with the findings of Onuk, Yahaya, and Nannim, (2010) on maize production in Plateau State, which states that the coefficient of multiple determinants (R^2) was 0.65 which is 65% variation.

Out of the six independent variables, five carried positive signs (farm size, fertilizer, plough-cost, seeds quantity, and labour); meaning that increase in the use of the variables directly increase the output while herbicide was negative which implies increase in its use reduce farmers yield this could be inadequate technical knowhow on the use of the herbicides.

Generally, from table 4.13, three inputs (farm size, fertilizer, plough-cost) used as regressors analysed were statistically significant at 1% and one input (seed quantity) is statistically significant at 5%. The remaining two regressors were, not significant (i.e. labour and herbicide).

Farm size: The coefficient for farm size (X_1) is positive (917.95) which imply that an increase in farm size will result in an increase in output all others remain equal. The positive sign indicate that farm size had direct relation to output. This is so, because land area is very strategic in maize production, therefore, when it is increased it also leads to an increase in output of maize.

Fertilizer: A unit change in fertilizer (X_2) will bring about a significant percent increase in the output of maize production. The more fertile the soil, the more its return on yield, the significance of the fertilizer could also be as a result of efficient use of the commodity as it is a major input in the sense that it improves the fertility of the soil.

Plough-cost: The coefficient of the cost of ploughing (X_3) is (0.13) and significant at 1% level. This shows that at 1% level of probability, any increased in ploughing cost will bring about 13% increased in maize output, this is because ploughing soften the soil and allow the plant roots to penetrate properly into the soil and extract the available essential nutrient for growth and development. The more the tillage operation (plough, harrow and ridging) the more the cost farmer incurred but the better the yield and hence higher income. Therefore when the farm land is properly tilled or plough it allows plants to grow faster hence increases the output.

Seeds: The coefficient of seeds is positive (64.4) and is significant at 5% level of probability, it is positively related to output of maize which implies the fact that seeds has to be planted before crop establishment is expected as well as output.

Table 1: Regression Analysis

Functional forms	**Linear**	**Semi-log**	**Double-log**	**Exponential**
Variables Constant	-3483.686 (-4.10)***	-25701.39 (-3.19)***	2.655129 (2.47)***	6.598735 (42.71)***
Farm size/ ha (X_1)	917.9455 (4.12)***	2908.502 (1.98)**	0.6010951 (3.06)***	0.1473186 (3.63)***
Fertilizer kg (X_2)	2.923218 (3.13)***	1713.806 (2.61)***	0.2655426 (3.03)***	0.0002943 (1.73)
Plough-cost₦ (X_3)	0.1259594 (3.17)***	1153.725 (1.23)	0.24093 (1.70)**	0.0000229 (3.16)***
Seed kg (X_4)	64.42412 (2.11)**	1103.692 (1.33)	0.1237848 (1.11)	0.0066202 (1.19)
Labour (X_5)	65.43022 (0.94)	-100.1857 (-0.08)	0.1546476 (0.89)	0.0236471 (1.87)
Herbicide lrt(X_6)	-7.555654 (-0.20)	1882.957 (2.00)**	0.1995361 (1.59)	-0.0025132 (-0.37)
R^2	0.64	0.59	0.699	0.56
SE	0.03	0.04	0.91	0.81
F-ratio	26.48***	12.83***	19.79	0.81***

Source: Computer print
Key;
******* = significance at 1% level of probability
****** = significance at 5% level of probability
SE = Standard Error
All figures in parenthesis are t-values

V. CONCLUSION

It can therefore be concluded that there is a positive and significant relationship between farm sizes, quality of seed used, fertilize, plough-cost, labour with maize output in the study area. Maize production among farmers was also found to be profitable.

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