



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & STUDIES

Technical Efficiency of Maize Production in Mubi North Local Government Area of Adamawa State, Nigeria

ISSN 2319-9725

Asabe Ibrahim

Research Scholar, Faculty of Science.
BHU, Varanasi

Jimjel. Zalkuwi

Research Scholars Institute of Agricultural science
BHU, Varanasi

Comfort Yusuf

Research Scholars Institute of Agricultural science
BHU, Varanasi

Abstract: *The study presents the technical efficiency of maize production in Mubi North Local Government area of Adamawa State, Nigeria. Data were collected from 100 farmers using purposive and simple random sampling with the aid of structured schedule.*

The result of the stochastic frontier production function analysis shows that the variance parameters, that is the sigma squared (δ^2) and the gamma (γ) were statistically significant at 1% level for maize production. The coefficient of farm size and seed were positive and significant at 1% level while family and hired labor was negative and not significant. Profit level can be increased by increasing the amount of farm size and quantity of seed, and decreasing the use of manual labor. Mean efficiency were 0.68, Farmers operate at 32.45% below frontier level due to variation in technical efficiency. . The inefficiency model shows that the coefficient of Age, Gender and family size have negative apriori sign and in consonance with the apriori expectation.

Keywords: *Technical efficiency, stochastic frontier production function, maize production, Mubi north L.G.A*

1. Introduction:

Agricultural industry was accorded scanty attention after the discovery of oil in commercial quantity in Nigeria. This has created a gap between the demand and supply of domestic food requirements. Consequently the country has found it increasingly difficult to feed her teeming Population and supply the local industries from the domestically produced food and raw materials. Worldwide production of maize is 785 million tons, with United States being the largest producer, producing about 42% of the total production. Africa produces 6.5% and the largest African producer is Nigeria with nearly 8 million tons, followed by South Africa. Africa imports 28% of the required maize from countries outside the continent.

Most maize production in Africa is rain fed. Irregular rainfall can trigger famines during occasional droughts.

Maize is one of the 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. Maize is a major important cereal crop being cultivated in the rainforest and the derived savannah zones of Nigeria. Maize has been in the diet of Nigerians for centuries. It started as a subsistence crop and has gradually become more important crop. Maize has now risen to a commercial crop on which many agro-based industries depend on as raw materials (Iken and Amusa, 2004). Maize is highly yielding, easy to process, readily digested and cost less than other cereals. It is also a versatile crop, allowing it to grow across a range of agro ecological zones (IITA, 2001). It is an important source of carbohydrate and if eaten in the immature state, provides useful quantities of Vitamin A and C. Maize thrives best in a warm climate and is now grown in most of the countries that have suitable climatic conditions.

The growth of maize production depends on the need to improvement in either productivity or through area expansion. The increase in maize production in Nigeria is mainly contributed by expansion of area. The productivity growth may be achieved through either technological progress or efficiency improvement (Coelli, 1995). Several studies indicated that the existing low levels of technical efficiency hinder efforts to achieve progress in production (Belete *et al.*, 1991; Seyoum *et al.*, 1997). Despite the significant growth in maize production, there is huge inefficiency in the production system of maize production. An improvement in the efficiency of production system will have direct positive impact on agricultural growth, nutritional security and rural livelihood in a country like Nigeria, where maize is one of the major crops.

Under these circumstances it is important to know whether the producers have the same or different levels of technical efficiency. The study therefore, tries to measure the technical efficiency under different farms in Mubi North Local Government Adamawa State of Nigeria.

2. Methodology:

Mubi North Local Government Area of Adamawa state lies on the west bank of the Yedseram River, a stream that flows into Lake Chad and is situated on the western flanks of the Mandara Mountain. It shares common boundaries with Borno State to the North, Hong Local Government Area to the West, Maiha Local Government to the South and Cameroun Republic to the East.

Temperature is normally warm to hot with a minimum temperature of 12^oc and maximum temperature of 37^oc (Adebayo, 2004). The ethnic groups are mainly Fali, Gude, Marghi and Fulani. The inhabitants are predominantly farmers and traders, Farming is the major occupation of the people of the area with sorghum and maize as main crops. Other crops cultivated in the area include rice, millet, sweet potatoes, cassava, cowpea and bambara nut.

3. Nature And Scope Of Data:

The study used mainly primary data, collected from the administration of structured questionnaires to 100 respondents. Purposive and random sampling were used to select respondent for the study

3.1. Analytical Tools:

The stochastic frontier production model was independently proposed by Aigner *et al.* (1977) and Meeusen and Van den Broeck (1977). It employs a Cobb-Douglas production function to simultaneously estimate the random disturbance term (V_i) which is outside the control of the production unit and the inefficiency effects (U_i) as proposed by Battese *et al.* (1996).

The stochastic frontier production function used in this study was specified as follows:

$$\text{Log}Y_i = B_0 + B_1\text{log} X_1 + B_2\text{log}X_2 + B_3\text{log}X_3 + \dots\dots\dots B_6\text{log} X_6 + V_i -U_i \dots\dots (1)$$

Y = Output of maize in kg

X_1 = Farm size in hectares

X_2 = Quantity of fertilizer applied in kg

X_3 = Quantity of maize seed planted in kg

X_4 = Quantity of herbicides used in litres

X_5 = Amount of family labour used in man-days

X_6 = Amount of hired labour used in man-days

X_7 = Expenses on ploughing (tractor and animal traction)

V_i = Random noise (white noise) which are $N(0, \delta^2, V)$

U_i = Inefficiency effects which are non-negative, half normal distribution $N(0, \delta^2, U)$

The technical efficiency of maize production for i^{th} farmers, defined by the ratio of observed product as to the corresponding frontier production associated with no technical inefficiency, is expressed by;

$$TE = \text{Exp}(-U_i) \text{ so that } 0 \leq Te \leq 1 \dots\dots\dots (2)$$

$$\text{Variance parameters are } \delta^2 = \delta^2_v + \delta^2_u \text{ and } \gamma = \delta^2_u / \delta^2 \dots\dots\dots (3)$$

So that $0 \leq \gamma \leq 1$

The inefficiency model is defined by,

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 \dots\dots\dots (4)$$

Where,

U_i = inefficiency effect

Z_1 = Age of farmer (in years)

Z_2 = Literacy level (in years)

Z_3 = Farming experience (in years)

Z_4 = Extension contact (1 contacted, 0 otherwise)

Z_5 = Gender of the farmer (1 female and 0 for female)

Z_6 = Family size (total number of person in household)

Z_7 = Access to formal credit (binary)

δ^2 , δ_0 , γ , β s are unknown parameters that were estimated.

The potential level of output was derived by averaging the yield of ten highest farmers. The maximum likelihood estimate (MLE) for all the parameters of the stochastic frontier production function and the inefficiency model defined above and the technical efficiency was obtained using the Frontier 4.1 computer programme (Coelli, 1994; Ajibefun, 1998).

4. Results And Discussions:

4.1. Stochastic Frontier Production Function And Inefficiency Model Result:

The maximum likelihood estimates of the stochastic frontier production function and inefficiency model results are presented in Table 1 and 2. The estimate for parameters of the stochastic frontier production function indicates that the elasticity of output with farm size was positive and approximately 0.534 and it was found to be statistically significant at 1 % level. This implies that a one percent increase in area under maize production will raise output of maize by 53 % this shows that land is a very important factor in maize production. This finding is at tandem with the findings of Eyo and Igben (2002); Maurice *et al.*, (2005); Odoh and Folake (2006), that land has positive sign and statistically significant.

The production elasticity of seed is 0.347 it was statistically significant at 1% level, this also, implies that a one percent increase in seed under maize production will raise the output of maize production by 35 %, So seed is also a very important factor of production. The significant and positive sign of seed variable also indicated that a moderate increase in population of maize on the field will increase the yield provided that, the farm is not overpopulated beyond the recommended maize carrying capacity that will lead to competition for nutrients which will lower the yield. This finding is in consonance with the work of Shehu *et al.* (2007a) and Ogundari (2008), who found that seed is an important factor in production.

The production elasticity of fertilizer was 0.017 it was not statistically significant. The production elasticity for herbicide was -0.014 and was significant for at 10 % level, the coefficient for family labour (-0.004) and hired labour (-0.013) were negative and not significant, which is contrary to *apriori* expectation signs. The negative effect and the insignificance of family and hired labour may be attributed to the over dependence of respondents on manual labour as well as over use of the variable inputs. This is a common feature of agricultural production in the developing countries like Nigeria. A unit increase in labour tends to increase the cost of maize production and consequently reduces the output. This findings therefore is an indication that labour is the most critical variable input in maize production in the study area which reduce the output of maize farmers.

5. Determinants Of Technical Inefficiency:

Table 2 presents the coefficients of inefficiency function which explain levels of technical inefficiency among the respondents. It should be noted that the signs of the coefficient in the inefficiency model are interpreted in the opposite way and such a negative sign means that, the variable increase efficiency and positive sign mean that it decreases efficiency (Adebayo, 2007). The coefficient of age (-0.994) had negative sign and in consonance with *apriori* expectation. It was statistically significant and different from zero at 5%. This implies that increase in the age of the farmers by one unit (year) will increase the efficiency of the farmers.

The estimated coefficient for years of farming experience was (0.467), it was statistically significant at 1% level. The maize production has a positive coefficient, implying that respondents' with high years of farming experience are not more efficient than those with lower years of farming experience. This is an indication that years of farming experience was not a critical factor of inefficiency among respondents who cultivated maize in the study area.

The estimated coefficient for extension contact is 0.002 for respondents involved in maize production; it had contrary sign of positive and was statistically insignificant. Its contrary sign may be attributed to the poor extension services experienced by respondents since the withdrawal of funding by the World Bank to the Agricultural Development Programme (ADP) in Adamawa as it is in other states of the federation.

The coefficient of gender and family size are (-0.028) and (-0.255) both the coefficient for gender and household size had the negative *a priori* expectation and was statistically not significant. This implies that increase in family size by one unit (Adult) will increase the efficiency of the farmer.

The estimated sigma square (δ^2) in Table 1 was large (0.523) and significantly different from zero. This indicates a good fit and the correctness of the specified distributional assumption of the composite error term. The variance ratio of gamma (γ) which was associated with the variance of technical inefficiency effect in the stochastic frontier was estimated to be 0.92 production system. This indicates that 92% of the total variations in maize output for the farmers were due to differences in technical efficiency (TE). This also implies that the ordinary least squares estimates may not be adequate enough to explain the inefficiency variation among the respondents hence the use of stochastic frontier production function.

6. Technical Efficiency Of Maize Farmer In The Study Area:

The technical efficiency in Table 2 was derived from MLE result of the stochastic production function. The result shows that the TE of the respondents was less than 1 (100 %) hence the variation in TE exists among respondents. It means that, all the respondents produced below maximum efficiency. The minimum efficiency of maize producers was 0.467, while their maximum efficiency was 0.884; and the mean efficiency was 0.6755.

The distribution of the farm efficiency in maize production shows that, majority (75 %) of the farmers operated above 59 % of their maximum efficiency and 41 % operated between 40-59 %.

Variable	Parameter	Coefficient	t-value
Constant	β_0	2.667	22.553***
Farm size (X_1)	β_1	0.534	6.251***
Fertilizer (X_2)	β_2	0.017	0.780
Seed (X_3)	β_3	0.347	5.009***
Herbicide (X_4)	β_4	-0.014	-1.168*

Family labour (X_5)	β_5	-0.004	-0.930
Hired labour (X_6)	β_6	-0.013	-0.373
Inefficiency model			
Constant	δ_0	1.554	2.308***
Age	δ_1	-0.994	-2.068**
Literacy level	δ_2	0.036	0.830
Farming experience	δ_3	0.467	3.108***
Extension contact	δ_4	0.0012	0.006
Gender	δ_5	-0.028	-0.772
Family size	δ_6	-0.256	-1.600
Variance parameters			
Sigma squared	δ^2	0.523	4.595***
Gamma	γ	0.923	7180.188***

Table 1: Maximum Likelihood Estimate of the Cobb-Douglas Stochastic frontier production function and inefficiency model for maize farmers

Efficiency	Frequency	Percentage
<0.40	5	5
0.40 – 0.49	11	11
0.50 – 0.59	10	10
0.60 – 0.69	31	31
0.70 – 0.79	14	14
0.80 – 0.89	3	3
0.90 – 1.00	11	11
Total	100	100
Minimum efficiency		0.467
Maximum efficiency		0.884
Mean efficiency		0.6755

Source: Computed from Stochastic Frontier Result

Table 2: Frequency Distribution of Technical efficiency rating of the maize farmers

7. Conclusion:

It may be concluded from the study that under the given socio-economic and farm conditions (including technology), the production of maize can be increased by more than 32 percent. Profit on the far can also be enhanced by reducing the human resources, which are over employed on the farm. It is suggested that the Government of Nigeria should strengthen the technology dissemination work in order to increase the efficiency of farmers. A policy should also be framed to transfer the surplus human resource from agricultural sector to another sector, which will increase the profitability of farms and improve the labor efficiency.

References:

1. Adamawa State Diary (1999). Ministry of Information, Yola Adamawa state, Nigeria.
2. Adebayo, A.A. (1999). Climate I (Sunshine, temperature, evaporation and relative humidity) In: *Adamawa State in Maps*, Adebayo, A.A. and Tukur A.L. (eds). Paraclete Publishers, Yola, Nigeria pp3-5.
3. Adebayo, A.A. and A.L. Tukur (1999). *Adamawa state in Maps* In: Adebayo, A.A and Tukur A.L. (eds). Paraclete Publishers, Yola, Nigeria 14p
4. Adebayo, E.F. (2007). Resource Use efficiency of Dairy Pastoralist in Adamawa State, Nigeria. *Journal of Arid Agriculture* 17:1-6.
5. Ajibefun, I.A. and A.G. Daramola (1999). Measurement and sources of technical inefficiency in poultry egg production in Ondo state. *Journal of Rural Economics and Development* 13:85-94.
6. Battese, G.E., Malik, S.J., and M.A. Gill (1996). An investigation of technical inefficiencies of production of what farmers in four districts of Pakistan. *Journal of Agricultural Economics* 47(1):37-49.
7. Belete, A., J. Dillion and F. Anderson (1991) “ Development of Agriculture in Ethiopia since tehe 1975 Land Reform” *Agricultural Economics*, Vol 6, pp. 159-175.
8. Coelli, T.J. (1995) “ Recent Development in Frontier Modeling and Efficiency Measurement” *Australian Journal of Agricultural Economics*, 39(3): 171-180.
9. Central Bank of Nigeria (2007). Annual reports and Statement of Account for the year ended 31st December, 2007. Central Bank of Nigeria, Abuja
10. Coelli, T.J. (1994). A computer programme for Frontier production function estimation FRONTIER version 2.0. *Economic Letters* 39:29-32
11. Eyoh, E.O. and S.I. Igben (2000). *Agricultural Economics: an Information to Basic Concepts and Principles*. Best Print Business Press Uyo, Nigeria, pp238
12. FAO (2012). Production year book. Food and Agricultural Organization of the United Nations, Rome, Italy
13. Igben, M.S. (1988). The Nigerian Food and raw materials crisis, the Nigerian farmers and agricultural institution: an assessment, Igben, M.S. (ed). Nigeria Institute for Social and Economic Research (NISER), Ibadan, Nigeria pp1-6.
14. Iken, J.E., & Amusa, N.A. (2004). Maize research and production in Nigeria. *African Journal of Biotechnology* 3(6): 302-307.

15. International Institute of Tropical Agriculture (IITA) (2001). *International Institute of Tropical Agriculture, Annual Report on Maize*. IITA publication
16. Maurice, D.C. (2004). Resource Production in Cereals Crop Production among Fadama Farmers of Adamawa State, Nigeria, Unpublished M.Sc Thesis University of Maiduguri.
17. Maurice, D.C., Amaza, P.S., and M.O. Tella (2005). Analysis of Technical Inefficiency of Rice-Based cropping patterns among dry season farmers in Adamawa state, Nigeria. *Nigeria Journal of Tropical Agriculture* 7(1):125-130
18. Meeusen, W. and J. Van den Broeck (1977). Efficiency Estimation from Cobb-Douglas Production Function with composed error. *International Economic Review* 18:435-444.
19. Odoh, E.J. and O. Falake (2006). Resource Use Efficiency and Productivity among Farmers in Nigeria. *Journal of Agriculture and Social Science* 4:264-268. Accessed from <http://www.fspublishers.org>.
20. Ogundari, K. (2008). Resource Productivity, Allocative Efficiency and Determinants of Technical Efficiency of Rain-fed Rice Farmers: A Guide to food Security Policy in Nigeria. *Journal of Sustainable Development in Agriculture and Environment* 3(2):26-27. Odoh, E.J. and O. Falake (2006). Resource Use Efficiency and Productivity among Farmers in Nigeria. *Journal of Agriculture and Social Science* 4:264-268. Accessed from <http://www.fspublishers.org>.
21. Ray, H. (1999). Soil and Erosion. In: *Adamawa State in Maps*, Adebayo, A.A. and Tukur, A.L. (eds). Paraclete Publishers Limited, Yola
22. Shehu, J.F., Mshelia, S.I. and A.K. Tashikalma (2007). Analysis of the Technical Efficiency of Small Scale rainfed upland rice farmers in the Northwest Agricultural Zone of Adamawa State. *Journal of Agriculture and Social Sciences* 3(4):133-136
23. Seyoum, E.T., G.E.Battese and E.M.Fleming(1997) “ Technical Efficiency and Productivity of Maize Producers in Eastern Ethiopia: A Study of Farmers within and outside the Sasakawa-Global 2000 project, <http://www.une.edu.au/econometrics/cepa.htm>. 1997.