Indian Streams Research Journal ORIGINAL ARTICLE ISSN:-2230-7850

IDENTIFICATION OF FACTOR THAT AFFECT TECHNICAL EFFICIENCY OF COWPEA PRODUCTION IN ADAMAWA STATE, NIGERIA

Abstract:-

The study investigates the technical efficiency of cowpea production in Adamawa State, Nigeria. Data were collected from 250 farmers using purposive and simple random sampling with aid of structured schedule .The result of the stochastic frontier production function analysis shows that the variance parameters, that is the sigma squared (δ2) and the gamma (γ) were statistically significant at 1 % level for cowpea production. The coefficient of farm size, labour, seed and chemical were positive and significant at 1% level while family and hired labor was negative and insignificant. Profit level can be increased by increasing the amount of farm size, labour, quantity of seed and chemical, and decreasing the use of fertilizer. Mean efficiency were 0.73, Farmers operate at 27% below frontier level due to variation in technical efficiency. The inefficiency model shows that the coefficient of Age, family size and farming experience have negative apriori sign and in consonance with the apriori expectation

Jimjel Zalkuwi

Research Scholar , Department of Agricultural Economics , Institute of Agricultural Science , Banaras Hindu University.

Keywords:

Technical Efficiency, Cowpea Production, Adamawa State, Stochastic Frontier Production Function

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. In opinion of Igben (1988), the annual widening gap between food and raw materials demand and supply in the country gave room for concern. The demand for food especially cowpea in Nigeria is increasing daily like in most developing countries because of the industrialization, increasing population and normal long dry spell in some parts of the country resulting to shortage of food crops thus leading to an increasing demand that need to be substituted (FAO, 2005). The productions of food and root crops have to be increased to bridge the gap between the demand and supply of food crops like cowpea (CBN, 2005)

Cowpea (*Vigna unguiculata* (L.) Walp.) is of vital importance to the livelihoods of millions of people in the semi-arid regions of West and Central Africa. It is the most important grain legume crop in sub-Saharan Africa. Cowpea is a protein-rich grain that complements staple cereal and starchy tuber crops. It also provides fodder for livestock, improves the soil by fixing nitrogen, and benefits households by bringing in cash and diversifying sources of income. The sale of cowpea stems and leaves for animal feed during the dry season provides vital household income. Nigeria is the largest producer and consumer of cowpea, producing 2.2 million metric tons of dried grain in 2010 (CGIAR). Adamawa state with increasing population over the years, the demand for the crop had gone up but the production has not been increase significantly (Agwu, 2001). This study is therefore to evaluate the technical efficiency of production of the crop and also identifies the factors affecting the inefficiency in the production process in Adamawa State, Nigeria

METHODOLOGY

Selection of the state and local government:

Adamawa State based on their production level has been selected purposively. The state has twenty-one Local Government Areas which are categorized into four agricultural zones; South West, Central, North West and North East Zone. Twenty percent of Local Government Area have been (i.e four LGA) have been purposively selected from each zone, comprise Viz; Ganye, Demsa, Madagali and Girei.

Selection of district

Ten percent i.e. one district from each Local government was selected purposively on the basis of highest cowpea production.

Selection of villages

A list of all villages in the four districts was prepared on the basis of cowpea production, 10 percent of the villages having the highest cowpea production in each district were selected, and then 10 percent of the farmers were selected randomly to give a total of 250 farmers

Collection of data

Primary data was used collected from 250 cowpea farmers from Adamawa state, Nigeria. The main instrument that was used for collecting the data was structured schedule. Simple random sampling and purposive sampling techniques were used at various stages as the selection procedures in the selection of 250 respondents.

ANALYTICAL TOOL

The stochastic frontier production model was used to determine the efficiency of the cowpea farmers;

The Empirical Stochastic Frontier Production Model

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

$$\text{Log}Y_i = B_o + B_1 \log X_1 + B_2 \log X_2 + B_3 \log X_3 + \ldots\ldots\ldots\ldots B_6 \log X_6 + Vi - Ui \qquad (1)$$

Where
Y = Output of cowpea (kg)

X_1 = Farm size (hectares)
X_2 = Amount of family labour used (man-days)
X_3 = Quantity of cowpea seed planted (kg)
X_4 = Quantity of fertilizer used (kg)
X_5== Quantity of chemicals used (litres)
V_i = Random noise (white noise) which are $N(0,\delta^2, V)$
U_i = Inefficiency effects which are non-negative, half normal distribution $N(0,\delta^2, U)$

Operational definition of the variables of empirical stochastic production function for Cowpea Production is as follow:

i.Output of Cowpea farmer: This is the total yield obtained per hectare by farmers in kilogram equivalent weight.
ii.Farm size: This is the size of land used in producing Cowpea crop by the farmers.
iii.Quantity of fertilizer: This refers to the quantity of fertilizer use in kilograms.
iv.Quantity of Seed: This refers to the quantity of seed in Kilogram equivalent weight used for planting by the farmers.
v.Chemicals: this refers to the quantity of herbicide used in litres.
vi.Labour: This is the total man days of labour per hectare supplied by house hold and hired during the farm operation. The standard man day is 8 hour per day.

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

$TE = Exp(-U_i)$ so that $O \trianglelefteq Te \trianglelefteq$ (2)
Variance parameters are $\delta^2 =$

$\delta^2V + \delta^2U$ and $\gamma = \delta^2U / \delta^2$ (3)

So that $O \trianglelefteq \gamma \trianglelefteq$

The inefficiency model is defined by,

$Ui = \delta_o + \delta_1Z_1 + \delta_2Z_2$ (4)

Where,
U_i = inefficiency effect
Z_1 = Age of farmer (in years)
Z_2 = Literacy level (in years)

The operational definition of the empirical inefficiency parameter of the stochastic frontiers for Cowpea Production is given as:

i.Age: This is the age of individual farmers involved in the farm operation.
ii.Literacy level: This is measured as the numbers of years put in by farmers to acquired basic formal education. Specifically 'O' years denotes no formal education: 6 years denote primary education. 12 years denote secondary education. 15 years denote diploma and NCE holder: while greater than 15 years denotes graduates.
iii.Farmer experience: This is measured as the number of years that farmers have been into Cowpea production.
iv.Extension contact: This measures the frequency of meeting between the farmers and extension workers during the last cropping seasons.
v.Family Size: This is the numbers of house hold member who have attained the age of 15 years and above that are available for farm operation.

RESULT AND DISCUSSION

Efficiency Estimation in Cowpea Production

This section examines the relative performance of the process used in transferring given input into output. The technical efficiency of the respondents in cowpea production were estimated using stochastic frontier functions.

Technical Efficiency

The maximum likelihood estimate of the stochastic frontier production for cowpea farmers in the study area is presented in Table 1. The estimated coefficients of all the Parameters of production function were positive. This means that total cowpea output increases by the value of each coefficient as the quantity of each variable input increases by one percent. All the inputs used in the model except fertilizer were statistically significant at 1%, 5% and 10% level.

Table 1: Maximum likelihood estimates of the parameters of the stochastic frontier production function

Variable	Parameter	Coefficient	t-ratio
Production factor			
Constant	β_0	2.6824***	17.3636
Farm size (X1)	β_1	0.4944***	4.4222
Labour (X2)	β_2	0.1343**	2.1094
Seed (X3)	β_3	0.4443***	4.6154
Fertilizer (X4)	β_4	0.0072	0.2455
Chemicals (X5)	β_5	0.2733***	0.3407
Inefficiency effects			
Gender	δ_1	-0.0230	-0.2309
Age	δ_2	-0.1334***	-0.5356
Family size	δ_3	-0.3407***	-2.4758
Literacy level	δ_4	0.0659	1.3295
Farming experience	δ_5	-0.2667***	-2.8768
Extension contact	δ_6	0.0241	-0.6067
Diagnostic statistics			
Sigma squared (σ^2)		0.0742***	3.3985
Gamma (γ)		0.6814***	4.6478

*** Estimates are significant at1% level,
** Estimates are significant at 5% level.
*Estimates are significant at 10% level

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. The estimate for parameters of the stochastic frontier production function indicates that the elasticity of output with farm size was positive and approximately 0.4944 and it was statistically significant at 1 % level. This implies that a one percent increase in area under cowpea production will raise output of cowpea by 0.4944%. This shows that land is a very important factor in cowpea production. This finding is at tandem with the findings of; Odoh and Folake (2006), Omonona (2010) and Gwandi(2012), that land has positive sign and statistically significant.

The production elasticity of labour was 0.1343 and statistically significant at 1 %level, indicating that availability of labour increases the likelihood of the farmer to go into crop diversification. This is because crop diversification guarantees substantial labour cost savings which otherwise will be incurred when there is no crop diversification. Different crops have different labour intensity; hence diversification is common among crops with low labour intensity than those with high labour intensity. This inconsonance with the findings of Omonona (2010) and Daniel et al 2013

The production elasticity of seed was 0.4442 and it was not statistically significant at 5% level this implies that a one percent increase in one kg of seed under cowpea production will decrease the output of cowpea production0.4442%. So seed is not an important factor of production. This is agreement with the finding of Zalkuwi (2012)

The production elasticity for fertilizer was not significant at any level. Fertilizer improves the productivity of existing land by increasing crop yields per hectare. A 1% increase in the use of fertilizers would decrease output of cowpea crop from the findings therefore is an indication that fertilizer is a not critical variable input in cowpea production in the study area which increase the output of cowpea farmers. This agrees with comparable findings by Zalkuwi (2012) who reported negative relationship between

fertilizer and output of farmers.

Chemicals have an elasticity coefficient of 0.2734 and statistically significant at 1%. This means that a 1% increase in the quantity of chemical use in cowpea production would increase output by 0.2734%. The use of chemical reduces expenditure on weeding and at the same time reduces fatigue and drudgery associated with production process. This implies that the use of chemical increases productivity and also enables farmers to cultivate large hectares of land which in turn bring about increase in output.

DETERMINANTS OF TECHNICAL INEFFICIENCY

Table 1 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 as such a, negative sign means that, the variable increase efficiency and positive sign mean that it decreases efficiency (Adebayo, 2007).

The coefficient of gender is estimated to be negative and not statistically significant . This implies that increase in the gender by one unit will decrease the efficiency of the farmers, This implies that decrease in family size by one unit (Adult male) will increase the efficiency of the farmer

The coefficient of age (-0.1334) had negative sign and inconsonance with apriori expectation. It was statistically significant and different from zero at 1%. This implies that increase in the age of the farmers by one unit (year) will increase the efficiency of the farmers.

The coefficient of family size was negative and statistically significant at 1% in agreement with a priori expectation, meaning that an increase in family size by one unit will increase the technical efficiency of the farmer, This is in harmony with the study of Gwandi(2012)

The coefficient of education variable is estimated to be negative and is not statistically significant. This implies that farmers that are illiterate tend to be more efficient in agricultural production; this is due to their enhanced ability to acquire technical knowledge, which enhances their Agricultural productivity. It is plausible that farmers with not education respond easily to the use of improved technology. This finding agrees with the study of

The coefficient of farming experience is negative and significant, meaning that as the farming experience of cowpea farmers in the study area increases, their technical inefficiency will decrease.

The coefficient of the extension variable is estimated to be negative but statistically insignificant. This indicates that increased extension services to farmers tend to decrease technical efficiency in food crop production

The estimated sigma square ($\delta 2$) in Table 1 were large (0.0745) and significantly different from zero at 1% level. 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 0.6814. This indicates that 68%of the total variation in study area was 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

Table 2 Technical Efficiency Rating of the COWPEA Farmers

Efficiency	Frequency	Percentage
<0.40	0	0.0
0.40 – 0.49	20	7.5
0.50 – 0.59	25	10.0
0.60 – 0.69	57	23.8
0.70 – 0.79	68	27.2
0.80 – 0.89	55	21.5
0.90 – 1.00	25	10.0
Total	250	100
Minimum efficiency	0.4302	
Maximum efficiency	0.9191	
Mean efficiency	0.7250	

Technical Efficiency of Cowpea 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 exits among respondents. It means that, all the respondents produced below maximum efficiency. The minimum efficiency was 0.4302, while their maximum efficiency was 0.9191; and their mean efficiency

were 0.7250. The distribution of the farm efficiency for cowpea production shows that, majority (80 %) of them operated above 59 % of their maximum efficiency and 0nly 20 % operated below 59% and none of them operate below 40%.

REFERENCES

1.Agwu, A.E (2001). Commercialization of agricultural extension services deliver in Nigeria. Prospects and problems proceeding of the seventh annual national conference of the agricultural extension society of Nigeria.
2.Adebayo, E.F. (2007). Resource Use efficiency of Dairy Pastoralist in Adamawa State, Nigeria. Journal of Arid Agriculture 17:1-6
3.Daniel,J.D, Adebayo, E. F, Shehu, J. F.,and Tashikalma, A. K., (2013) Technical Efficiency of Resource-use among SugarcaneFarmers in the NorthEast of Adamawa State, Nigeria. International Journal of Management and Social Sciences Research (IJMSSR) ISSN: 2319-5521Volume 2,
4.Gwandi .O (2012). Economics of Beniseed (sesamum indicum l) production in mubi region of Adamawa state, NigeriaUnpublished M. Sc thesis, Department of Agricultural Economics and Extension, SAAT, FUT, Yola, Adamawa State, Nigeria
5.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.
6.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
7.Omonona, B.T., Egbetokun, O.A. and Akanbi, A.T. (2010). Farmers Resource-Use and Technical Efficiency in Cowpea Production in Nigeria. Economic Analysis and Policy 40(1), 87-95
www.cgiar.org retrieved on 18th of August 2014
8.Zalkuwi, J. (2012). Comparative Economic Analysis of Sole Sorghum and Sorghum Mixed with Cowpea Production Systems in Guyuk Local Government Area of Adamawa State, Nigeria. Unpublished M. Sc thesis, Department of Agricultural Economics and Extension, SAAT, FUT, Yola, Adamawa State, Nigeria