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Maximum Likelihood Estimation Technique of Rabbit Production in Akwa Ibom State, Nigeria

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Abstract: The study estimated quantitatively the technical efficiency of production and its determinants in rabbit enterprise in Akwa Ibom State of Nigeria employing a stochastic frontier production function approach. A total of sixty rabbit farmers across the six agricultural zones were purposively selected using a well structured questionnaire. Information were sought on the socio-economic characteristics and other quantitative variables of interest. The Maximum Likelihood Cobb-Douglas estimation procedure was used. Careful analysis revealed that labour, feeds/ feed supplements, feeder livestock purchased and farm size were major factors determining total output of the enterprise. The study also showed that membership of cooperative society, farm size, extension contact and gender significantly determine efficiency level in the study area. The maximum technical efficiency attained by the farmer is 92.0% while the minimum technical efficiency is 35.0%. The Mean Technical Efficiency (MTE) is 62.0%. The sum of output elasticities which denotes returns to scale is 1.24 signifying increasing returns to scale. In essence, the enterprise did not attain maximum production frontier. With respect to this findings, appropriate policy options and recommendations are fully made and if properly implemented would enhance efficiency of production in the enterprise through better use of available farm resources.

Key words: Technical efficiency, stochastic frontier, rabbit enterprise, Akwa-Ibom State, Nigeria

INTRODUCTION

Efficiency of the various livestock sub-sectors can be improved through efficient use of the existing technologies, reallocation of resources and adoption of new technologies. The challenge to policy makers is how to improve efficiency especially of the small farmers so as to attain large gains in agricultural output hence reduction in food insecurity in the region.

Eleagu (1999) stressed that Nigeria as a developing country is faced with a worsening situation of inadequate protein consumption. The reason for this is not a new phenomenon. The per-capita animal protein was estimated to be 7.6% of the total 54.5 g recommended in 1985 (Okuneye, 1998).

Owolabi (2000) however reported that the protein supply per capita was 44g out of which animal products was less than 2.0%. This has led to protein deficiency which is responsible for under-nutrition and malnutrition which are widespread to all ages and in Nigeria in general. Enyenihi (2001) emphasized that it is a well known fact that efficiency of farm animals in most developing nations is very low and cannot support the per-capita requirements for animal proteins in those countries. Ademosun (1999) pointed out that the present average level of protein consumption per capita in Kwara state is less than 7.5 grams. This according to his study is in line with most states of the federation.

It is important to stressed that in Akwa Ibom State, small scale farmers dominate most of our rabbit farming enterprises and are regarded as major contributors to livestock growth in the state. It is therefore ideal to lay emphasis in allocating and distributing adequate resource inputs, investment in research and eliminating the bottlenecks to efficient resource use and utilization at the farm level. To cushion the problems, government has embarked on several livestock agricultural policies and programmes and the level of success as of now cannot be accurately determined because of incessant policy somersaults, government swabbing and inconsistent livestock policy. In essence, continued scarcity of livestock products and inability to invest meaningfully in its production would continue to depress socio-economic and developmental aspirations in general. In order to

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ascertain this study, the specific objectives were to determine the technical efficiency of production of rabbit enterprise in the state, identify the factors influencing efficiency levels and make policy recommendations towards improving the sector in Akwa Ibom State, Nigeria.

MATERIALS AND METHODS

The study area, sampling and data collection procedure: The study was conducted in Akwa Ibom State comprising thirty one Local Government Areas, six agricultural zones namely Oron, Eket, Etinan, Abak, Uyo, and Ikot Ekpene respectively.The state is located on the South Eastern part and on the rain forest zone of Nigeria.The ecological conditions are conducive for an impressive diversity of livestock such as goats, cattle, sheep, pork, fish, rabbit, poultry etc. The state has a population of 2,359,736 people (NPC, 1991 census).

Primary data were collected using structured questionnaire on rabbit owners and complemented with secondary data on socio-economic characteristics of farmers and production activities in terms of inputs, outputs and their respective prices for the year 2004. Six agricultural zones of the state were involved and in each zone, ten rabbit farms were randomly selected giving a total sample size of sixty rabbit farms in the state for a detailed study. Resident agricultural extension agents and the state Ministry of Agriculture, Uyo were contacted to provide the list of rabbit farmers which formed the sampling frame for the study.

Analytical techniques: The stochastic production frontier approach was used in estimating technical efficiency scores for rabbit production as well as the factors influencing efficiency levels. The frontier production function was specified by the Cobb-Douglas production function including all the explanatory variables. Following Battese and Coelli (1995) a one-stage procedure was employed given away the biases of the two step potential estimation procedure. It is worth stating that this functional form has been widely used in farm efficiency analysis for both developing and developed countries with greater success. Furthermore, in one of the few studies examining the impact of functional form on efficiency, Kumbhakar (2001) concluded that functional specification has a discernable but rather small impacton estimating efficiency.

However, the empirical model for technical efficiency in rabbit enterprises is stated explicitly thus:

$$InYij = \beta o + \beta 1\ InX1\ ij + \beta 2\ InX2\ ij + \beta 3\ InX3\ ij + \beta 4\ InX4\ ij + \beta 5\ InX5\ ij + B\ 6\ InX6\ ij + Vi - Ui$$

Where :

In = Logarithm to base e βo, β 1-β 6 are parameters to be estimated.
Y = Output or total value of rabbit products (N Kg^{-1})
X 1 = Labour (mandays)
X 2 = Feeds and feed supplements (N)
X 3 = Drugs and Medication (N)
X 4 = Feeder livestock purchased (N)
X 5 = Capital inputs (N)
X 6 = Farm size (Number of rabbits housed on the farm)

V 1 = Normal random errors which are assumed to be independent and identically distributed having N (0,6^2). They are not under the control of the farmer. e.g weather, disease, good luck, measurement error.
U 1 = Non negative random variables associated with the technical efficiency of the enterprise. It accounts for inefficiency and under the control of the farmer.

RESULTS AND DISCUSSION

Technical efficiency for rabbit enterprise: The constant term for rabbit enterprise is positive and statistically significant. It shows the level of output or revenue accruable to the farmer at zero level of use for each of the inputs. The estimated coefficient is 3.30. In essence, the farmer could rent out some fixed cost items owned by the enterprise which could as well account for the positive constant terms.

Obioha (1999) has described labour as the most critical input in traditional agriculture. The estimated coefficient for labour is statistically significant at 1% and positively signed which conforms to a-priori expectations. It is a common phenomena that farm operations have remained labour intensive especially in developing countries such as Nigeria. (Iwueke, 1987). The estimated coefficient is 0.258.

The feeds and feed supplements coefficient is significant at 0.01 probability level and positively related and follow a-priori expectations in the estimated model. The estimated coefficient is 0.307 which implies that a 1% increase in feeds and feed supplements inputs would lead to a 0.307% increase in the output or revenue accruing to the enterprise. Chavas and Alibe (1993) stressed that feed is an important and indispensable resource in livestock production especially to non-ruminant animals as is the case in this study. Rabbit is good in converting feed into meat and this makes it more efficient.

The feeder livestock estimated coefficient is positively related and statistically significant at 0.01 probability level. The 0.330 elasticity of feeder livestock

implies that a 1% increase in feeder livestock purchased would lead to an increase of 0.330% in rabbit output. The positive sign conform to a-priori expectations. As more and more feeder livestock is employed in the production process, output increases. Bhagwat (1989) opines that feeder livestock cost constitute about 10 -15% 0f the total operating cost and the profitability of the enterprise is influenced to a large extent by the quality of younger rabbits (fryers) selected.

The estimated coefficient of farm size is positively signed and statistically significant at 0.01 level. This conforms to a-priori expectations. The scale of production in a given farm enterprise affect the profitability of the farms. Williamson *et al.* (1998) stressed that the more farm animals that are housed together, the more economic the operation becomes. Nayer (1993) also stressed that net income increases in direct proportion to the size of the flock. The elasticity of farm size is 0.375, which implies that a one% increase in farm size would lead to a 0.375 increase in the output or revenue accruing to the enterprise.

Determinants of technical efficiency in rabbit enterprise: The determinant of technical efficiency in rabbit enterprise is presented in Table 1 above.

Table 1: Estimated stochastic frontier production function for rabbit enterprise

Production factors	Parameters	Estimated coefficients	Standard errors	t-values
Constant term	$\beta 0$	3.302	0.528	6.259***
Labour (X 1)	$\beta 1$	0.258	0.046	5.564***
Feeds (X2)	$\beta 2$	0.307	0.035	8.809***
Drugs/medication(X3)	$\beta 3$	-0.054	0.060	-0.899
Feeder livestock (X4)	$\beta 4$	0.330	0.058	5.726***
Capital inputs(X5)	$\beta 5$	0.028	0.044	0.654
Farm size (X6)	$\beta 6$	0.375	0.121	3.090**
Efficiency Factors				
Constant (Zo)	$\delta 0$	-0.319	0.661	-0.482
Age (Z1)	$\delta 1$	0.102	0.126	0.815
Level of Education (Z2)	$\delta 2$	-0.049	0.075	-0.662
Farming experience (Z3)	$\delta 3$	0.026	0.083	0.309
Membership to coopera-tive society (Z4)	$\delta 4$	0.203	0.109	1.959*
Farm size (Z5)	$\delta 5$	0.180	0.080	2.250**
Access to credit (Z6)	$\delta 6$	-0.067	0.069	-0.973
Extension contact (Z7)	$\delta 7$	0.024	0.007	3.314***
Gender (Z8)	$\delta 8$	0.178	0.098	1.955*
Household size (Z9)	$\delta 9$	0.276	0.189	1.453
Diagnostic statistics				
Sigma-squared	(δ^2)	0.037	0.007	5.689***
Gamma(γ)		0.797	0.355	2.246**
LR test		16.637		
Log-likelihood functions	15.021			

Source : Computed from survey data, 2004.
Note: ***, **, *indicates statistically significant at 1, 5 and 10%, respectively

The estimated coefficient for membership of cooperative society is positively signed and statistically significant at 0.1 level (10%), which conforms to a-priori expectations. The number of associations a farmer belongs to is expected to influence his interactions positively with his fellow farmers and enhances the possibility of accessing agricultural credit. In essence, if resources are properly mobilized and channeled, farm association will have great potentials for contributing positively to farmers level of technical efficiency.

Farm size estimated coefficient is positive which conform to a-priori expectations and significant at 0.05 level. Therefore the 0.180 elasticity of farm size implies that a 1% increase in farm size, ceteris paribus would lead to an increase of 0.180 % in the level of technical efficiency. Abaelu (1983) however stressed that significant reduction in cost per naira of revenue arising mainly from technical economies was reported for large (medium) size farms when compared with small farms.

The coefficient for extension contact is positive and statistically significant at the 0.01 probability level, which conform to a-priori expectations. It indicates that group of farmers who had more extension contact and teachings tend to be more technically efficient than those with fewer or no contact. Extension contact however will provide farmers with the opportunity to learn improved technologies, new techniques of farming and more so how to acquire needed inputs and services.

The coefficient for gender variable was positive as expected and significant at 0.1 probability level. This however suggests that male farmers who are in majority are relatively more efficient than their female counterparts. The estimated coefficient is 0.178.

The results showed that 50 % of the sampled farmers have technical efficiencies ranging between 0.41 to 0.60. The technical efficiency estimates are widely distributed across the respective rabbit farmers Table 2. The minimum technical efficiency value was 36% indicating that some farmers are located far from the frontier region while the maximum technical efficiency value was 92% indicating that some farmers are very close to the frontier region. The mean technical efficiency value of 62% however portrays that there is a wide opportunity for the rabbit farmers to increase their current level of technical efficiency.

This analysis however imply that it will take an average rabbit farmer (1- 0.62/0.92) which equals 33% cost saving to become the most efficient rabbit farmer on the sampled ten group while the worst performing rabbit farmers(1-0.35/0.92) would need 61 % cost saving to become the most efficient rabbit farmer in the worst 10 sampled group.

Elasticity of production and returns to scale for rabbit enterprise: With respect to labour, feeds and feed supplements, feeder livestock, capital inputs, farm size, a one unit change brings about a change in the same direction of 0.258, 0.307, 0.330, 0.028 and 0.375 while drugs and medication input brings a change in the opposite direction of 0.054. from the overall production elasticity result, rabbit farmers in the study area are operating at Increasing Returns to Scale (IRTS)of 1.243, which implies that they are in stage one of the classical production function Table 3.

This however shows that the relevant inputs are underutilized and it is ideal to keep increasing the level of inputs used. The rabbit farmers are not using their resources efficiently.

Policy options and recommendations: However, the following policy options will be delineated on the basis of which recommendations have been made. These include:-

- Enacting policy that would attract educated and young people into rabbit production. There is need to have education policy that would encourage operators of the rabbit enterprise to undergo literacy and training programs. Workshops, adult education seminars and similar meetings should be encouraged. Policy that would encourage experience farmers to remain in rabbit farming should be put in place.Experience is expected to increase technical efficiency all things being equal.

Table 2: Frequency distribution of technical efficiency estimates of rabbit farmers

Technical efficiency range	Frequency	Percentage
0.10-0.20	0	0
0.21-0.40	3	3
0.41-0.60	30	50
0.61-0.80	20	33.33
0.81-0.90	5	8.33
0.91 1.00	2	3.33
Total	60	100.00
Maximum technical efficiency	= 0.92	
Minimum technical efficiency	= 0.35	
Mean technical efficiency	= 0.62	
Mean of worst 10	= 0.43	
Mean of best 10	= 0.82	

Source: Computed from survey data, 2004

Table 3: Distribution of production elasticities among variables for rabbit enterprise

Variables	Estimated values
Labour	0.258
Feeds and feed supplements	0.307
Drugs and medication	-0.054
Feeder livestock	0.330
Capital inputs	0.028
Farm size	0.375
Sum of elasticities	1.243

Source: Computed from survey data, 2004

- Most traditional settings in Nigeria currently favour male farmers more than the female farmers. In most cases women do not have equal access to facilities like their male counterparts. Therefore policy that would encouraged farm production by females through equal or even more access to credit, extension and inputs such as feeds and feed supplements, drugs and vaccine, utilities should be encouraged.
- Farmers should be encouraged to belong to farm cooperative societies. In essence, several loans are disbursed through cooperative societies. More so policy that would promote credit should be rightly provided.
- Policy potions should be made to encourage extension agents through providing incentives such as in-service courses or training, technical aid corps program and improved salary be made available to them to improve their services.
- There is need to direct more research into the development of feed stuffs that are cheaper and rich in concentrates. Species of these livestock that are more efficient food converters should be encouraged.

CONCLUSIONS

The study has presented measures of technical efficiency of rabbit enterprise in Akwa Ibom State of Nigeria. The analysis revealed average levels of technical efficiency in the enterprise which was low. The results however suggest that substantial gains could be enhanced through good and adequate utilization of improved livestock inputs and recommended rabbit production technologies. Although the prices of variable inputs were on the increase, effective management of the available resources could lead to an improvement in the profit margin and output in the enterprise.

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