DETERMINANTS OF ECONOMIC EFFICIENCY OF MUSHROOM PRODUCTION IN ABIA STATE: A TRANSLOG STOCHASTIC FRONTIER PROFIT FUNCTION APPROACH

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ABSTRACT
This study employed a translog stochastic frontier profit function to measure the level and determinants of economic efficiency in Mushroom Production. A multi-stage randomised sampling technique was used in selecting 30 mushroom farmers from each of the three Agricultural Zones of Abia State. A well-structured questionnaire was used to collect input/output data and their prices using the cost route approach. The result of the analysis showed that the mean farm level economic efficiency was about 85%. The Translog stochastic profit function first order parameter depicted that profit increase with price of labour input and farm size and decreased with capitalinputs. Similarly, age, education and membership of cooperative society positively influenced efficiency.

INTRODUCTION

Mushroom is an edible fungi, it belongs to the genus known as fungi. They are classified based on edibility and shape of the fruit body. Mushroom has been widely cultivated as food since the 1700's and presently more than 30 known species are cultivated as food. Total world production of edible mushroom in 2006 was 26mt and 33.4mt in 2007 (Celik and Reker 2009). Mushroom cultivation has various advantages: It is easy to propagate due to Its numerous spores; utilizes a large variety of agricultural waste such as cotton waste, wood waste, rice bran etc (Ibekwe et al., 2008)

Mushroom has also been successfully used in the bioremediation of polluted environment (Stamet, 1993). In Nigeria, mushroom production capacity may not be statistically ascertained but mushroom production is just beginning to catch up with other crops especially in big cities. In Abia State especially, mushroom cultivation was incorporated into the Agricultural Development Programme (ADP) in the year 1993 as one of the integral products of Agro-forestry component. Presently, over 300 farmers engage in mushroom cultivation across the Abia Agricultural Zones comprising of seven local government areas. Farm efficiency no doubt is an important subject in developing countries agriculture (Pakleh et al, 1995 and Hazarika and Subramanian, 1999).

Efficient use of farm resources is an important part of agricultural sustainability. One way peasant farmers can achieve sustainability in agricultural production is to raise the production of farmers, by improving efficiency within the input of existing resource base and technology (Ajibefun 2004). Farrell 1957 provided the impetus for developing the literature on empirical estimation of technical, allocative and economic efficiency. Among the approaches used in measuring efficiency, stochastic frontier approach has been used extensively in measuring the level of inefficiency/efficiency. Aigner et al (1977) and Meausen and Broeck (1977) independently proposed the stochastic frontier model. The stochastic frontier approach is preferred for assessing efficiency in agriculture because of the inherent stochastic involved. (Kirkley et al., 1995 and Coelli et al., 1998)

Economic efficiency however depends on market forces, which in turn are influenced by the sectoral and marketing policies of the country. However, economic efficiency was measured based on the estimation of a Translog profit function in which certain restriction were imposed (Ali et al, 1990). Empirical literature has shown that efficiency could be measured from production function or a profit function approaches. The profit function is much more helpful when individual& sole enterprises are considered.

METHODOLOGY

The theoretical model

The stochastic frontier profit function is specified thus:

$\pi^*=\pi/p= f_i^*(r_i z)\ exp_i$ 1

Where

π = Normalized profit of the ith farm

r_i = Vector of variable inputs

z = Vector of fixed inputs

e_i = Composed error term

The transcendental logarithmic model for estimating economic efficiency of mushroom farmers is specified thus:

$\ln \pi^* = \ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + 0.5\beta_6 \ln X_1^2 + 0.5\beta_7 \ln X_2^2 + 0.5\beta_8 \ln X_3^2 + 0.5\beta_9 \ln X_4^2 + 0.5\beta_{10} \ln X_5^2 + \beta_{11} \ln X_1 \ln X_2 + \beta_{12} \ln X_1 \ln X_3 + \beta_{13} \ln X_1 \ln X_4 + \beta_{14} \ln X_1 \ln X_5 + \beta_{165} \ln X_2 \ln X_3 + \beta_{16} \ln X_2 \ln X_4 + \beta_{17} \ln X_2 \ln X_5 + \beta_{18} \ln X_3 \ln X_4 + \beta_{19} \ln X_3 \ln X_5 + \beta_{20} \ln X_4 \ln X_5 + V_i - U_i$ 2

Where;

π= Normalized profit in Nara per farm

X_1 = normalized price of labour inputs in ₦/per man day

X_2 = normalized price of spawn in Naira per kg

X_3 = land rent in naira/ha

X_4 = price of capital (Depreciation) in Naira

X_5 = normalized price of cassava peels in Naira per 25kg

β_o = intercept

β_1-β_{20} = Parameters to be estimated.

Vi-ui = Error terms

The choice of translog stochastic profit function was based on its inherent advantage as well as suitability in estimating sole enterprise and analyzing interactions among inputs. The determinants of economic efficiency were modeled in terms of the socio-economic variables of the farmers specified as follows

Exp. $(-U_i)$ = $b_o + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5xb_5 + b_6x_6 + e$................................ (3)

Where;

Exp. $(-U_i)$ = Economic efficiency of the ith farm

$X_{.j}$= Age of farmer (years)

X_{2j} = Level of Education (years)

X_{3j} = Farm size (hectare)

X_{4j} = Farming experience (years)

X_{5j} = Membership of Cooperative Society (dummy variable; member=1, non member=0)

X_{6j} = Farming experience (year)

b_o, b_1, b_2. – $b_{6\ =}$ parameters to be estimated.

The coefficient of unknown parameters are to be estimated by the method of maximum like had using the computer software programme frontier
Version4.1 (Coelli,1996).

Data

The study was conducted in Abia State. Abia state lies between longitude 04˚45 North and 07˚00 East. The state is situated in the south-eastern part of Nigeria. It is made up of 17 local governments with a total land mass of 5,833,775 square kilometers. The state has a relatively high population density of about 580 persons per square kilometer (Abia 2005) it has a population of 2,833,999 persons according to the national Census (NPC, 2007) the Climate is tropical and humid all year round with annual range from 2000mm- 3000mm.

This favors the cultivation of mushroom as it requires high rainfall and relative humidity. The temperature ranges between 22˚C - 31˚C (World Bank Report, 2000). The vegetation is predominantly low land rainforest. The major crops grown are arable crops such as cassava, rice, yam, vegetables and melon. Other farming activities include goat and sheep keeping, poultry and rabbit keeping, homestead fish farming, bee keeping, snail farming and other off-farm activities. Multistage sampling technique was used for the study; the three agricultural zones were purposively selected for the study. They are Aba, umuahia and ohafia agricultural zone. The second stage involved a simple random selection of 30 mushroom farmers from each agricultural zone which gave a total of 90 mushroom farmers.

RESULTS AND DISCUSSION

Economic efficiency in this study refers to profit efficiency, which is the ability of the farmer to attain the highest possible profit given the prices and levels of fixed factors of the farm (Ali and Flinn 1998) and Onyenweaku and Effiong (2005). The maximum likelihood estimates of transcendental stochastic profit function parameters are presented in Table 1.The variables; price of labour and land rent have positive coefficients and are statistically significant at 10.0% probability level indicating direct relationship between these variables and profit . However, the sign of the coefficient for depreciation on fixed inputs was negative and statistically significant at 1.0% level of probability. This depicts that decreased expenditure on farm tools would increase profit. The coefficient of price of spawns and price of cassava peels are positively and negatively sined but not significant.

The diagnostic statistics of the transcendental profit function showed a total variance ratio of 0.27, which is statistically significant indicating goodness of fit and correctness of the specified distribution assumptions of the composite error. However, the estimated of the variance ratio was 0.95 indicating that 95% of the disturbance in the system is due to inefficiency. The result of the parameters of economic efficiency from this study is in line with previous studies. The negative and statistically significant with economic efficiency of depreciation is similar with the findings of Nwachukwu and Onyenweaku, (2007)

Table1. Maximum Likelihood Estimates of the Translog Stochastic Profit Function

Production factors	Parameter	Coefficient	standard error	t-value
Constant Term	β_0	19.753	1.090	18.127***
Price of labour input	β_1	1.479	0.942	1.570*
Price of spawns	β_2	0.026	1.052	0.025
Land rent	β_3	1.541	0.786	1.961*
Depreciation	β_4	-3.370	0.821	-4.105***
Price of cassava peels	β_5	-1.445	0.992	-1.457
Price of labour input^2	β_6	-0.245	0.541	-10.449
Price of spawns^2	β_7	-0.899	0.553	-1.618*
Land rent^2	β_8	-0.021	0.036	0.571
Depreciation ^{2}	β_9	0.185	0.080	2.312**
Price of cassava peels^2	β_{10}	-0.534	0.145	-3.682***
Price of labour X price of spawns	β_{11}	0.002	0.501	0.003
Price of labour X Depreciation	β_{12}	0.001	0.088	0.014
Price of labour X Land rent	β_{13}	-0.083	0.148	-0.564
Price of labour X Price of Cassava peels	β_{14}	0.137	0.020	0.679
Price of spawns X Land rent	β_{15}	-0.321	0.103	-3.117***
Price of spawns X Depreciation	β_{16}	0.408	0.156	2.602**
Price of spawns X price of cassava peels	β_{17}	0.199	0.252	0.787
Land rent X Depreciation	β_{18}	0.044	0.022	2.195**
Land rent X price of cassava peels	β_{19}	-0.054	0.045	-1.189
Depreciation X price of cassava peels	β_{20}	0.141	0.057	2.471**
Efficiency factors				
Intercept	b_0	-2.662	1.17	-2.28**
Age	b_1	0.020	0.01	1.63*
Education	b_2	0.120	0.04	2.33**
Farm size	b_3	-8.238	4.62	-1.78*
Farming experience	b_4	-0.113	0.08	-1.36
Membership of Cooperatives	b_5	0.532	0.26	2.04**
Length of training	b_6	-0.089	0.07	1.27
Diagnostics statistics				
Log –likelihood function		21.943		
Total variance	σ^2	0.269	0.08	3.33***
Variance ratio	Υ	0.945	0.03	37.16***
L – R Test		27.073		

Source: Computed from survey Data 2008

*****, ***, * are significant levels at 1.0%, 5% and 10% level respectively.**

Determinants of Economic Efficiency

The estimated determinants of economic efficiency of mushroom production in Abia State are presented in Table 1. The coefficient of the farmer's age was positive and statistically significant at 10% level which disagrees with a prior expectation that decreasing age leads to decreased efficiency since ageing farmers would be less energetic to work in the farm (Abaelu, 1998 and Akinsani, 1975)

This result disagrees with that of Bravo-Ureta and Pinheiro (1997). The coefficient of education was positive and statistically significant at 5% level indicating direct relationship between education and economic efficiency. Education increase productivity as well as enhancing farmer's ability to understand and evaluate new production techniques (Onyenweaku and Effiong, 2004).

The coefficient of farm size was negative and statistically significant at 10% level. This indicates that mushroom farmer with small farm sizes were more efficient than their counterparts with large farm sizes. This result agrees with ShultZ (1999) who reported that small scale farmers are more efficient than large scale farmers. Farmers in the study area have farm holdings less than 1ha. The coefficient of farming experience was negative but statistically not significant as well as length of training which was positively signed.

The results of the frequency distribution of economic efficiency in mushroom production are shown in table 2.

Table 2. Frequency distribution of economic efficiency for mushroom farmers in Abia State

Economic Efficiency Range	**Frequency**	**Percentage**
< 0.60	2	5. 56
0.61 – 0.70	2	2. 22
0.71 – 0.80	13	14. 44
0.81 – 0.90	29	32. 22
0.91 – 1.00	41	45. 56
Total	90	100
Maximum Economic Efficiency	0.98	
Minimum Economic Efficiency	0.33	
Mean Economic Efficiency	0.85	
Mean worst 10	0.58	
Mean best 10	0.95	

Source: Computed from field survey Data, 2008

Individual economic efficiency indices range between 33.17% and 98.50% with a mean of 85.28%. About 93.34% of the mushroom farmers have an economic efficiency index above 70%. The high levels of economic efficiency obtained in the study are consistent with the low variance of the farm effect which implies that the stochastic frontier profit function and the average profit function are expected to be quite similar following Onyenweaku and Effiong (2004). The result indicates that the percentage of the frontier farmers is 84.45%, which indicates that they are more or less profit maximizers while the non-frontier farmers are represented by 15.55. This result differs from that of Nwachukwu and Onyenweaku (2007) who showed that only 4.0% of the fadamaTelfaira farmers operate almost on the frontier while 45.33% are non-frontier farmers. For the average best frontier farmer to attain the level of the best frontier farmer in the groups he would require a cost saving of 13.27% (1 – 0.85/0.95 *100) while the least farmer require a cost saving of 66.33% (1 – 0.33/0.98*100). The result also suggests that there are still opportunities to increase profit through increased efficiency in resource utilization.

CONCLUSION

The study revealed that mushroom farmers are not fully economically efficient. The individual farm level economic efficiency in mushroom production in Abia state range from 33% to 98% with a mean of 85%. This indicates that opportunities exist for increasing income and profit of the farmers through increased economic efficiency. The study showed that age, education and membership of cooperative society positively influenced economic efficiency while farm size and farming experience have negative influence on economic efficiency. The results therefore call for policies and programs that would improve the effectiveness of extension services to educate and train farmers on improved mushroom production techniques. Also farmers should be encouraged to form cooperative societies. This will help them to realize certain benefits such as capital inputs, technical and economic information which enhances productivity.

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