Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 16, Issue 1, 2016
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ANALYSIS OF THE TECHNICAL EFFICIENCY OF SNAIL FARMERS IN ABIA STATE, NIGERIA

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Abstract

Assessing the relative performance of the processes used in transforming given inputs into output is key to increasing agricultural productivity and enhancing food security and income. This study therefore examined the technical efficiency of snail farmers in Abia State, Nigeria. Simple random sampling technique was used in selecting the respondents used for the study. Primary data, collected using structured questionnaire were analyzed using descriptive statistical tools and maximum likelihood estimation procedure using the computer software frontier version 4.1. Results showed that the significant factors influencing output of the snail farmers were stock size, labour, feed and capital. The significant determinants of technical efficiency of the snail farmers were age of the farmer (P = 0.05), educational attainment (P = 0.05), farming experience (P = 0.01), extension contact (P = 0.05), and cooperative membership (p = 0.01). The result also showed that majority (52%) of the snail farmers have an efficiency of between 61 – 80%, with the least efficient and most efficient farmers having efficiencies of 41.6% and 99.9% respectively. The mean level of efficiency was 75.6%. It was recommended that in order to enhance the efficiency and thus productivity of snail farms, policies that would encourage the youths to go into farming should be put in place. In addition, educational and training programmes should be organized regularly for the farmers as well as strengthening the extension services delivery system to provide the farmers the needed information on improved farming practices and innovations.

Key words: *distribution, sources, snail farm, technical efficiency*

INTRODUCTION

Despite of the significant progresses made in the agriculture in the past decade, poverty and malnutrition continue to be major problems in Sub-Saharan Africa [21]. The [36] reported that Africa still lags far behind national overall economic growth, with per capita agricultural incomes expanding at less than 1 percent per year during 2000–09. [21] noted that in Sub-Saharan Africa, agricultural production increased to 12.3 percent of gross domestic product in 2009 and yet, 72.9 percent of the population live on less than US$2 per day, 27.5 percent consume inadequate calories, and 23.6 percent of children under five are underweight. Fostering agricultural growth is often seen as being central to development strategies aimed at reducing poverty and hunger in the region [34].

In Nigeria, the agricultural sector is of notable relevance in the country's economic development and growth. It has been described as the engine room for sustainable growth of Nigerian economy [31]. It contributes more than the 48% of the total annual GDP (gross domestic product), employs and provides over 80% of the food needs of the country [1]. Despite these notable roles, food insecurity ranks top most among the developmental challenges facing Nigeria [7]. According to [23], some 200 million or 28 percent of Africa's population are chronically hungry. Of note is the low intake of protein by most Nigerians. An average Nigeria diet contains 7gm/caput/day of animal protein as against the recommended intake of 28gm/caput/day for normal health [25, 13, 20]. This represents a gross shortfall of 70 percent and has predisposed many Nigeria to malnutritional disease.

The economic utility for animal protein supplies is best assessed by the ability of species as a whole to produce consumable food protein. Snails as a species have an inherently high reproductive rate. Thus, [30] stated that the commercial production of snails can be seen as an honest approach towards realizing improved meat protein intake in Nigeria.

Snail meat (Congo meat) is high in protein, iron, calcium and phosphorus, but low in sodium, fat and cholesterol, and also contains almost all the amino acids needed by man [4, 11, 2, 6]. The major species of snail reared in the study area are *Archatina archatina* and *Archatina marginata*.

The protein content of snail meat to be 37-51% compared to that of a guinea pig (20.3%), poultry (18.3%), cattle, (17.5%) sheep (16.4%) and swine (14.5%). The iron content is 45-59mg/kg, low in fat (0.05-0.08%) in addition to containing almost all the amino acids needed for human nutrition, as reported by [12].

The non-edible parts, the visceral and the shell which represent at least 40% of the snail's weight can be recuperated for feeding monogastric animals. Substances from snail cause agglutination of certain bacteria. This could be of value against a variety of ailments like whooping cough [9]. Also the low fat content and low cholesterol level makes snails meat a good antidote for vascular diseases such as hypertension and heart attack. The shell of snail are used in production of buttons, ring, jewelleries and other ornaments and for decoration of walls.

It has been noted that increasing agricultural productivity can increase food availability and access as well as rural incomes as rural areas are home to 75 percent of Africa's population, most of whom count agriculture as their major source of income. As noted by [21], future sustainable agricultural growth in most countries will require a greater emphasis on productivity growth. One key way of ensuring productivity growth is through efficient utilization of inputs. With the difficulties encountered by farmers in developing countries for developing and adopting improved technologies due to resource poverty. [5] noted that efficiency has become a very significant factor in increasing productivity. The concept of efficiency is concerned with the relative performance of the processes used in transforming given inputs into outputs [15]. Technical efficiency shows to the ability of firms to employ the "best practice" in an industry so that not more than the necessary amount of a given sets of inputs is used in producing the "best level of output [8]. It is the ability of a farmer to achieve a given level of output from a minimum set of input. A farm firm is said to be technically efficient if it is producing maximum output from the minimum quantity of inputs, such as labour, capital and technology.

Given the above scenario, it has become pertinent and indeed imperative to analyze the current level and determinants of technical efficiency among snail farmers in Abia State, Nigeria. Thus, the study would guide policy makers in formulating appropriate policies aimed at raising the present level of efficiency, given the fact that efficiency of production is directly related to the overall productivity of the farm.

MATERIALS AND METHODS

Study area: The study was conducted in Abia State of Nigeria. Abia is a State in South Eastern Nigeria. It is located between latitude 4^o 40^I and 6^o 14^I North of the equator and longitudes 7^o 10^I and 8^o O^1 East of the equator. Abia has a total land area of 5,243.7 km^2, approximately 5.8% of the land area of Nigeria. It has a total population of 2,833,999 inhabitants from the 2006 population census, with a population density of 448.4/km^2 [24, 35]. It shares common boundaries to the North with Ebonyi State; to the South and Southwest with Rivers State; and to the East and Southeast with Cross River and Akwa Ibom States respectively. To the West is Imo State and to the Northwest is Anambara State. The State is made up of 17 Local Government Areas, divided into three agricultural zones namely: Ohafia, Umuahia and Aba Agricultural Zones. Agriculture is the major economic sector of the rural inhabitants.

Simple random sampling technique was adopted in selecting the samples used for the study. The list of snail farmers in the State was collected from State Agricultural Development Programme. This was updated by including snail farmers whose names were not in the list. These farmers were got though the help of key informants during the pre-test of the survey instrument. The updated list formed the sampling frame from which a total of 100 snail farmers were selected randomly for the study.

Primary data was used for the study. The data were collected using structured questionnaires administered to the respondents. However, only 97 questionnaires were retrieved and 95 were found useful and used for the study. The data relates to the 2014 production season. Data collected were on inputs and output and their respective prices and on the socioeconomic characteristics of the respondents. Data analysis was by estimation of stochastic frontier production model.

Theoretical concept: Technical efficiency results when maximum output is obtained from a given combination of resources (ability to produce at the production frontier) [3]. A stochastic frontier production function is given as:

Yi = f (Xi; β) exp. (Vi – Ui), i = 1, 2, …, n (1)

where Yi is the output of the i-th farm, Xi is the vector of input quantities used by the i-th farm, β is a vector of unknown parameters to be estimated, f( ) represent an appropriate function such as Cobb-Douglas, translog, etc; Vi is a symmetric error accounting for the effect of random variations in output due to factors beyond the control of the farmer e.g. weather, diseases outbreaks, measurement errors, etc. Vi is assumed to be independently and identically distributed as N (O, δv2) random variables independent of the Uis which is a non-negative random variable representing inefficiency in production relative to the stochastic frontier. The Uis are assumed to be non-negative truncations of the N (O, δv2) distribution (i.e. half normal distribution) or have exponential distribution. The stochastic frontier model was independently proposed by [22] and [3]. Its major advantage is that it provides numerical measures of technical efficiency. The technical efficiency of an individual farmer is defined in terms of the ratio of the observed output to the corresponding frontier output given the available technology.

Technical efficiency (TE) = Yi/Yi* = f (Xi; β) exp. (Vi – Ui)/ f (Xi; β) exp. (Vi) = exp (-Ui) (2)

where Yi is the observed output and Yi* is the frontier output and other parameters were as previously defined. The parameters of the stochastic frontier models are estimated using the maximum likelihood techniques [3].

Empirical model

The production function of the snail farmers was assumed to be represented by a Cobb-Douglas stochastic frontier production function and was specified as follows:

$$InY = \beta_0 + \beta_1 In\ X_1 + \beta_2 In\ X_2 + \beta_3 In\ X_3 + \beta_4 In\ X_4 + \beta_5 In\ X_5 + V_j - U_i \quad (3)$$

where In is the natural logarithm, β_0 is the intercept, β_1 to β_5 are the parameters estimated, Y is the value snails sold (naira), X_1 is the stock size (number), X_2 is labour in mandays, X_3 is cost of medication (naira), X_4 is feed (kg), X_5 is capital (made up of capital consumption allowance, interest charges, rent, etc) (naira), and other variables were as previously defined in equations (1) and (2).

In order to determine the factors contributing to technical efficiency, the following model was formulated and estimated jointly with the stochastic frontier production function in a single stage maximum likelihood estimation procedure using the computer software frontier version 4.1 [10]:

$$TE = a_0 + a_1Z_1 + a_2Z_2 + a_3Z_3 + a_4Z_4 + a_5Z_5 + a_6Z_6 + a_7Z_7 + a_8Z_8 + a_9Z_9 \quad (4)$$

where: TE_i is the technical efficiency of the i^{th} farmer, Z_1 is the age of the farmer (in years), Z_2 is gender (a dummy which takes the value of unity for male and zero for female) Z_3 is household size, Z_4 is farmer's level of education in years, Z_5 is years of farming experience, Z_6 is number of extension contact made by the farmer in a year, Z_7 is stock size (number), Z_7 is membership of farmers association or cooperative society (a dummy which takes the value of unity for members and zero if otherwise), Z_8 is access to credit (a dummy which takes the value of unity for access and zero if otherwise), and a_1, a_2, a_3, ..., a_9 are regression parameters estimated. It was expected *a priori* that a_1 and a_2 would be negative while the others would be positive.

RESULTS AND DISCUSSIONS

Socioeconomic profile of the respondents

The socioeconomic characteristics of respondents are were summarized and presented in table 1. Table 1 showed that majority (69%) of the farmers were aged between 35 – 54 years of age. The mean age of the snail farmers was 45.6 years. This implies that the farmers are still reasonably energetic to cope with the daily demands of snail farming. Also, more males are involved in snail farming than females.

Table 1. Socioeconomic characteristic of the respondents

Socioeconomic factor	Frequency	Percentage	Mean
Age			
25 – 34	12	12.63	
35 – 44	27	28.42	
45 – 54	42	44.21	
55 – 64	14	14.74	45.6
Gender			
Male	58	61.05	
Female	37	38.95	
Marital status			
Single	16	16.84	
Married	57	60.00	
Widowed	22	23.16	
Educational attainment			
Primary	22	23.16	
Secondary	36	37.89	
Tertiary	37	38.95	
Household size			
1-3	14	14.74	6
4-6	50	52.63	
7-9	31	32.63	
Farming experience			
1-3	29	30.53	5
4-6	38	40.00	
7-9	19	20.00	
10-12	9	9.43	
Membership of cooperative			
Member	46	48.42	
Non-member	49	51.58	
Extension contacts			
Had contact	50	52.63	
Had no contact	45	47.37	

Source: Field Survey data, 2014.

Table 1 showed that 60% of the respondents were married. This implies that the households were stable. The educational distribution of the respondents showed that the snail farmers were literate. This is desirable because according to [29], the level of education of a farmer not only increases his farm productivity but also enhances his ability to understand and evaluate new production techniques. This is given the fact that snail farming requires skills.

The mean household size of the respondents was 6 person per household. This posit positive implications for increased snail productivity as households rely more on members of their households than hired workers for labour on their farms. The result showed that the mean farming experience was 5 years. This means that commercial snail farming is relatively being embraced of recent in the area. According to [15, 17] and [27], the number of years a farmer has spent in the farming business may give an indication of the practical knowledge he has acquired on how he can overcome certain inherent farm production problems.

About 48.42% of the respondents were members of cooperative/farmers association while 52.63% had extension technical services. [16] noted that as change agents, extension workers serve as channels for diffusion of technical innovations.

Technical efficiency of Snail farmers

The maximum likelihood (ML) estimates of the Cobb-Douglas production function of the snail farmers is summarized and presented in Table 2. The estimated variance (δ^2) for these snail farmers is statistically significant at 1 percent indicating the goodness of fit and correctness of the specified distribution assumption of the composite error. Gamma (γ) being 0.602 is statistically significant at 1 percent. These imply that 60.2 percent of the variations in value of output is due to technical efficiency. The coefficients of stock size, labour, feed and capital were all statistically significant at 1% level of significance.

Table 2. Production function of the snail farmers

Variable	Parameter	Coefficient	t - ratio
Intercept	$\beta1$	0.497	5.885***
Stock size	$\beta2$	0.337	18.897***
Labour	$\beta3$	0.001	-3.040***
Medication	4	0.004	0.252
Feed	5	0.032	3.195***
Capital	7	0.038	2.758***
Diagnostic statistics			
Sigma squared	δ^2	0.477	5.748***
Gamma	γ	0.602	5.162***
Likelihood function		47.414	

Source: computed from Frontier 4.1 MLE/Survey data, 2014
Note: *** indicates statistically significant at 1% level of significance.

The coefficient of stock size was positively signed, showing a direct relationship with output. This implies that output increases as the size of stock increases. On the other hand labour was negatively signed indicating an inverse relationship with output. Labour here refers to the available human effort for use in snail production. The negative relationship between labour and output may have resulted due to increased use of labour beyond the point of economic optimum (that is, to the point of its diminishing returns). This may be the case when labour is supplied by members of the household and therefore not paid for.

The coefficients of feed and capital were both positively signed indicating that increase in these variables, ceteris paribus, would lead to increase in output.

Sources of technical efficiency

The estimated determinants of technical efficiency of the snail farmers in Table 3. The coefficients education, farming experience, extension contact, and cooperative membership were significant and positive, while age was negative.

Table 3. Determinants of technical efficiency of the snail farmers

Variable	Parameter	Coefficient	T-ratio
Intercept	a_0	0.927	5.112***
Age	a_1	0.001	--2.460**
Gender	a_2	-0.007	-0.126
Household size	a_3	0.121	1.370
Years of education	a_4	0.040	2.440**
Experience	a_5	0.008	3.514***
Extension contact	a_6	0.148	2.003**
Stock size	a_7	-0.412	0.998
Cooperative membership	a_8	0.422	2.613***
Access to credit	a_9	0.001	1.110

Source: computed from Frontier 4.1 MLE/Survey data, 2014

Note: ***, **, and * indicates statistically significant at 1%, 5% and 10% level of significance respectively

The coefficient of age was significant at 5% and negatively related to technical efficiency. This implies that the efficiency of the snail farmers decreases as the farmer gets older. This result with respect to age is consistent with a priori expectation and [19], [17], [26], and [14]. [14] explained that the order a farmer becomes, the more he is unable to combine his resources in an optimal manner given the available technology . [18], [19] and [27] stated that the risk bearing abilities and innovativeness of a farmer, his mental capacity to cope with the daily challenges and demands of farm production activities and his ability to do manual work decrease with advancing age. This explains the negative relationship between age and technical efficiency. In this guise, the youth should be encouraged to take up farming generally and in particular snail farming so as to achieve the goal of increased agricultural productivity.

The coefficient of years of educational attainment was significant at 5% level of significance and negatively related to technical efficiency. This result is consistent with those of [19], [17], [33], and [32] and implies higher educational attainment enhances the efficiency of the farmers. According to [19] and [18], education increases the ability of the farmers to adopt agricultural innovation and hence improve their efficiency and productivity. Educating the farmers is of great importance as snail farming requires technical skills. Therefore, education and training programmes should be organized for these farmers to enable them acquire the necessary skills for the operations as snail farmers.

The coefficient of years of farming experience was significant at 1% level of significance and positively related to technical efficiency. This implies that the higher the experience of the farmer, the greater his efficiency. This result conforms to a priori expectations. According to [27], the number of years a farmer has spent in the business of farming may give an indication of the practical knowledge he has acquired on how to overcome certain inherent farm production problems. Also of note is the assertion that farmers will count a lot more on their farming experience for increased productivity and efficiency.

The coefficient of extension contact was significant at 1% level of significance and positively related to technical efficiency. This implies that increased extension contact increases technical efficiency. Extension services provide informal training that helps to unlock the natural talents and inherent enterprising qualities of the farmer, enhancing his ability to understand and evaluate new production techniques leading to increased farm productivity and incomes with concomitant increase in the welfare of the farmer [28]. [17] stated that farmers' interactions with extension agents would help them to receive and synthesize new information on economic activities in his locality and beyond.

The coefficient of cooperative membership was significant at 1% level of significant at positively related to the technical efficiency of the snail farmers. This implies that farmers who belong to cooperatives/farmers association has higher efficiency than non-members. Cooperative societies/ farmers' associations are sources of good quality inputs, labour, credit, information and organized marketing of products. According to [32], members of cooperative societies have enhanced ability to adopt innovations than non-members.

Distribution of technical efficiency for the snail farmers

The frequency distribution of the technical efficiency of the snail farmers is summarized and presented in Table 4. According to the Table, the individual technical efficiency indices ranges from 0.416 to 0.999 with a mean of 0.756. Majority (52%) of the snail farmers have efficiency of between 61 – 80%. The level of technical efficiency obtained in this study suggests that ample opportunities exist for the snail farmer to improve on their efficiency and hence productivity and income

Table 4. Technical efficiency distribution for the snail farmers

Range of efficiency	Frequency	Percentage
0.41 – 0.60	14	14.74
0.61 – 0.80	52	54.75
0.81 – 1.00	29	29.00
Minimum efficiency	0.416	
Maximum efficiency	0.999	
Mean efficiency	0.756	

Source: computed from Frontier 4.1 MLE/Survey data, 2014

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