Nigerian J. Anim. Sci. 2020, 22 (1): 233-240

Analysis of the determinants of technical efficiency of snail farmers in Ogun State, Nigeria

***[1]Aminu, F.O., [2]Edun, T.A. and [1]Abiodun, G.T.**

[1]Department of Agricultural Technology, School of Technology, Yaba College of Technology, Epe Campus, P. M. B. 2011, Yaba, Lagos State, Nigeria
[2]Department of Agricultural Education, School of Vocational and Technical Education, Adeniran Ogunsanya College of Education, Oto/Ijanikin, P. M. B. 007, Festac Town, Lagos State, Nigeria

****E-mail:** folaafe02@gmail.com*

***Target Audience:** snail farmers; micro livestock professionals and policy makers*

Abstract

The study examined the technical efficiency of snail farmers in Ijebu East Local Government Area of Ogun State, Nigeria. A two-stage sampling method was used in selecting the respondents for the study. Primary data collected with the aid of questionnaire were analyzed using descriptive statistics and stochastic frontier production function. The results revealed that majority (63.3%) of the snail farmers were male with a mean age of about 42 years, literates (88.3%) married (65%) with a mean household size of 6 people. The significant factors influencing output of the snail farmers in the study area were stock size ($p<0.01$), family labour ($p<0.05$) and feed ($p<0.05$). The significant determinants of technical efficiency of the snail farmers were age of the farmer ($p<0.05$), educational status ($p<0.01$), snail farming experience ($p<0.05$), extension contact ($P<0.01$), total income ($p<0.01$) and nature of farming ($p<0.01$). The result also showed that majority (55%) of the snail farmers had an efficiency level of between 61 – 80%, with a mean efficiency level of 0.615. This indicated that an average snail farmer could increase efficiency level by 38% subject to good input usage in the study area. The study recommended that extension services should be fortified to organise educational workshops, training and timely dissemination of information on snail farming technologies so as to enhance the efficiency and productivity of the snail farmers in the study area.

***Keywords:** Determinants, stochastic frontier, technical efficiency, snail farmers*

Description of Problem

Snail (*Archatina achatina* and *Archachatina marginata)* belong to the family of Archatinidae, a group of large land snails that originated from Western, Eastern and South Africa with long slender shells (1). This family of snail is highly prolific and could lay up to 1,000,000 eggs per annum which makes it possible to have good output (2; 3). Snail, being a micro livestock animal with its attendant characteristics of small body size, moderate nutrition, little labour with no vigorous physical activities, can be easily moved and reared by all categories of farmers and even children with little or no training and at minimum cost (4; 5). The start –up capital for snail production is low and affordable even by poor households or people with small compounds due to small land area, housing and simple equipment requirements which most times can be achieved using local farm products and scraps. The feeding cost is also low as they can be fed with leaves of pawpaw, okro, cassava and household wastes (6).

Snail is an excellent source of animal protein in the diet of both the poor and rich households in Nigeria. Snails, in no small measures, offer people rich sources of protein,

amino acids and some vital micro nutrients needed for healthy living (7). According to (8), "the protein content of snail meat is 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, the non-edible parts, the visceral and the shell which is about 40% of the snail's weight is useful for feeding monogastric animals. Snail also contains some substances that cause agglutination of certain bacteria useful in treatment of a variety of ailments like whooping cough (9). Snail is good for pregnant women and also used for the treatment of diseases such as hypertension, anaemia, asthma, stomach ulcer, vitality in men, heart diseases, pile, rheumatism and many others. Its meat is also a good antidote for vascular diseases due to its low fat and cholesterol content. The shell is a good input in production of buttons, ring, jewelleries and other ornaments for decorations (9; 10).

The production of snail is an important source of livelihood to the producers. The demand for snail meat has increased over the years in both local and international markets, probably due to rising population or the need to make up for animal protein deficiency, thereby widening demand-supply gap as only few farms exist for commercial breeding and production of snails in Ogun State. This widening demand-supply gap can also be attributed to the existence of inefficiency in the production system due to inability of the farmers to use resources optimally (11). As a result, the bulk of snails that are consumed in the state are from children or women who gathered them from bushes and sell in local markets or along roadsides. However, there is a significant degeneration in the population of snails in the wild as a result of human factors such as indiscriminate collection of immature snails, use of agrochemicals, bush burning, deforestation for urban development, clearing for agricultural purposes and climate change (12; 13). The study therefore seeks to analyse the determinants of technical efficiency in snail production in Ogun State, Nigeria.

Methodology

The Study Area

The study was carried out in Ijebu East Local Government Area (IELGA)of Ogun State, Nigeria. Its headquarters are in the town of Ogbere on the A121 highway at coordinates 6^0"44N "$4^0$10E. The IELGA borders Lagos State and Lagos lagoon in the south. It has a land area of 2,234km2 and a population of 110,196 at the 2006 census. It has 3 major districts Fetedo, Ogbere and Ojowo. The major occupation of the people in the area is farming and livestock rearing.

Sample Procedure and Sample Size

A two-stage sampling technique was used to select respondents for this study. The first stage was purposive selection of one village each from the three districts in Ijebu East LGA. The basis of selection was large numbers of snail farmers in the area. The second stage involved the selection of 20 snail farmers from each of the selected village using snowballing sampling technique to make a total of 60 respondents for the study.

Primary data on socio-economic characteristics of the snail farmers, inputs and output realized were obtained from the respondents using an interview schedule with the aid of questionnaire.

Analytical Techniques

The following analytical tools were employed in the study:

Descriptive Statistics: Descriptive statistics such as mean, frequency, and percentages was used to analyse the socio-economic characteristics of the snail farmers in the study area.

Table 1: Socio-economic characteristics of snail farmers in the study Area *N = 60*

Variable	Frequency	Percentage (%)
Sex		
Male	38	63.3
Female	22	36.7
Age (years)		
≤30	04	6.7
31- 40	20	33.3
41 – 50	28	46.7
Above 50	08	13.3
Mean	41.69±12.140	
Educational Qualification		
No Formal Education	07	11.7
Primary Education	13	21.7
Secondary Education	29	48.3
Tertiary Education	11	18.3
Marital Status		
Single	12	20.0
Married	39	65.0
Widowed	09	15.0
Household Size		
1-5	12	20.0
6-10	41	68.3
>10	07	11.7
Mean	6±2.479	
Snail Farming Experience		
≤5	06	10.0
6-10	35	58.3
>10	19	31.7
Mean	8±2.208	
Credit Access		
Yes	18	30.0
No	42	70.0
Cooperative Membership		
Yes	39	65.0
No	21	35.0
Extension Contact		
Yes	33	55.0
No	27	45.0
Stock Size		
≤500	14	23.3
501-1,000	36	60
>1,000	10	16.7
Mean	774.08±258.263	
Income (₦)		
≤20,000	12	20.0
21,000-40,000	31	51.7
>40,000	17	28.3
Mean	33,400.00±11269.064	

Source: Field survey data, 2019

Stochastic Frontier Production Function

The Cobb-Douglas functional form of the stochastic frontier production function was used to estimate the technical efficiency of snail production. The stochastic frontier production model is specified as follows:

Following (14; 15)

$Y_i = F(Xi; \beta) \exp(Vi - Ui)$; : =1,2,- -n ------- (1)

Where,

Y_i = denotes snail output (kg)

X_i = is a vector of functions of actual input quantities used by the i^{th} snail farm

β = is a vector of parameters to be estimated

$V_i - U_i$ = is the composite error term

V_i and U_i = are assumed to be independently and identically distributed

U_i = is a non-negative random variable, associated with technical inefficiency in production.

V_i = is a random error, which is associated with random factors not under the control of the snail farmers.

The model is explicitly specified as: $InYi = \beta 0 + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + \beta_4 InX_4 + V\text{-}U$ … (2)

Where, ln = represents the natural logarithm

The subscript i represents i-th sample farmer

Y_i = Snail output (kg), X_1 = Stock Size (no), X_2 = Family Labour (manday), X_3 = Feeds (kg), X_4 = Depreciation on capital inputs such as wooden boxes and concrete trenches (physical structures (₦), β_o = intercept, B_1-β_5= coefficients estimated.

Determinants of Technical Efficiency

The following model was estimated jointly with the stochastic frontier model in a single stage maximum likelihood estimation procedure to analyse the determinants of technical efficiency in snail production. The model is specified as:

$U_i = Z_0 + Z_1 W_1 + Z_2 W_2 + Z_3 W_3 + Z_4 W_4 + Z_5 W_5 + Z_6 W_6 + Z_7 W_7 + Z_8 W_8$ e… ……. (3)

U_i = Technical inefficiency of the snail producers.

W_1=Age (years), W_2=sex (dummy), W_3=level of education (years of schooling), W_4= Household size (no of people), W_5= Snail farming Experience (years), W_6=Extension contact (dummy), W_7= Access to credit (dummy), W_8= Total income (₦), W_9= Cooperative association membership (dummy), W_{10} = Nature of farming (1 if full time, 0 otherwise),

e_i= error term, Z_1-Z_9 are parameters to be estimated.

Results and Discussion

Results on the socio-economic characteristics of the snail farmers is presented in Table 1. The result reveals that majority (63.3%) of the snail farmers were male while 36.7% were female. This implies that snail farming was dominated by male in the study area. This result is in tandem with the findings of (16) that more males were involved in snail farming than females. The result was however contrary to findings of (17) who reported female dominance among snail farmers in Ogun State. Age distribution reveals that a larger proportion (46.7%) of the respondents were between 41 and 50 years, 33.3% were within 31 to 40 years and 13.3% were above 50 years while 6.7% were less than or equal to 30 years of age. The mean age of about 42 years implies that the snail farmers were within their economically active age group and able to cope with rigours of snail farming. The result is in consonance with the findings of (18) and (19) that snail farming was dominated by the active segment of the population which may not be unconnected with scarcity of white collar jobs. About 88.3% of the snail farmers had formal education ranging from primary to tertiary. Only 11.7% had no formal education. This implies that majority of respondents were literate which can serve as a driving force for improvement in snail production skills and technology adoption. The result agrees with (18) that lack of education was one of the most serious constraints against the efficiency of snail production in Cross River State.

Table 2: Technical efficiency of snail farmers in the study area

Variable	Coefficient	T-ratio
Constant	1.511	6.004***
Stock size	3.016	2.701***
Family Labour	-1.135	-2.421**
Feed	0.153	2.058**
Capital	1.009	1.572
Diagnostic Statistics		
Sigma square	0.424	3.867***
Gamma	0.856	5.313***
Likelihood function	62.666	

Source*:** Field survey data, 2019 * significant at 1% and** 5% levels respectively*

Table 3: Determinants of technical efficiency of snail production

Variable	Coefficient	t-ratio
Constant	1.616	1.329
Age	0.042	2.187**
Sex	0.018	0.727
Education	-0.023	-2.677***
Household Size	0.686	1.543
Experience	-0.003	-2.377**
Extension Contact	-1.945	-3.058***
Access to Credit	0.027	1.496
Total Income	-0.000	-3.234***
Cooperative Membership	0.023	0.008
Nature of Farming	-0.082	-12.623***

Source*:** Field survey data, 2019 * significant at 1%, and ** 5% levels respectively*

The result further reveals that 65% of the respondents were married with a mean household size of 6 people. This could have a positive effect on family labour availability as the respondents rely on their family members to help rather than hire labours. Majority (58.3%) of the respondents had between 6 and 10 years' experience in snail farming. The mean year of snail farming experience of 8 years implies that commercial snail farming is still relatively recent in the study area. Majority (70%) of the respondents had no access to credit facilities. This could have negative effect on the capacity of the snail farmers to expand their farming enterprise in the study area. Also, 65% of the respondents were members of cooperative association and 55% had contacts with extension agents in the study area. This will enhance dissemination of innovation on snail farming and access to inputs in the study area.

Furthermore, majority (60%) of respondents had stock size of between 501 and 1,000. This implies that snail farming is done on a small scale in the study area. about 52% of the respondents made between 21,000 and 40,000 after sales. The mean income realized after sales at about 6 weeks' interval was ₦33, 400. This implies that snail farming is profitable in the study area. This result is in line with the findings of (20; 17) that snail production is a poverty reducing business in Nigeria.

Technical Efficiency of Snail Farmers in the Study Area

Table 2 presents the results of the maximum likelihood (ML) estimates of the Cobb-Douglas production function of the snail farmers in the study area. The estimate of the

sigma-square is significantly different from zero at one percent level, attesting to the goodness of fit of the model. The gamma estimate which measures the deviation of the observed output from the frontier output is estimated to be 0.856. This implies that, about 86% of the deviations in the total output are largely as a result of the inefficiency in input use and other farm practices, whilst the random factors which may include unfavourable weather conditions, pest and disease infestation, statistical errors in data measurement and the model specification contributes 14% to the deviations of the actual output from the frontier output.

The result reveals that the coefficient of stock size ($P<0.01$) and feed ($p<0.05$) had positive significant relationship with snail output in the study area. This implies that output from snail farming increases with increase in stock size and feed intake of the snails in the study area. A percentage increase in stock size and feed will increase output by 3.016 and 0.152kg respectively

The coefficient of family labour ($P<0.05$) was however negative and statistically significant at 5%. This implies that output from snail decreases with increase in family labour use. A man-day increase in family labour usage will reduce snail output 1.135. This result is supported by (16) that the negative relationship between labour and output may be due to over use of members of the households beyond the point of economic optimum where diminishing return sets in

Table 4: Technical efficiency distribution of the snail farmers

Range of efficiency (%)	Frequency	Percentage
41 – 60	08	13.3
61 – 80	33	55.0
81 – 100	19	31.7
Minimum efficiency	0.467	
Maximum efficiency	0.941	
Mean efficiency	0.615	

Source: Computed from Frontier 4.1 MLE/Survey data, 2019

Determinants of Technical Efficiency of Snail Production

The result of the inefficiency model is presented in Table 3. The result reveals that age ($p<0.05$) of the snail farmers was positive and significant. This indicates that inefficiency in snail production increases with increase in the age of the farmers implying that younger farmers were more technically efficient than the older farmers in the study area. The reason for this is that the younger farmers are agile, educated and more receptive of innovation on snail farming than the older ones. This is consistent with the findings of (21) that the risk bearing and innovative abilities of a farmer, his mental capacity to cope with the rigours of farm production activities and his ability to do manual work decreases with age.

Educational status was found to decrease efficiency of snail farmers as it was negative and significant at 1% alpha levels. This implies that educated snail farmers were more technically efficient than the non-educated ones as educated farmers were more likely to attend seminars, workshops to acquire improved skills on snail farming. The result agrees with (22) that education increases the ability of the farmers to adopt agricultural innovation and hence improve their efficiency and productivity.

The years of snail farming experience ($p<0.05$) also had a negative significant relationship with inefficiency implying that as the years of experience of snail farmers' increases, inefficiency in snail farming decreases. Experience enhances the practical

knowledge of farmers.

Extension contact ($p<0.01$) was also found to reduce inefficiency in snail farming. This implies that snail farmers who attend extension meetings, paid attention to information disseminated and training given were more technically efficient in the study area.

In the same vein, the coefficients of total income and nature of farming were found to have negative significant relationship with inefficiency in snail farming at 1% alpha levels respectively. This implies that full time snail farmers with higher income were more technically efficient and vice versa in the study area.

Technical Efficiency Distribution of the Snail Farmers

Table 4 presents the summary of the frequency distribution of the technical efficiency of the snail farmers in the study area. The table shows that, the individual technical efficiency indices ranges from 0.467- 0.999. Majority (55%) of the snail farmers had efficiency range of 61-80%, about 32% of the farmers had efficiency range of 81-100% while 13.3% of the farmers had efficiency range of 41-60%. The mean efficiency level is 0.615. This indicates that the snail farmers are producing about 62% of their potential output. This also suggests that there is still room for the snail farmers to improve on their efficiency levels up to 38% in the study area.

Conclusions and Application

The study concluded that:

1. Snail farmers were not realising their full productivity potential in the study area.
2. Youth should be encouraged to go into snail farming because they are more educated and more receptive to adoption of technologies than older ones as the age of the snail farmers were found to increase inefficiency.
3. In order to enhance efficiency, productivity and income of snail farmers, the extension services in the study area should be fortified to organise educational and training workshops on best practices in snail farming as well as timely dissemination of information on innovations in snail farming.
4. The findings of this study if well applied would help enhance the efficiency of snail farmers, increase snail production and availability of snail as an alternative protein source at affordable rate to the society at large

References

1. Food and Agricultural Organization (FAO) (1989). Snail production series 11-29 Rome City
2. Lameed, G.A. (2006). Socio-Economic Characteristics of Snail Farmers, Consumers and Sellers in Selected Zones of Oyo State Agricultural Development Programme. *Journal of* Agriculture, Forestry and the Social Sciences, 4(2):68-78.
3. Afolabi M.O. (2011). Reducing poverty through snail farming in Nigeria. Agriculture and Biological Journal of North America, 2(1):169-172.
4. Ekanem, E. O. and B. I. Umoh (1997). Development of Micro-livestock as a Complementary MacroEconomic Strategy for Animal Protein Supply in Nigeria In: Issues in Sustainable Agricultural Development. edited by Fabiyi Y. L. Nyienakuna M.G. Vol.1, August, 1997.
5. Akinnusi, O. (1998). Introduction to Snail Farming. Lagos Omega Science Publisher, Tinuose House, Nigeriapp1-18
6. Ayodele, I. A. and Asimalowo, A. A. (1999). Essentials of Snail Farming: A Technical Guide to Snail Farming in the Tropics. Agape Printer, Ibadan. Pp1-30.
7. Akinnusi, O. (2002). Introduction to Snails and Snail Farming. Triolas Exquisite Ventures, Abeokuta, Nigeria.

8. Engmann, F. (2013) Proximate and nutritional Composition of Snail (Achatina achatina) Meat: Any Nutritional Justification for Acclaimed Health Benefits. *Journal of Applied Scientific Research,* 3 94): 8-15.
9. Cobbinah, J. R. (1993) A practical guide to Snail Farming in West Africa. Technical Centre for Agriculture and Rural Cooperation (C. T. A.). Sayce Publishers, United Kingdom
10. Abere, S.A. and Lameed, G.A. (2008). The Medicinal Utilization of Snails in Some Selected States in Nigeria. In: JC Onyekwelu, VAJ Adekunle, DO Oke (Eds.): *Proceeding of the First National Conference of the Forest and Forest Products Society (FFPs)* held in Akure, Ondo State between 11th and18th of April, 2008, pp. 233-237.
11. Ugwumba, C.O.A. and Okoh, R.N. (2010). Price spread and the determinants of catfish marketing income in Anambra State, Nigeria. *Journal of Agriculture and Social Sciences,* 6: 73-78
12. Efarmspro, 2006. Snail Farming and Management. From <URL www.efarmspro.com> (Retrieved on 29th of August, 2008).
13. Cobbinah, J.R., Vink, A. and Onwuka, B. (2008). *Snail Farming: Production, Processing and Marketing.* 1st Edition. Agromisia Foundation, Wageningen, Netherland, pp. 78-82.
14. Aigner D.J., Lovel, C.A.K., and Schmidt P.J. (1977). Formulation and estimation of Stochastic Production Function Models. *Journal of Econometrics,* 6: 21-37
15. Meeusen, W. and van den Broeck, J. (1977). Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error. *International Economic Review*, 18: 435-444.
16. Iheke, O. R. and Nwankwo, N. F. (2016). Analysis of the technical efficiency of snail farmers in Abia State, Nigeria. Scientific Papers Series *Management, Economic Engineering in Agriculture and Rural Development,* 16(1): 201-212
17. Olawumi, A.T., Shittu A.M., Adedokun, M.O., Jaiyeola, O.A. and Oluwalana, S.A. (2012). Economic Analysis of Feral Snail Collection in Ogun Waterside Local Government Area of Ogun State, Nigeria. A Paper presented at the 1st International Conference on Giant African Land Snails, Februaury12 – 15, FUNNAB, Ogun State, Nigeria
18. Adinya, I.B., Ediet, D., Nyienakuna, M.G. and Ikpi, G.U. (2011). Estimation of efficiency constraints using CobbDouglas production function in snail production by small farmers in Cross River State, Nigeria. *Journal of Animal and Plant Sciences,* 21(2): 274-282
19. Afolabi, J. A. (2013). Snail Farming as an Environment Friendly and Viable Enterprise in Ondo State, Nigeria. *Journal of Human Ecology*, 42(3): 289-293
20. Agbogidi, O.M. and Okonta, B.C. (2011). Reducing poverty through snail farming in Nigeria. *Agriculture and Biology Journal of North America*, 2(1): 169172.
21. Iheke, O. R., Nwaru, J. C. and Onyenweaku, C. E. (2013). The Impact of Migrant Remittances on the Technical Efficiency of Arable Crop Farm Households in South Eastern Nigeria. Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia.
22. Iheke, O. R. and Nwaru, J. C. (2014). Impact of Innovation on Smallholders' Productivity and Poverty Status: The Case of Arable Crop Farmers in South-East, Nigeria. *Asian Journal of Agricultural Extension, Economics and Sociology*, 3(4): 301-318.