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Analysis of Technical Efficiency and Constraints to Small Holder Heliculture Farming in Ovia South West Local Government Area, Edo State, Nigeria

***EGBODION, J; IGBINUDU, O**

Department of Agricultural Economics and Extension Services, University of Benin, Bening City, Edo State, Nieria

**Corresponding Author Email: John.egbodion@uniben.edu*

ABSTRACT: Heliculture by rural households is becoming popular due to the necessity of income diversification and reducing decency on monoculture. This paper therefore examined the technical efficiency and constraints to snail production by smallholder farmers in Ovia south West Local Government Area Edo State, Nigeria, using appropriate techniques with 90 responses. The result shown that most (51.11%) of the farmers were females, with age brackets of 31 – 40 years, with a mean farm experience of 3 years respectively. Result further shown that most (46.7%) of the farmers had secondary education and household size of between 6 – 10 persons with a stock size of between 10 – 100 snails respectively. Most (Labour, feeds, fixed asset and stock size) contributed respectively to the output of farmers with a mean efficiency score of 0.903, indicating existence of efficiency gap. Education level and farming experience contributed significantly to the efficiency of the farmers but the farmers were constrained mostly by inadequate credit, dearth of stable market price, bad weather, and disease infestation in the study area. Policy makers and stakeholders could encourage women and youth participation.

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Snail farming is otherwise known as Heliculture, and has in recent times gather an increasing acceptance both in the level of consumption of snail meat and the scale of production. Agriculture supposed to drive and boost the Nigerian economy and ensure food security. However in order to achieve food and nutrition security, diversification in Agriculture must be practiced and one of such area of alternative to conventional livestock farming is Heliculture. Snail production by rural household is becoming popular due to the fact that the household have realized that the need to diversity their source of income, thereby reducing risks involved in depending on only crop or animal production as the source of income (Ojo and Zira, 2017). Today snail consumption and acceptability cuts across many parts of Nigeria and other parts of the world and date back to the prehistoric times. One major factor that has improve the production and consumption of snail meat in many households today is its dietary importance. It is high in protein (83%) on dry weight basis, low in fat (15.6%), low in cholesterol 20.28mg/100g and contains almost all the amino acids needed by humans (Akharume, Alao and Eyinade, 2019). It serves as an excellent source of calcium and phosphorus and good substitute for beef and eggs (Ogunkunle, 2015). Snail meat is also considered important in the treatment of anemia (Ahmadu and Ojogho, 2012). The bluish liquid found in snail when consume is good for infant development and an antidote for fat related diseases such as hypertension (Ahmadu and Ojogho, 2012). Snail production is relatively cheap to start and manage and can yield high produce and returns (Ahmadu, Ida – Ogbomo and Oyoboh 2021). However, inspite of the potentials and advantages of snail farming, wide spread participation in its production by farmers has not been achieved in Nigeria. Much of the snails produced in the country today are collected from the

wild and very few small-scale farms exist for commercial breeding and production of snails (Onuigho, 2015). This probably is attributed to the dearth of the technical know-how which the farmers lack. Hence the following research questions; what are the socio-economic characteristics of snail's farmers, what is the cost and returns in snail farming? What is the technical efficiency of snail famers and their constraints in the study area.

MATERIALS AND METHODS

Study Rea and Sampling: The study was carried out in Ovia North – East Local Government Area of Edo State, Nigeria. It is located on longitude $6^{0}4^{1}$ East, $6^{0}43^{1}$ East and $5^{0}44^{1}$, $7^{0}34^{1}$ North, with an area of 2,324 km^2 and a population of 203,500 (NPC, 2006). The administrative head quarter is located in Okada town. The local government area has a natural vegetation that supports agricultural activities such as crop production, snail farming, fishing etc. principal crops grown by farmers include maize, yam, cassava, melon, tomatoes, plantain among others in the study area. A two stage sampling techniques involving purposive and simple random sampling was used. Firstly purposive sampling was used to collect communities were snail production was highest and simple random sampling was used to select 10 farmers from each of the selected communities giving a total of 90 farmers used for the study. Primary data was used for the study. The data were collected through the use of structured questionnaire. Data collected were examined using descriptive statistics such as mean, frequency count, tables, percentages and stochastic frontier production function and cost and return using gross margin analysis.

Model specification: Efficiency model

$Y_i = f(X_iB) \exp V_i - U_i$ (implicit)…….1

$TE_i = Y_i / Y_i = f(X_iB) \exp (V_i - U_i) / f(X_i,B) \exp V_i = \exp(-U_i)$… 2

$\ln Y_i = B_0 + B_1 \ln X_1 + B_2 \ln X_2 = \ldots B_5 \ln X_5 = (V_i - U_i)$ …3

Where: Y_i*= the frontier output; X_1 = Kilograms of snail raised; X_2 = Snail farm size (total area of the farm in m^2); X_3 = Cost of feed (₦); X_4 = Normalized cost of pen (₦); X_5 = Normalized cost of hired labour (₦); In = Logarithm to base e; i= jth= observation of the $_i$ th farmer; V_i - U_i= error term (Σ); B_0= Constant term to be estimated

B_1- B_5 = Coefficient of the independent variable to be estimated; TE = Technical efficiency (ranges between 0 and 1)

Technical inefficiency model: Ui is defined as:

$Ui = \delta 0 + \delta 1z1 + \delta 2z2 + \delta 3z3 + \delta 4z4 + \delta 5z5$ (4)

Where Zi= Age; Z2= Household size (number of household members); Z3= Education level of farmers (years of formal schooling); Z4= Farming experience (years); Z5= Sex (male=0, female=1); δ = constant term

Constraints faced by farmers was measured using a five-point Likert scale

$Xs = \Sigma fn/nr$-------- (5)

Where Xs = mean; Fn = frequency of respondent responses; Nr= number of respondent responses

Model for gross margin

GM = GFI-TVC

GFI = TI= Q X P

NFI= ……. = TI -TC

TC= TFC +TVC (Olukosi and Erabor, 1989)

Where: GM= Gross margin (₦); GFI= Gross farm income (₦); TVC= Total variable cost (₦); TC= Total cost (₦); TL= Profit (₦); Q= Quantity of Snails produced (kg); P= Price (₦)

RESULT AND DISCUSSION

The Analysis of the socio-economic characteristics of the small holder snail farmers are presented in table 1. It was observed that most (51.11%) of the farmers were female with age brackets of 31 – 40 years. This result collaborated Ranmen (2002) who had similar age bracket and opined that this age bracket is the economically active age and as such farmers will respond positively to any intervention aimed at improving their productive capacity. The analysis also shown that most (46.7%) of the farmers had secondary education, with a household size of 6 – 10 person and a stock size of 10 – 100 snails in their farm, by implication, a reasonable number of these farmers should be able to understand and use improved technologies and adopt it to improve their production, consequently improve on their farm income (Egbodion and Igbinidu, 2011).

Maximum likelihood value (MLE) for Stochastic Frontier production function for the snail farmers in the study area: The coefficients of the variables are the estimates from production function. The maximum likelihood estimates are presented in table 2 and are interpreted as the elasticities of the variables. The coefficients are properly and positively signed except

the coefficient of medication (-0.084), that was negative.

Table 1: Socio- economic characteristics of farmers

Variables	Frequency	Percentage (%)
Sex		
Male	44	48.89
Female	46	51.11
Age		
1 – 30 years	21	23.60
31 – 40	36	33.71
> 51	14	15.73
Farm Experience		
1 – 5 Years	72	80.0
6 – 10	16	17.78
11 and above	2	2.22
Household size		
1 – 5	44	48.89
6 – 10	46	51.11
Stock size		
10 – 100	59	65.56
101 – 200	17	18.89
201 – 300	12	13.33
> 300	2	1.8
Education Level		
No formal	8	8.89
Primary	10	11.11
Secondary	42	46.67
Tertiary	30	33.33

Source: Field Survey, 2022

The elasticities of labour (0.286), feed (0.869) and stock size (0.412) wheel barrow (0.424) were statistically significant at 5% and 1% level respectively and these are the most important factor in snail production in the study area. By implication for a 10% increase in the quantities of these factors will lead to a proportionate increase the output of snail farms and profit in the study area c*eteris paribus*.

Inefficiency Model: The results of the inefficiency model is presented below in table 2.

Table 2: Estimate for farmers technical efficiency in the study area

Variable	Coefficient	T – Ratio
Labour	0.286*	5.450
Mediation	- 0.084	- 0.385
Feed	0.869*	6.014
Size of stock	0.412**	3.058
Wheel barrow	0.424**	3.195
Hand towel	0.043	0.150
Watering can	0.321	0.141
Inefficiency model		
Age (years)	0.000 *	7.022
Household size	0.278	-1.091
Education level	- 0.002**	- 3.051
Farming Experience	- 0.002**	- 3.014
Sex	0.415	- 0.680
Sigma	0.532	
Gamma	0.678	
Log likelihood	- 71.32	

Source: Survey data, 2022

As can be observed from the result, Education level of farmers and farming experience values were negative and significant at 1%, implying that the higher education and more years of farming experience of farmers, the increase in their technical efficiency to almost operate at the frontier. However this result is consistent with apriori expectation. But the coefficients of Age, household size and sex were positive and only Age of farmers was significant at 5%. Implying that these variables jointly contributed to the level of the snail farmers inefficiency in the study area; and the associated efficiency gap, which also implied that the older the farmer and the smaller the household size the more inefficiency among the snail farmers.

Efficiency distribution of the snail farmers in the study area: The Frequency distribution of TE of the Snail farmers is presented in table 3. It is observed that majority (90%) of the snail farmers had TE between (90% - 100%) indicating that most of the farmers were almost operating at the frontier, however opportunities still exist for increasing productivity in snail farming in the Study area through increased efficiency in resource utilization.

Table 3: Efficiency range of farmers

Technical Efficiency indices	Freq	%
90 - 100	90	100
Mean TE = 0.903		
Minimum TE = 0.9011		
Maximum TE = 0.9875		

Source: Survey data, 2022

Return to scale (RTS) in the farmers farm operations: The results of the MLE model coefficients are treated as the elasticity of the inputs use by the farmers in the study area and are presented in table 4. The summation of the elasticities gave the RTS of (2.271), indicating that the farmers were operating at an increasing return to scale, which is an irrational stage to produce. This result also connoted that some inputs were underutilized, it will be rational for the farmers to increase their level of input utilization to maximize output and move to the economic region of production. This findings collaborated Egbodion, 2021; Oniugbo (2015) who had similar RTS and Technical Efficiency results in snail production in Enugu East of Nigeria.

Table 4: Return to scale of farmers

Inputs	Elasticities
Labour (Man/day)	0.286
Medication	- 0.084
Feed	0.869
Size of stock	0.412
Wheel barrow	0.424
Hand trowel	0.043
Watering can	0.321
RTS	**2.271**

Source: Survey Data, 2022

Constraints to Snail Production in the Study Area: Constraints to snail production in the study area is presented in table 5. Value obtained from the Likert scale above 3.0 were the significant constrains to snail farming in the study area. It is observed from the results that inadequate credits, dearth of stable market price, bad weather conditions, poor technical know-how, beliefs and disease and pest were the factors mainly constraining snail production in the study area. This findings is consistent with aprior, expectation. Since in Nigeria today, there are no regulatory body on the control of agricultural produce price and prices are heavily affected by the seasonal nature of Agriculture and outputs; and there are peak and line seasons which implicate on the prices of agriculture produce.

Table 5: Constraint to farmers snail production in the study area

Constraints	Mean	Std Deviation
Inadequate credits	3.97	1.19
Dearth of stable market price	3.82	
Poor pricing	3.78	
Bad weather conditions	3.34	
Poor technical know how	3.32	
Beliefs	3.31	
Disease and pest	3.22	
Inadequate labour	2.99	

Source: Survey data, 2022; x > 3.0 are serious constraints

Conclusion: Using stochastic frontier production function analysis, it can be concluded that Heliculture is profitable in the study area, but policy makers should focus policies on (Age, Household size and sex of snail farmers to bridge efficiency gap in the study area.

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