sciendo DOI: 10.2478/ats-2022-0017 AGRICULTURA TROPICA ET SUBTROPICA, 55 OV, 159–168, 2022

Original Research Article

Economic analysis of snail production and its contribution to food security of farming households in Nigeria

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Abstract

The numerous resources in snail production have largely remained untapped in developing countries despite the increasing awareness of the many benefits and potentials embedded therein. This study was done to analyze the economics of snail production and to estimate its contribution to the food security of farming households in Oyo State, Nigeria. Primary data were obtained through the use of a structured questionnaire that was administered to the snail farmers. Based on the discovery of this work, the result shows that 39.2 % of the sampled farmers were within the active age bracket (41–50 years). 92.5 % of the farmers were males indicating men were actively involved. The majority of the farmers were literate with (83.3 %) having tertiary education. The mean farming experience was about 7 years with most of the farmers (47.5 %) having experience of 5–8 years. Most (86.7 %) of the respondents were married. The majority (40 %) engage in farming as an occupation primarily. The result showed that the returns to snail production were high (net profit ₦317.88/0.75 USD per jumbo-size snail). Every naira investment generated about ₦1.96/0.0046 USD. This demonstrated a high economic return of the snail farming business for boosting the revenue of the farming household. It was revealed that the cost of breeding stock, stocking density, and labour cost had a significant effect on revenue generated from snail production. Snail production was also not seen to have a significant contribution to the food security of farming households in the study area. The result further showed that the major constraints faced by snail farmers in the study area include lack of financial capacity for business expansion, unavailability of collaterals for loan acquisition to aid farm activities, and lack of inadequate extension visits among others. Hence, the study emphasizes the need for the government to invest heavily in snail production and encourage people to venture into snail farming business.

Keywords: *Archantina archantina; Archantina marginata*; food security index; household food security; net income analysis; revenue; constraints

INTRODUCTION

Lately, the rearing of miniature livestock by remote dwellers is getting pronounced because firstly, the households have discovered the essence of having multiple streams of revenue, thus lessening the danger associated with relying on crop cultivation as their major stream of revenue. Secondly, protein prerequisites and the exact protein taken in by the masses are wide apart because they are not adequately provided by crop production and it becomes necessary

to shorten that gap (Ajibefun, 2000; Titilola, 2015). It has been accounted for that the animal protein consumed in Nigeria on average is little, and this requires coordinated exertion and synergy to tackle this problem of protein deficiencies. Lamentably, the most common animal proteins available in the market such as meat from cows, pigs, poultry birds, and goats have gotten excessively costly and are evading the common populace due to the economic meltdown (Omole, 2003). Hence, the more reason to come up with measures to incorporate certain non-traditional sources of meat into our system of farming (Ebenebe, 2000).

One of the significant secondary animal protein sources which have gotten generally sparse consideration in Nigeria is Snail (Baba and Adeleke, 2006; Cobbinah et al., 2008). Snail is among the miniature livestock that has as of late stood out among Nigerian farmers as an aftereffect of the alert sounded by FAO on the insufficiency of protein derived from animals among Nigerian citizens (Adesope, 2000). Numerous farming methods have been embraced in the country, yet the daily animal protein assimilation *per capita* (assessed as under 10 g) stays a long way from the Food and Agricultural Organization (FAO) suggested the least prerequisite of 35 g (FAO, 2022). In order to close this gap, it has been proposed that it becomes necessary to look into other alternatives of animal protein to complement the common sources which include red meat from livestock and white meat from poultry. Asides from the medical advantages, snail production is an essential means of revenue for farmers in villages and towns.

Snail farming should be encouraged as a new subdivision of sustainable animal production. Snails generally have been perceived as a solid protein avenue to human beings and they are valuable in research. The productivity of snail farming depends to a great extent on the utilisation of present-day improved techniques and strategies in production which requires gaining information on snails' hatchery, feeding, housing, and marketing of its end products. Ongoing improvement in snail production includes the use of concentrate diets in the feeding of snails and this requires elaborate information from experts (Jimoh and Akinola, 2020). Snails are commonly fed on diets such as fruits of pawpaw, pineapple, banana, pear, oil palm and watermelon and leaves of cassava, pawpaw, cocoyam, and water leaf. Snail rearing has various benefits which include the following: it is economical to manage the housing types, healthcare, and feeding system in snail production; high adaptability to various sorts of geographical predicaments (can be reared in urban or rural areas); they are profoundly reproductive; they are proficient meat producers; they have high health restorative worth – they have prophylactic and curative functions for certain diseases such as hypertension. Agbogidi et al. (2008) opined that snail contains a relatively high amount of protein and iron and a low amount of fat. Given that snails are of small sizes, are quiet moving creatures, and are simple to raise as against other livestock, they can be raised in urban areas without encroaching and disturbing the neighbourhood (Agbogidi et al., 2008; Okonkwo et al., 2013). Despite the enormous potential attached to the production of snails and the health benefits it renders, there is a record of setbacks in the production level which is traced to certain human activities.

Of recent, snail populations in Nigeria have declined massively due to the negative impact of human activities on their natural habitats. Such practices include the falling of trees, indiscriminate bush burning, and gathering of immature snails for consumption, etc. (Efarmspro, 2006; Owolade, 2012). This trend, coupled with the fact that there are no significant efforts at large-scale snail breeding (likewise with other domesticated animals such as the ruminants and poultry birds) means the possibility of snails going into extinction is not far-fetched. However, the continuous use of conventional methods in snail production cannot meet the present demand for the teeming population. The ever-growing demand for the local production of snails necessitates increases in its production. According to Iheke and Nwankwo (2016), to bring about an expansion in the production ability of snail farmers, there is a need to furnish them with important information and thorough enlightenment. This can only be accomplished in the presence of keenly developed interest on the part of the farmers to add to their knowledge. A few factors that affect the information-seeking behavior of snail farmers have been recognized which include the availability of infrastructures, technical know-how, and literacy level of farmers (Owolade, 2012).

Many research works have been done to examine the socio-demographic characteristics of snail farmers, analyse the economics of snail production and determine the factors militating against snail production in West Africa, especially Nigeria. In an attempt to assess the economics of snail production, Ngenwi et al. (2010) adopted a well-structured questionnaire and focus group approach to collect data in specific districts in Ghana and Cameroon. The data collected were analyzed using descriptive and inferential statistics such as regression analysis. The results indicate that about 42–

62% of rural income is obtained from the proceeds of snail production. They also found out that the causes of decreasing snail populations were as a result of habitat loss through "deforestation, overexploitation, indiscriminate harvesting, climate change". The study posited that a pragmatic approach to building the capacity of existing and prospective farmers should be adopted to improve the snail supply chain. Chah and Inegbedion (2012) looked into the different production systems of snail farmers in Edo State, Nigeria. *Archantina archantina* and *Archantina marginata* were found to be the most commonly reared species by the farmers with the former being 43.3% and the latter being 26.7%. 40.0% of the farmers used the semi-intensive rearing system. The potential in snail production has largely remained untapped in the study area which was evident by the small-scale production level of farmers. A study by Afolabi (2013) on the economics of snail production in Ondo State, Nigeria concluded that snail production is a profitable business venture and that climatic factors favour snail production in the study area. The study showed that 92% of the farmers make up the working populace. The mean total income farmers earned per production cycle in the study area is N33,798.82 with a net income of N25,452 while they incurred an average total cost of N 8,347. The result of the regression analysis showed that 64.4% of the variation in the dependent variable was explained in the independent variables.

These studies are among the few that are centred on snails. There is, however, a dearth of knowledge and attention accrued to snail production and its contribution to the economy at large. Little or no study has been carried out on the socio-characteristics of snail farmers especially in Ibadan, Oyo State, Nigeria. More so, no empirical study has been carried out to examine the contribution of snail production to the food security of the households of farmers in the study area. However, this research was done to fill the identified gap in knowledge.

The general aim of the study was to analyse the economics of snail production and estimate its contribution to the food security of farming households in Ibadan, Oyo State, Nigeria.

The major aims of the study are to:

i) describe the snail production system and characteristics of snail farmers.
ii) examine the cost and returns to snail farming.
iii) ascertain the factors affecting revenue from snail production.
iv) estimate snail production contribution to household food security.
v) identify the constraints facing snail farmers.

MATERIALS AND METHODS

The study area

This study was carried out in Oyo State in Southwestern Nigeria which has Ibadan as the capital city. Its north, east, and west boundary states are Kwara, Osun, and Ogun respectively. Oyo State is partly bounded in the west by Ogun State and the Republic of Benin. Its area mass is 28,454 square kilometers which is the 14 largest in Nigeria by size. It is located at latitude 8°00 N and longitude 4°00 E, with a population estimated to be 5,580,894. Dome-shaped hills and old hard rocks are major constituents of the landscape of the state. The hills and rocks reach 1,219 metres high above sea level in the northern part. Its rising originates from about 500 metres in the southern part.

The climate is characteristically equatorial, evidenced by its wet and dry seasons and the high humidity that comes with it. The wet season spans from April to October while the dry season spans from November to March. "Average daily temperature ranges between 25°C (77.0°F) and 35°C (95.0°F)", which is characteristically almost throughout the year. The state has an annual rainfall of about 1311 mm.

Source of data

Primary data were used for the study and collected through the use of a well-structured questionnaire that was administered to the snail farmers in Oyo state. The questionnaire was structured and designed to collect information about the socio-economic characteristics (such as age, gender, level of education, household size, years of experience) and others to fulfill the objectives of the study. The questionnaire involved both closed and open-ended questions. Direct observation was also used to gather information related to the study.

Sampling technique and sampling size

A list of snail farmers was obtained from the snail farmers' association at the "Institute of Agriculture Research and Training (IAR&T), Apata Ibadan". There were 350 registered members, out of which 120 respondents were selected by a simple random sampling technique.

Analytical techniques

Descriptive statistics, Net income analysis, Regression analysis, Food security index, and Likert scale were employed in analysing the data.

Descriptive statistics

Descriptive statistics tools such as frequency distribution and percentage were given to describe the

snail production system and characteristics of snail farmers in the study area.

Net income analysis

Net income analysis was used to estimate the costs and returns of snail production in the study area.
"NI = TR – TC.
And TC = TVC + TFC
Nl = Net income
TR: Total Revenue
TC = Total Cost
TVC = Total Variable Cost
TFC = Total depreciated Fixed Cost

Return per naira on investment

RPI = TR/TC
where RPI = Return per naira on investment
TR = Total Revenue
TC = Total Cost (total fixed cost + total variable cost)".

Regression analysis

This was used to ascertain the factors that influence the revenue generated from snail production. The relationship is expressed as

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, \ldots\ldots\ldots\ldots e_i)$$

where:
Y = Revenue (N)
X_1 = household size
X_2 = feeding stuff type
X_3 = depreciated cost
X_4 = stocking density
X_5 = cost of feed
X_6 = cost of breeding stock
e_i = error term.

The following production model functional forms namely; "linear, semi-log, and Cobb-Douglas functions" were fitted for the regression analysis. This was to ensure the selection of the function that gave the best fit for the result.

Food security index

Food security index was used for objective four to estimate the contribution of snail production to household food security. Households were grouped into food secure and food insecure. Those, whose *per capita* monthly food expenditure is above or equal to the food security line will be regarded as food secure and those households whose per capita food expenditure is below the food security line will be regarded as food insecure. The index is given by

$$F_i = \frac{\text{per capita food expenditure for the ith household}}{2/3 \text{ mean per capita food expenditure of all households}}$$

where:
F = food security index
F ≥ 1 = food-secure household
F ≤ 1 = food-insecure household.

Likert rating scale technique

The Likert scale was used to identify the major constraints to snail production in the study location. Mean, frequency and percentage were used alongside a 4-point Likert scale. The 4-point scale rating was graded as Very serious = 4, Serious = 3, Less serious = 2, and Not serious = 1. The mean score of respondents based on the 4-point rating scale was computed and the items were ranked.

RESULTS AND DISCUSSION

Socio-economic characteristics of snail farmers

The results of the demographic distribution of the respondents in Table 1 indicate that most (39.2%) of the respondent's age fall in the range of 41–50 years with a mean of 41.58. It also showed that the majority (92.5%) were males indicating the strength of men in the snail production sector of farming. Aiyeloja and Ogunjinmi (2010) also revealed the predominance of men (90%) in snail production. It was never expected that an enterprise such as snail production will be less represented by females due to the simple, easy, and low capital requirement nature of the business. Hence, it becomes necessary to encourage women to engage in the snail production enterprise. Most (86.7%) of farmers were married with large family sizes (mean household size of 4.12). The predominance of married farmers is most likely born out of the necessity to fend for their household.

The results indicate further that snail production in Oyo State was an enterprise for the educated farmers; 91.7% of the respondents had at least formal education with most of them (83.3%) having a university education. This substantiates the findings of Ogunniyi et al. (2015) who posited that most (59%) of the snail farmers were educated; and Aiyeloja and Ogunjimi (2010) who found that all respondents who were farmers engaged in snail production had tertiary training. The significant level of education of the farmers can probably afford them some degree of organizational capability in their business enterprise. The farmers, on average had high years of experience (mean years of experience of 6.67) in snail farming and this will most likely enhance their managerial skills and capabilities.

Table 1. Socio-economic and demographic characteristics of respondents

Variables	Frequency	Percentage	Mean
Age			
<30	22	18.3	41.58
31–40	32	26.7	
41–50	47	39.2	
>51	19	15.8	
Sex			
Male	111	92.5	
Female	9	7.5	
Marital status			
Married	104	86.7	
Single	11	9.2	
Widow/widower	5	4.2	
Educational status			
None formal	10	8.3	
Primary	6	5.0	
Secondary	4	3.3	
Tertiary	100	83.3	
Household size			
1–4	75	60.8	4.12
4–8	47	39.2	
Years of experience			
1–4	33	27.5	6.67
5–8	57	47.5	
9–12	16	13.3	
>12	14	11.7	
Occupation			
Farmer	48	40.0	
Artisan	32	26.7	
Civil servant	25	20.8	
Trading	15	12.5	

Source: Field survey 2019

The snail production system of snail farmers

Table 2 shows that the majority (52.5%) practice commercial farming snail production. The majority employed the use of enclosed wooden cages and enclosed iron cages in farming their snails which account for 25.8% and 24.2%, respectively. *Archantina marginata* species of snail is mostly reared by the respondent accounting for 51.7% of the population. *Archantina marginata* is commonly found in the southwestern part of Nigeria while the *Archantina archantina* breed is commonly found in southeast, Nigeria. Hired and rented land are the most common method of land acquisition by the snail farmers in the study area.

Cost and returns to snail production

Table 3 indicates that snail production was worth every penny invested in it (net profit = ₦317.88/0.75 USD per jumbo-sized snail). Each naira deposited in the enterprise yielded about 1.96 naira/0.0046 USD. This demonstrated the high monetary capability of the snail farming business for augmenting family revenue and improving the living expectation of the farmers (Onyeagocha et al., 2012). it is suggested that jobless people and low-salary earners ought to venture into snail production to ameliorate food insecurity and augment their revenue.

Factors affecting the revenue from snail production

The result in Table 4 shows the multiple regression analysis of the factors affecting revenue generated from snail production in the study area. Based on the requirement for choosing the lead equation, the linear function was selected and it indicates that about 76% of the variation in the dependent variable (revenue) was

Table 2. Production systems of snail farmers

Variables	Frequency	Percentage
System of farming		
Subsistence	57	47.5
Commercial	63	52.5
Snail rearing method		
In an enclosed wooden cage	31	25.8
In drums or tyres	21	17.5
In a trench	21	17.5
In an enclosed iron cage	29	24.2
In a fenced piece of land	18	15.0
Species of snail reared		
Archantina archantina	16	13.3
Archantina marginata	62	51.7
Both	42	35.0
Method of land acquisition		
Rented land	49	40.8
Hired land	51	42.5
Family land	15	12.5

Source: Field survey 2019

Table 3. Average costs and returns in snail production

Variables	Value/respondent return	Value/snail	% of the total cost
Output (no of snails)	526.44		
Selling price/snail (₦)	480.17		
Gross income	252,780.69	480.17	
		Variable cost (N)	
Feed	15,319.17	29.10	17.96
Labour (man-days)	12,791.67	24.30	15.00
Initial Stock	13,856.67	26.32	16.25
Clearing and disinfectant	4,965.00	9.43	5.82
Transportation	11,404.35	21.66	13.37
Total variable cost	58,336.86	110.81	68.28
		Fixed cost (N)	
Land (Depreciated value)	6,654.17	12.64	7.80
Market tax	100.00	0.19	0.11
Cost of equipment and farm setup	20,345.83	38.65	23.86
Total fixed cost	27,100.00	51.48	31.72
Total cost	85,436.86	162.29	100
Gross margin (₦)	194,443.83	395.68	
Net profit (₦)	167,343.83	317.88	
Return/(₦) invested	1.96		

Source: Field survey 2019

$$\text{Return on investment (ROI)} = \frac{\text{NR (Net Revenue)}}{\text{TC (Total Production Cost)}}$$

Table 4. Factors influencing revenue generated from snail production

Variables	Coefficient	P value
Constant	45904.09	0.119
Farming experience (years)	0.277	0.340
Cost of breeding stock	0.580**	0.000
Cost of Feed	-0.165	0.119
Feeding stuff type	0.353	0.090
Depreciated cost	0.004	0.898
Stocking density	0.199**	0.018
Labour cost	-0.759**	0.000
Household size	0.013	0.827
R^2 = 0.760	Adjusted R^2 = 0.741	
F value = 38.744		0.000

Source: Field survey, 2019 **Level of significance < 5%

Table 5. Food Security Line for the Snail Farmers' Household

Deciles	Mean per capita food expenditure (MPCFE)	Deciles	Mean per capita food expenditure (MPCFE)
First	7,878.06	Seventh	20,278.65
Second	15,709.68	Eighth	13,623.26
Third	8,823.53	Ninth	6,903.63
Fourth	9,361.11	Tenth	7,141.13
Fifth	7,666.67	Eleventh	4,656.12
Sixth	5,638.29	Twelfth	11,668.29
Total	119,348.41		
2/3 MPCFE	79,565.61		

Source: field survey, 2019

explained by the changes in the independent variables (factors influencing revenue). The F-statistic indicates a good fit for this model because it was significant at 1%. The influences of stocking density, cost of breeding stock, and cost of breeding stock on the revenue were significant. The positive significant effect of stocking density is in line with the findings of Baba and Adeleke (2006). The positive coefficient of stocking density implies that the higher the number of snails in the pen, the more revenue generated, the implication of the negative coefficient of labour cost is that the higher the labour cost incurred in snail production, the lower the revenue generated and vice versa. The effects of feed cost, household size, farming experience, feeding stuff type, and depreciated cost on the revenue were not significant.

Food security index findings

This analytical tool evaluated the food security status of farming households. The mean per capita expenditure of the various household on food was used and grouped in deciles (Table 5). The households were divided into twelve deciles and the mean per capita food expenditure (MPCFE) was calculated. The two-third mean per capita food expenditure is 79,565.61. It was observed that 65% of the household's expenditure is less than the two-thirds MPCFE, thus they are food insecure while 35% of the households are food secure because their food expenditure is more than the two-third MPCFE and this might be because less than 50% of the snail farmers practice snail production on a small scale, most of the commercial snail farmers happened to be food secured.

Constraints to snail production

Table 6 shows the challenges faced by snail farmers in the study area. Lack of financial capacity for business expansion has a mean score of 3.03, Lack of collateral security to secure loan to support farming has a mean score of 2.98, Lack of inadequate extension visits has a mean score of 2.93, Low patronage or acceptance of snail in your area has a mean score of 2.85, Poor access to information relating to snail farming has a mean score of 2.81, Effect of harsh weather condition has a mean score of 2.78, Insufficient knowledge of credit source has a mean score of 2.64, Lack of proper farmland

Table 6. Constraints to snail production among farmers

Constraints	Very serious	Serious	Less serious	Not serious	Mean	Rank
Lack of financial capacity for business expansion	44(36.7)	50(41.7)	12(10.0)	14(11.7)	3.03	1st
Lack of collateral security to secure loans to support farming	44(36.7)	43(35.8)	20(16.7)	13(10.8)	2.98	2nd
Lack of inadequate extension visits	32(26.7)	65(54.2)	6(5.0)	17(14.2)	2.93	3rd
Low patronage or acceptance of snail in your area	47(39.2)	45(37.5)	14(11.7)	14(11.7)	2.85	4th
Poor access to information relating to snail farming	55(45.8)	26(21.7)	0(0.0)	39(32.5)	2.81	5th
Effect of harsh weather condition	24(20.0)	60(50.0)	21(17.5)	15(12.5)	2.78	6th
Insufficient knowledge of credit source	24(20.0)	54(45.0)	17(14.2)	25(20.8)	2.64	7th
Lack of proper farmland ownership	39(32.5)	34(28.3)	0(0.0)	47(39.2)	2.54	8th
Level of education of farmers	31(25.8)	15(12.5)	30(25.0)	44(36.7)	2.28	9th
Lack of stable market for snail produced	10(8.3)	35(29.2)	45(37.5)	30(25.0)	2.21	10th
Problem of disease infestation from contamination	11(9.2)	25(20.8)	59(49.2)	25(20.8)	2.18	11th
Inadequate input such as juveniles	11(9.2)	25(20.8)	45(37.5)	39(32.5)	2.07	12th
High cost of feed supplement	16(13.3)	20(16.7)	37(30.8)	47(39.2)	2.04	13th
Tedious nature of snail farming business	10(8.3)	16(13.3)	51(42.5)	43(35.8)	1.94	14th
Religious or cultural belief against snail consumption	10(8.3)	27(22.5)	29(24.2)	54(45.0)	1.92	15th
Shortage of labour	16(13.3)	15(12.5)	30(25.0)	59(49.2)	1.90	16th
Involvement of the farmers in some off-farm jobs	16(13.3)	22(18.3)	14(11.7)	68(56.7)	1.88	17th
Poor infrastructural facilities	8(6.7)	24(20.0)	30(25.0)	58(48.3)	1.85	18th
Transportation difficulty	9(7.5)	17(14.2)	36(30.0)	58(48.3)	1.81	19th
Low technical know-how in handling snail products	5(4.2)	20(16.7)	41(34.2)	54(45.0)	1.80	20th

Source: Field survey, 2019

ownership has a mean score of 2.54, Level of education of farmers has a mean score of 2.28, Lack of stable market for snail produced has a mean score of 2.21, Problem of disease infestation from contamination has a mean score of 2.18, Inadequate input such as juveniles has a mean score of 2.07, High cost of feed supplement has a mean point of 2.04, Tedious nature of snail farming business has a mean point of 1.94, Religious or cultural belief against snail consumption has a mean point of 1.92, Shortage of labour has a mean point of 1.90, Involvement of the farmers in some off farm jobs has a mean point of 1.88, Poor infrastructural facilities has a mean score of 1.85, Transportation difficulty has a mean point of 1.81 and Low technical knowhow in handling snail products comes last with a mean of 1.80.

CONCLUSION AND RECOMMENDATION

The results of this study demonstrated the high monetary capability of the snail farming business for augmenting family revenue and improving the living expectation of the farmers. It was also discovered that stocking density and labour cost are factors that affect the revenue generated from snail production. It was observed that 65% of the household's expenditure is less than the two-thirds MPCFE, thus they are food insecure while 35% of the households are food secure because their food expenditure is more than the two-third MPCFE using the food security index. The main constraints to snail production in the study area include lack of financial capacity for business expansion, unavailability of collaterals for loan acquisition to aid farm activities, and lack of inadequate extension visits among others:

Given the findings of this research, the accompanying suggestions were made:

i) The return per naira contributed to snail production is massive. Thus, it is suggested that jobless people ought to be urged by the government to venture into snail production.

ii) Government ought to ensure snail farmers are motivated to give their production a big boost considering the return on investment and benefit of snail rearing.

iii) Extension officers should be well-trained to disseminate new ideas, techniques, and better ways of improving snail production among snail farmers.

iv) Government should invest heavily in the agricultural sector of the economy such as livestock production including snail production as it commands high prices and is highly demanded in some areas with high utility.

v) Snail meat is a rare source of protein in the human diet with high nutritive benefits which many are ignorant about, thus it should be encouraged in meals, especially for adults.

CONFLICT OF INTEREST

The authors declared no conflicts of interest with respect to the research, authorship, and publication of this article.

ETHICAL COMPLIANCE

The authors have followed ethical standards in conducting the research and preparing the manuscript.

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Received: June 11, 2022
Accepted after revisions: October 24, 2022