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# Determinants of Snail Production in Delta State

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## Abstract

*This article is on determinants of snail production in Delta State. The objectives of the study include: describe the socioeconomic characteristics of snail farmers, estimate the cost and return of snail farming, analyze the factors affecting snail profit. The study was carried out in one Local Government Area of Delta State -Warri South. Five communities were selected out of six and 50 farmers were randomly selected. Gross margin, farm budget and regression analyses were used in the study. Net farm income was positive (N53,124). Household size, stocking size and variable cost were positive and had impact on profit. Factors affecting snail production include: high cost of feed, high cost of transportation, scarcity of quality breeding stock, poor storage facilities among others. Recommendations include: more people to go into snail farming and need to sensitize people on the health benefit of snail farming.*

## Introduction

Livestock contribute to peoples' livelihood in areas of income, food, employment and social status (National Bureau of Statistics, NBS 2015). However, according to Food and Agricultural Organization (FAO, 2019) its production is currently low as it contributes around 1.7 percent to Agriculture value. Snail is a small edible animal with soft body and no legs, with the body covered by a hard shell for housing and protection. According to Oladejo, Arowolo and Oguntoye (2019), Snails are bilaterally symmetrical invertebrates with soft segmented exoskeleton in the form of calcerous shells and they belong to the phylum Mollusca. There are many varieties of snail grown in the south eastern Nigeria which include *Archatina archatina, A. marginata* and *A. fulica*, but the most grown is *A. archatina*. The giant African land snail is a good substitute for animal protein for majority of the rural poor to whom there is great deal of malnutrition as a result of poverty as they cannot afford most animal protein. As noted by Onodugo et al (2019), Asheye, Omele, Adetoro and kehinde (2017), snail could be used to reduce the problem of malnutrition. Also, Snail meat being rich in calcium, potassium, magnesium and iron is recommended for a hypertensive patient and pregnant women. It is important source of protein to human diet, and an additional source of income to farmers in recent times. (Nnodim and Ekpo, 2019)

Snail production (heliculture) is a process of raising edible land snail for human consumption both as a source of high-quality protein, medicinal and cosmetic uses. As observed by Emerbore and Ademosum (2015), protein from snail meat is said to be very rich in all essential amino acid such as lysine, leusine, argininine and tryptophan. Also, Efarmpro (2008) reported that the high iron content of snail meat is considered important in the treatment of Anaemia and also for combating Ulcer and Asthma. The

snail meat has very low cholesterol level which is useful in the treatment of arteriosclerosis and other heart-related diseases (Abere and Lameed, 2008).

Snail is usually found within the environment especially in the rural areas during the rainy season. Despite its uses and importance, its' domestication is still shabby hence the demand for snail meat has increased over the years in both domestic and foreign markets. As noted by Olufemi (2019), it is capable of providing economic empowerment, self-employment and rural development. Snail farming according to Abdulkareen (2020), Onodugo et al (2019) is a practical and viable business venture that is yet to be fully explored in Nigeria and rest of Africa. Much of the snail in the market are picked from the wild mostly by women and children, thus there has been a rapid decline in the size and number of snail population as a result of human activities such as deforestation, bush burning and rural development. However, Munonye and Moses (2019), reported that it was on this basis that heliculture which involves manipulation of the environment to make it suitable for large scale and all-season production of wholesome and desired species of snail introduced.

Akinbile (2016), opined that the advantage of snail farming over most livestock include, low capital requirement for its establishment and operation, less demand for professional knowledge, fecundity and low mortality, less labour requirement and availability to local and international markets among others. Snail is very prolific in nature and according to Olukayode (2018), it is estimated that if one starts a snail farm with one thousand adult Snail, one is sure to harvest over 16,000 snails in six months and 16,000 snails in 12 months.

**Statement of the Problem**

Snail is an excellent source of animal protein in the diet of both poor and wealthy households in Nigerians. The demand for snail meat has increased over the years as a result of its variant uses including being a very tasty and refreshing meal; this has widened the gap between its demand and supply which has made it less affordable to both the average income earners and the poor. Being very rich in so many nutrients, too many people are chasing the little being produced hence its high cost. Agbogieli, Okonta and Ezeani, (2015) also reported that snails are high in protein, iron and low in fat and it also contain almost all the amino acid required by man (Adeyeye, 2016). Even though snail farming requires small capital some people cannot provide it. Illiteracy is another problem that affects snail farming.

Ezeano (2016) noted that international trade on snails are flourishing in Europe and North America, however in spite of the considerable foreign and local demand, commercial snail farms such as those in Europe, South East Asia and America hardly exist in Africa. It is evident that snail farming requires little expertise, small space for its production and cost of production is relatively low compared to other small animals; and the nutritional composition is very high. With the rapid and continuous increase in unemployment, the youth are expected to harness such great opportunity to better their living and reduce the gap in its supply. As noted by Ugwumba, Obiekwe and Ozor (2016), Several efforts are being made to ensure that animal protein supply to

Nigerians does not decrease irrespective of the fact that population size is increasing without a commensurate increase in food production especially meat. One way of ensuring adequate meat supply to Nigerians as observed by them is to divert attention to the production of micro livestock such as grass cutter, rabbit, snail and others which have long been neglected. Despite the importance of snail farming to human, very little people go into its production. With the increasing need for organic feeding to cub disease incidents caused by too much eating of animals produced with chemicals, it is therefore important that snail farming be encouraged as they feed mostly from our kitchen left overs, herbs and fruits; and also, because it is only through conscious effort made by man to farm snail that the conservation and availability of these small animals can be made possible.

**Objectives of the study**

The broad objective of the study was to ascertain the determinants of snail production in Delta State. Specifically, the objectives were to:

i. describe the socio-economic characteristics of snail farmers
ii. identify snail production system / rearing techniques in the study area
iii. estimate the cost and return of snail farming
iv. analyze the factors affecting snail profit
v. describe the constraints to snail production in the area.

**Literature review**

**Snail production**

According to Nigerian Forum for Agricultural Advisory services (NIFAAS) (2016), to start a snail farm, it is advisable to get snails directly from the forest instead of buying from the market after they have been exposed to sunlight and have dehydrated. This is because snails drink a lot of water, so are easily dehydrated and this stresses them out and reduces their fertility capacity. The intending snail farmer could pick the snails from the bush with a very simple technique; clear a little portion of land during rainy season and sprinkle spicy fruits like pineapple, pawpaw, plantain, banana, etc at about 5o'clock in the evening, when you go back there about 7pm or 8pm, you will pick up snails suitable for rearing. Repeat the procedure until you get enough quantity. Snail meat has been consumed by humans throughout the world since prehistoric times (Yahya, 2012), and 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 (Aminu, Edun and Abiodun, 2020). Snail according to Ejidike (2002) can be reared in urban environment without infringing on the peace of neighbors. The practice also has the need for small space requirement. Besides, snail has been shown to adapt to various environmental conditions hence can be raised in small towns, cities, farms, at backyard, commercial level and villages.

Snail farming (helizculture) is an evolving industry that is laying a solid foundation for long-term economic freedom for the people

involved. The business yields good returns. Many Nigerian entrepreneurs are beginning to think that way. The need to achieve food security (produce enough food) for about 206 million (NPC 2020) has always worried the government of Nigeria and several schemes were implemented in the past to achieve this objective (FAO 2015).

In recent times, wild snail production declined due to the impact of man and other factors such as; deforestation, slash and burn, agricultural practices and overexploitation of this animal resource stemming from the world teaming population hence the few remaining species are captured before they reach maturity (Esak and Takerhash, 2018).

The land snail of West Africa which is an edible snail cultured in the study area and belongs to two closely related general; *Achatina achatina* and *Achatina marginata*. The major difference between A. *achatina* and A. *marginata* is in their shell pattern, shape of shell, apex, colour and numbers of eggs laid per clutch. These land snails are marginal but very successfully terrestrial. When actively moving they continuously use water. During period when water is unavailable, they retreat into their shell and remain inactive until conditions improve.

Interest in snail farming date's far to the Rome Empire when nobles kept snail in their backyard. It is not clear when interest in eating snails become established in Nigeria. However, before independence in 1960, the local people of Southern Nigeria used to gather snails especially the local species A. marginata from the rain forest for consumption. This happens in the early rainy season when the snails come out in large numbers.

Naturally, the snails are collected from the forest (their natural habitat). However, with the upsurge in human population of region, the pressure on the forest for other development projects and for fuel wood has increased, resulting in the loss of the habitat of these snails thereby making them very scarce and expensive. Its therefore, becomes very necessary to introduce commercial snail domestication into our farming systems.

These snails are vegetarians and will accept many types of food items. Investigation has shown that A. achatina and A. margnata are capable of utilizing a remarkable wide range of food items. However, it also prefers wet rather than dry leaves and thrives on the food plants provided in the pen. This makes for very low cost of domesticating snail. Domesticating the snail would provide conducive atmosphere for its growth and productivity all through the year. This would ensure an uninterrupted supply of the product to satisfy the demands of the consumers and as well provide regular income for the farmers.

**Socio-economic Characteristics of Snail Producers**

Ngenwi, Mafeni, Etchu and Oben (2010), in the economic analysis of edible land snail production in Jos North Local Government area of Plateau state, Nigeria, stated that majority (75.5%) of the snail farmers were male while 24.5% were female. This shows that snail farming is mostly dominated by male. 37% of the sampled snail farmers in Jos North Local Government Area, Plateau state, Nigeria, fell within the age bracket of 30-39 years, this age bracket is a productive age which portend better future for snail production. It is considered as economically

active age as stated by (Olowosegun, Sanni, Sule and Bwala (2012). This indicates that very few old people are involved in snail farming in the study area. Majority of the snail farmer (79.2%) are married while 20.8% of the farmers were single. This indicates that married people are more involved in snail farming in the study area probably to increase household income. This study is in line with findings by Yahya, (2012). In Jos metropolis, majority of the snail farmers (81.5%) were married while 18.5% of the farmers were single. Majority (98.1%) of the snail farmers were educated (secondary 56.6%, primary 22.6% and tertiary 18.9%) while 1.9 had no formal education. Education is vital to snail rearing especially in the area of record keeping and proper management. Also, commercial snail rearing being new in agroforestry production activity is seen to be embraced by educated people (Hamzat, 2014). About 81.1% of the respondents belonged to social organization such as co-operative society, farmers development union, farmers congress and community development associations. This implies that from snail rearing activities, they still have other activities they attend to and this is possible since rearing is not time consuming.

Assessing the occupational status of the respondents, Raheem, (2015), stated that majority (60%) of the snail farmers engaged more in other farming activities apart from snail farming than any other occupation. 42.8% of the respondents have years of experience in snail production ranging between 1-5 years, while 50% had between 6-10 years of experience. Also 67.4% of the respondents practice snail farming on part-time basis while the remaining 32.6% practice snail farming on full-time basis. This implies that snail farming does not deprive the respondent of the time for other productive activities. Majority (62.3%) of the part time farmers were civil servant, 25.8% were traders while 6.9% and 5% were students and contractors respectively. This implies that they are involved in snail rearing as source of increasing household income and for household consumption. Also 25% of the respondents purchased the land they are using for snail farming, 30% rented the land, while 30% and 15% got the land through inheritance and gift respectively. Raheem (2015) stated that 55% of the farmers depended on borehole, 5% of respondents depended directly on either stream or river as major source of water, 40% depended on deep well as source of water.

In terms of rearing structure, Raheem, (2015) stated that 44.7% of the respondents reared their snail in trench pen, followed by drums or pots rearing (30.8%), while 24.5% use tyre. This implies that trench pen is then most preferred among the rearing locations. Furthermore, they observed that majority 55% of snail farmers adopt intensive system of snail. Raheem, (2015), stated that snail grows well when reared under intensive system and also in this system adequate attention is channelled towards the welfare of the snails. Majority (95%) of snail farmers in the study area rear mainly Archachatina marginata, because of its excellent source of animal protein, having large body size and it's easy to manage.

According to Ebenebe, (2013) 78.5% got their laying stock from snail farmers or research institutes that produce snails for farmers, while 21.5% of the respondents got their laying stock from the bush. Especially during the rainy season and some farmers

take advantage of this to capture them for rearing. Although this is not reliable as purchasing from snail farmers, it remains quite popular probably because of it is less expensive. Also, majority of the farmers (96.2%) fed their snails once a day. This implies that snails do not require much feed since it is able to convert low quality of feed to high quality animal protein and meat. The most commonly used feeds were vegetable (71.2%), plant leaves 67.8% and kitchen waste (59.3%). Records of snail production activities were kept by 75.6% of the respondent. Kitchen waste should not contain salt, as salt draws moisture from the snail, and they basically dehydrate. They also lose the ability to move as they are unable to produce the slime that allows glide over surfaces.

Majority (98.1%) of initial source of capital used in setting up a snailery in the study area is from personal savings while the remaining 1.9% is from relatives and friends. This finding also agrees with the finding of Raheem, (2015) that 96% of the snail farmers used personal saving as source of initial capital.

**Snail rearing techniques/system**

Bayode (2010) in the snail production techniques in Owerri Agricultural Zone Imo State, Nigeria stated that 70% of the snail farms were involved in intensive system of snail rearing, 20% of snail farmers were involved in semi-intensive while 10% of snail farmers were involved in extensive system of snail farming. This implies that farmers were more involved in intensive system because snail grow well under this system.

Munonye and Moses (2010) stated that Intensive system is a commercial system and the most productive system of rearing, in this system adequate attention is channeled towards the welfare of snails. They are kept in a controlled system where feeding, watering and proper medications are provided at a regular period. Archachatina marginata when there is regular supply of water, food and lime they can grow and reproduce throughout the year (Ebenebe, 2016).

Bayode (2015) stated that in semi-intensive system the snails are commonly reared on pasture but at times in cages where minimal attention is given to the snails. They are commonly served supplementary feed to provide some nutrient and improve the productivity of the farm. In this system egg laying and hatching occur in a controlled environment, the young snails are then sorted after 6-8 weeks after hatching to grow-out pens for fattening depending on their sizes.

Munony and Moses (2010) stated that extensive system is also called outdoor, free-range snail pen, here snails are reared on pasture field majority. There is no precise feeding requirement and little attention is given to the snails, they are allowed to move around the pasture sourcing for food and water. This is a traditional method of rearing snail and commercially, it is not productive as it slows the growth rate of the snails.

**Cost and return from snail Farming**

Baba and Adeleke (2017) in the economics of snail production in Akwa Ibom State, Nigeria, used costs and return analysis to determine the profitability of snail production. This indicated that fixed cost constitutes 65.49% of the total cost of snail production while the variable cost constituted 34.51%. The cost of pen construction

(27.99%), building / structure (18.77%) were the major fixed costs incurred by the respondents while the cost of management/ staff salaries (25.12%) and feed (25.60%) constitute the major variable costs. The total quantity of snail sold by the respondents in the production period of (2010/2011) was (₦230,000) and the average price per snail at the market price in 2011 was ₦300.00. Baba and Adeleke (2017), also stated that the total cost of snail production was ₦39,855,240.00 and the total revenue of ₦59,294,900.00 was realized from sales of snail, making a net income of ₦19,439,660.00. The costs and return analysis showed that snail production is profitable in the study area. Cobbinah, Vink and Onwuka, (2014) reported that snail production is profitable in Akwa Ibom state, Nigeria.

Ajibefun and Yusuf (2016) in economic analysis of snail production in Ibadan, Oyo State, Nigeria, ascertained that the average total variable cost or rearing 600kg of snail in the study area was ₦200,370.00 while the total revenue per 600kg was #810,000.00. The analysis showed that snail producers realized ₦609,630.00 per 600kg as net income. The return per naira investment was ₦3.04. This is in line with the finding of Ahmadu and Ojogho (2012), who reported the return per naira invested in snail to be ₦1.73 in Edo State of Nigeria. Snail production was economically viable because the return on investment (ROI) was ₦3.04 which imply that for every ₦1.00 invested, ₦3.04 was realized. This shows that snail production in the study area was profitable. Labour cost was the largest component of total cost (₦90,000.00). This is at variance with the other type of livestock such as poultry where feed is the most expensive input (Ajibefun and Yusuf, 2016. The cost of vegetative materials might be low but the labour involved in obtaining them might have contributed to the high labour cost. This finding confirmed the assertion that snail production requires high capital and labour investment (Cobbinah, vink and Onwuka, 2014).

**Factors affecting snail profit**

The result of the economic analysis of edible land snail by Ojo *et al* (2019), revealed that level of education; years of experience in snail farming and farm size were significant factors influencing the profit made by the snail farmers in the study area. Also, in Mononye and Moses (2019), the profitability analysis of snail farming in Owerri agricultural zone Imo state, the F-statistic was significant at 1% level of probability indicating a good fit for the model used. The result of the coefficient of multiple determinations ($R^2$) was 0.633 implying that the independent variables jointly explained 63.3% of the variation in snail production. The remaining 37% were taken care of by variables not included in the model. Household size, cost of production was negatively related to the output of snail farmer. Increase in them reduced output. Number of snail and gender confirmed that increase in this input increase the level of returns generated. Household size and gender were statistically significant at 5% level while number of snails was positive and significant at 1% level of probability and cost of production was negatively significant at 1%. Age and education were not significant but were positively related to output. In Baba and Adeleke (2017), in the economics of snail production in Akwa Ibom State, Nigeria shows that about 89% of the variation in

profit was explained by variation in the socio-economic variables included in the model. The high explanatory power of the variables is further confirmed by the highly significant ($P<0.01$) F-value. The results in the table further show that all the explanatory variables, except age, had positive relationships with profit. However, only the coefficient with respect to stock size was statistically significant, suggesting that profit in the area was largely determined by this variable. Hence snail farmers in the area could substantially increase profits by increasing their farm sizes. In fact, an increase in stock size by one snail, other factors remaining constant, would increase profit by about 40.

**Analytical Framework**

In carrying out analysis, several analytical techniques could be used. The choice of which techniques to use is a function of the type of analysis to be carried out (Uzoagulu 2009). Analysis involving mere description are usually undertaken t using descriptive statistics that will be used in this study include likert rating scales, tables, means and charts,

However, there are other analytical techniques that will also be used in the study. These other techniques, in the view of Uzoagulu (2011) require more detailed analysis, and are used to achieve particular results.

These include linear repression analysis, gross margin analysis and Z- test statistics.

**Multiple Regression Analysis**

Multiple Regressions is one of the analytical tools that are used to determine the effect(s) of one or more variables on another. Gujarati and Porter (1995) noted that it is an economic tool which describes in mathematical form the relationship that exists between variables. It helps to determine the extent the effect to which changes in a given variable affect the other. It also helps to determine the cause - effect relationship of variables (Greene, 2003); it is said to be multiple when it has more than two variables.

The regression analysis will determine if any variable is statistically associated with the level of profitability of rice farmers in the area. However, ordinary least square (OLS) is often used in multiple regression analysis. According to Awoke (2003) it is used in constructing the production model as it gives the best fit.

Mathematically, it is expressed as $Y= F(X,X_2 X_3, ..... Xn U)$.

$Y = bo + b_1X_1+ b_2 X_2 + b3X3 ..... bnXn + U$

Where Y = dependent variable

X = individual variables induced changes or explain the behaviour of depend variable.

According Awoke (2001), the independent variable (X1) is determined outside the mode. He further stated that the dependent variable forms the bases for the predictions of the regression. bo, b1, b2, b3 ..... bn are the parameters which are the basic for the predictive measures of population or the value expected while expected while ‘’F’’ is the functional relationship and U is the error term or stochastic variables.

**Farm Budgeting Analysis**

This method is used to ascertain profitability efficiency and rates of returns on inputs (Alimi and Odogun 2000). The method essentially and extensively measures the economic efficiency or profitability of each farm enterprises.

Sani, Malumfashi, Daneji and Alao (2007) identified some measures of farm performance as follow:

1. Operating ratio (OR): This was calculated by dividing the total operating costs by the total revenue operating Ratio = Total Variable Costs = TVC

   Total Revenue

   TR

2. Fixed ratio (FR): the fixed ratio calculated by dividing the total fixed costs by the total revenue Total Fixed Cost = TFC

   Total Revenue TR

3. Net Farm incomes (NFI): This is the difference between the gross receipts and the total cost of production. It is defined as the surplus resulting from business operation which could be withdrawn without reducing the future scale of the business

   NFI = GR – (FC + VC)

   NFI = Net farm income

   GR = Gross Receipts

   FC = Fixed Costs

   VC = Variable Costs

4. Profit ($\pi$): This is difference between the gross margin and the total fixed cost

   $\pi$ = GM – TFC = (TR - TVC) = TFC = TR – TC

   Where $\pi$ = Profit (net)

   GM = Gross margin

   TFC = Total Fixed Cost

   TR = Total revenue

   TC = Total Cost

   TVC = Total variable cost

   TC = Total Cost

Odii (1999) noted that this method is used to identify unprofitable enterprise; it entails dividing and apportioning the fixed cost among the various farm enterprises that utilize the fixed cost items of the farm.

**Methodology**

**The Study Area**

The study was carried out in Warri South Local Government Area (LGA) of Delta State, Nigeria. Warri south is one of the local Governments among the 25 Local Government Areas in Delta State. It has a population of 936,789. The L G A is located at co-ordinates 5.704°N and 5.9339°E. It is made up of five communities namely; Okere, Igbudu, Iyara Odion, Ubeji and Ekurede.

The State has two distinct climatic seasons that is wet season which starts around April and ends by October and dry season which

start from November to March. Warri South has 94% humidity with average temperature estimated at 27.5 degree centigrade and it has an average rainfall of 265.31mm which gives rise to thick vegetation cover. The major occupation of the inhabitants of the study area is agriculture. Agricultural practices carried out in the area include arable and tree crops production, fishing, snailery, poultry and livestock rearing.

**Population and Sampling procedure**

The study population comprises of the entire snail producers in Warri South Local Government Area Delta State. Multi-stage random sampling technique was used to select respondents for the study. The first stage involved the selection of five communities out of six local government (Okere, Igbudu, Iyara Odion, Ubeji and Ekurede) due to predominance of snail farmers in the area. Secondly, from each of the five communities simple random sampling was used to select ten (10) snail farmers each from the communities in Warri South L G A, totaling 50 snail farmers who constituted the sample size for the study.

**Data collection**

Data for the study were collected from primary source. The data were collected using structured questionnaire and direct observation. The questionnaire included questions on the: socio-economic characteristics of snail farmers, farming system, species of snail reared, cost and return and constraints of snail farming in the study area.

**Measurement of variables.**

A reasonable number of variables were deployed in this study. These variables were measured as follows:

**i. Socio-economic Variables**

**Gender:** The measurement of gender was conducted using dummy variables to represent sex, taking on the value of 1, if the farmer is a male and 0 if the farmer is female. They could have either a positive or negative influence as the case may be.

**Age:** This was measured in years.

**Education level:** This was measured as number of years spent in school by the farmers.

**Marital status:** The respondents were asked to indicate whether they are single, married, divorced or widowed. Dummy variable 1 represent married and 0 represent otherwise.

**Household size:** The respondents were asked to indicate the total number of family members living together and eating from the same pot. It was expected to have negative influence on production output.

**Farming experience:** This was measured as the number of years the respondents had spent in snail production business. It was expected to have an influence on production output

**Farm size:** The farm size depends on the type of pen and the stocking density.

**Net farm income:** This was measured by the returns from snail production business in naira and kobo

**Access to credit facilities:** This refers to the total production credit accessed by a snail farmer from formal or informal sources within the production period. Dummy variable that were used are as follows: accessed credit = 1, otherwise = 0. It was expected to have a positive or negative effect on production output.

**ii. Snail production variables**

**Snail production output:** The output of snail was measured as the total quantity in kilograms of live snail from the production unit(s) of a farmer for a production period of 8 months.

**Snail production inputs:**

**Snail feeds:** In nature, snail obtains nutrients from various sources. Natural and artificial feeds are types of feed that can be made available to snails in the pen. Snail feed include fruits and vegetables which can be planted in another environment but harvested and fed to snail in pens. Artificial feed or compounded feeds are a mixture of ingredients. Most ingredient used have little to do with the food item the snail would consume in nature, These include millet, maize offals, sorghum offals, wheat offals etc snail feed was measured in Kilograms.

**Snail rearing system/techniques:** The respondents were asked to identify the techniques used from the list of rearing techniques listed.

**Species of snail reared:** To ascertain the species of snail reared by the respondents in the study area, a possible list of all species was listed and the respondents were asked to indicate which of the species they rear.

**Price of inputs and outputs:** The average current market prices of inputs and outputs was employed in working out the revenue and cost figures for data analysis.

**Labour:** This is the aggregate of all human physical and mental efforts used in the production. Labour is needed in snail farming in order to make sure that day to day activities in the farm are completed for the enterprise to succeed. It was measured in man-days.

iii. **Production constraints variables.**

A list of possible constraints to the economics of snail production was presented to the respondents, to indicate on four point Likert-type scale the degree of seriousness of the constraints. Their response categories were Very Serious = 4, Serious = 3, somewhat serious =2 and Not Serious = 1.

1+2+3+4 / 4= 2.5 cut – 0ff point

Using the cut-off point 2.5 for decision rule, constraints with mean value greater than or equal to 2.5 was considered as constraints facing snail farmers in study area, on the other hand items with mean values less than the cut-off point value of 2.5 was considered as not being a constraint to snail farming in the study area.

**3.5 Method of Data analysis**

The data for this study was analyzed using both descriptive and inferential statistics. Objective 1, 2 and 5 were realized using descriptive statistics such as mean, frequency distribution, percentages and tables.

Objective 3 was achieved using gross margin analysis and objective 4 achieved using multiple regression analysis.

The gross margin is given as:

GM =GI -TVC ……..

Where; GM = Gross margin (N)

GI = Gross income(N)

TVC = Total variable cost(N)

The net income is given as:

π =GM –TFC …….

Where; π = Net profit

TFC = Total fixed cost

GM = Gross margin.

**Results and Discussion of the Study**

**Socio – economic Characteristics of the Respondent**

Finding from the study (table 1) shows the distribution of snail farmers with respect to their socio – economic characteristics. Age percentage (50%) of snail farmers in the study area fell within the age bracket of 31 - 40 years, (28%) fell within 41-50 years, (16%) also fell within 30years , while (6%) fell within 51 – 60 years. This age bracket is a productive age which portends better future for snail production. It is considered as economically active age. This is in line with the findings of Ngenwi, Mafeni, Etchu and Oben (2010). This indicates that very few old people are involved in snail farming in the study area. This is because snail farming requires adequate attention and a lot of sense of responsibility.

Sex plays a very important role in snail farming and agriculture, in terms of property acquisition for example, fixed assets like land and machines. Majority (70%) of snail farmers were male while 30% were female. This result can be justified by the assertions of Anowor, Ukwueni and Ezekwem (2013), Ahmudu et al (2012) that heliciculture activities are mostly dominated by men. In this study, it was discovered that majority (60%) of the farmers were married while 20% were also single, 10% each were widowed and divorced. 18% of the respondents had tertiary education, 30% of the farmers had secondary education, 32% of farmers had primary education while the respondents without formal education were 20%. This means that snail farming is dominated by the educated class. This is so because snail farming requires a lot of technical and scientific knowledge to be successfully undertaken. The mean household size was found to be appropriately 7 people per household, this was an indication that the more educated and urban – based an individual is, the less family-size that individual will keep. This is consistent with the finding of Yahya, 2012.

Table 1 revealed that 48% had snail farming experience ranging between 1-10 years, while 50% had between 11-20 years of experience. As a result, the respondents with the highest number of years of experience should have a good skill and better approaches to snail farming business. The

respondents with longer years of experience were also able to forecast market situation in which they sell their products at higher prices. Those with less years of experience, especially with less than 5 years, faced many risks in the early days of their snail farming business. 30% of the respondents purchased the land they are using for snail farming, while 32% rented the land, while 32% and 6% got the land through inheritance and gift respectively. Majority (60%) of the sampled respondents in the study area do not have access to extension service.

The study shows that majority (80%) of the sample respondents in the study area do not belong to any registered or unregistered society which may be as a result of lack of awareness and interest. Hence, being a member of association group could create peer pressure for farmers to adopt new technologies. This is in line with the finding of Anowor et al (2019) and Ahmudu and Ojogho (2012) who observed that groups ensure that members derive benefit from the groups in which they cannot derive individually if they were acting alone. More than one quarter of the farmers did not have group status so they operated as ordinary members and this may have effect on their access to credit facilities and adoption of technologies as it is easier to pass information to a group then individual farmer.

**Table 1 Socio-Economic Characteristics of Snail Farmers in the Study Area**

| Variable | Frequency | Percentage | Mean |
|---|---|---|---|
| **Age** | | | |
| 0-30 | 8 | 16 | 36.22 |
| 31-40 | 25 | 50 | |
| 41-50 | 14 | 28 | |
| 51-60 | 3 | 6 | |
| **Gender** | | | |
| Male | 35 | 70 | |
| Female | 15 | 30 | |
| **Marital Status** | | | |
| Single | 10 | 20 | |
| Married | 30 | 60 | |
| Widowed/widower | 5 | 10 | |
| Divorced | 5 | 10 | |
| **Educational Level** | | | |
| No-formal education | 10 | 20 | |
| Primary education | 16 | 32 | |
| Secondary education | 15 | 30 | |
| Tertiary education | 9 | 18 | |
| **Household Size** | | | |

| | | | |
|---|---|---|---|
| 1-5 | 16 | 32 | 7 |
| 6-10 | 30 | 60 | |
| 11-15 | 4 | 8 | |
| **Years of Experience** | | | |
| 1-10 | 24 | 48 | 10.9 |
| 11-20 | 25 | 50 | |
| 21-above | 1 | 2 | |
| **Mode of Land Acquisition** | | | |
| Purchase | 15 | 30 | |
| Lease/ rent | 16 | 32 | |
| Inheritance | 19 | 38 | |
| **Co-Operative Society** | | | |
| None | 40 | 80 | |
| Members | 10 | 20 | |

**Source: Field Survey, 2021**

**2 Snail Production System/Techniques**

The data in table 2 shows that 70% of snail farmers adopt intensive system. Snail farmers in the study area preferred intensive system to extensive system. This is because snail grows well under intensive system. This was also supported by Bayode (2015) who observed that snail grows better when reared under intensive system also help the species to grow to its biggest size. Majority of the farmers reared their snail in trench pen (50%) followed by fenced pens (20%) and the least used tyres. This implies that trench pens are the most preferred among the breeding location.

Farm record is very important in agricultural business because it shows the overall performance of that particular enterprise as any point in time. As a result of the importance of record keeping data in table 2 shows that greater number of respondent (90%) keeps record of their snail production activity, while 10% doesn't keep record. 30% of snail farmers feed their snail with formulated feed, 20% of the respondent feed their snail with leaves/fruit also 14% of the respondent feed their snails with domestic waste without salt content. Most snail farmers in the study area feed their snail once a day with mean frequency of feeding being 1.06 which is approximately one. This implies that snail does not require much feed since it's able to convert low quantity feed to high quality animal protein and meat.

More than three quarters (42%) of the respondent used well water in their snailery. This implies that the farmers would not be spending much on water since a well can be dug in the snailery to ease management activity thereby reducing the cost of snail production in a long run.

**TABLE 2 Snail Production System/Techniques**

| Variable | Frequency | Percentage |
|---|---|---|
| **Types of Rearing System** | | |

| | | |
|---|---|---|
| Intensive system | 35 | 70 |
| Semi intensive | 5 | 10 |
| Extensive | 10 | 20 |
| **Methods of snail rearing** | | |
| Trench pens | 25 | 50 |
| Fenced pen | 10 | 20 |
| Drums or pots | 7 | 14 |
| 7 14 | | |
| Tyres | 5 | 10 |
| Others | 3 | 6 |
| **Record Keeping** | | |
| Yes | 46 | 92 |
| No | 4 | 8 |
| **Feed Consumed** | | |
| 1. Formulated feed | 15 | 30 |
| 2. Leaves/fruits | 10 | 20 |
| 3. Domestic waste | 7 | 14 |
| 1 and 2 | 8 | 16 |
| 1 and 3 | 5 | 10 |
| 2 and 3 | 5 | 10 |
| **Frequency of Feeding Per Day** | | |
| Once | 25 | 50 |
| Twice | 18 | 36 |
| More than twice | 7 | 14 |
| **Source of Water** | | |
| Well | 21 | 42 |
| Stream | 11 | 22 |
| Bore hole | 18 | 36 |

**Source: Field survey 2021**

## Profitability of Snail Production in the Study Area

Table 3 shows the estimate of costs and return analysis made from snail farming using average cost (fixed and variable) and yield data generated by each of the sample snail farmers per season. The costs and return analysis reveal that variable cost accounted for the smallest proportion of the total cost of snail farming in the study area. This shows the amount of money spent by the snail farmer on variable cost in the study for purchase of snail feeds, initial stock, labour and cost of other materials. The fixed cost of production consists of fixed asset, cost of land purchase /rent, trench pen, wooden pen, water, wheel barrow e.t.c which accounted for the largest proportion of the total cost. This is in line and consistent with the findings

of Ahmudu and Ojogho (2012) from their studies on Economics of snail production in Edo state, Nigeria. The result show that an average total cost (TC) of ₦43,164 was incurred by the respondent per cropping season while Total Revenue (TR) of ₦96,288 was realized with a returning Net farm income (NFI) of ₦53,124 and the Rate of return on investment of 1.99. This shows that for every ₦1 invested additional ₦1.40kobo is gained by the respondent in the study area. This indicates that snail farming in the study area was profitable. This result is consistent with the finding of Ahmudu and Ojogho (2012), who reported that the returns per naira invested in snail to be N1.73 in Edo State of Nigeria, indicating that snail farming is a profitable venture to invest in.

**Table 3: Profitability/Costs and return of snail production in the Study Area**

| Items | Quantity/ Cost | Amount (₦) |
|---|---|---|
| 1) Total Revenue (TR) | | |
| Sales from matured snail | 802.4/600kg @₦120 | 96,288 |
| 2) Variable cost | | |
| Labor in man-days | 1,446 | |
| Transportation | 1,762 | |
| Brooding stock | 5,860 | |
| Feed | 5,430 | |
| Water | 1,050 | |
| Medication | 1650 | |
| Detergent | 1300 | |
| Total Variable Cost | | 18,498 |
| 3) Fixed cost | | |
| Opp. Cost of land | 7800 | |
| Hatchery | 8510 | |
| Basin/ basket | 6306 | |
| Wheel barrow | 2050 | |
| Total Fixed Cost | | 24,666 |
| Total Cost (TC) | | 43,164 |
| Net Farm Income | TR-TC | 53,124 |
| Return on investment | ROI (TR/TC) | 1.99 |

**Source:** field survey 2021

**Factors affecting profit in snail production.**

The result of the regression analysis showed a high coefficient of multiple determination ($R^2$) value of 0.753 implying that 75% variability in profit of snail production were explained by the independent variables included in the model. The F-ratio (18.276)) is significant at 99% implying goodness of fit of the model. The result show that the coefficient of stocking size and household size were positively significant at 99% and 95% respectively indicating that a unit increase in them will lead to increase in snail profit. This is in line with Baba and Adeleke (2006) and in Aminu *et al* (2020) where stock size was positively significant at 99% level. Increase in household size may lead to more provision of family labour which will in turn reduce labour cost. The coefficient of variable cost was negatively significant at

90% indicating that any increase in variable cost will lead to a decrease in snail profit. This is in line with the "*a priori*" expectation that cost has an inverse relationship with profit. This is also in line with Caroline (2015), that labour cost and cost of feed were negatively significant to profit in snail production. The coefficient of fixed cost and years of experience were negatively not significant to snail profit in the area. The coefficient of educational qualification and cooperative membership were positive but not significantly affecting profit in snail production. This conforms with Oladejo *et al* (2019) that educational level was but not significant in snail profit.

**Table 4: Result of the linear regression on factors effecting profit in snail production.**

| **Variables** | **Coefficients** | **Standard errors** | **T-Values** |
|---|---|---|---|
| Constant | 2737.164 | 7895.189 | 3.469*** |
| Educational qualification | 180.960 | 161.820 | 1.118 |
| Household size | 12.680 | 3.852 | 3.292** |
| Stocking size | 74.649 | 10.400 | 7.178*** |
| Variable cost | -0.965 | 0.440 | -2.194* |
| Fixed cost | -0.162 | 0.424 | -0.381 |
| Years of experience | -82.536 | 209.055 | -0.395 |
| Cooperative society member | 274.563 | 1619.884 | 0.169 |
| F-stat | | | 18.276*** |
| $R^2$ | | | 0.753 |
| Adj. $R^2$ | | | 0.712 |

**Source: Field survey 2021.**

**Constraints Facing the Respondents**

Table 5 shows the mean distribution of the respondents according to constraints faced. Only 5 out of the 14 presented were rated as serious constraints facing snail farmers in the study area. These were; high cost of feed (2.62), low/lack of financial capacity for business expansion (2.38), poor storage facilities (2.16), scarcity of quality breeding stock (2.12), and high cost of transportation (2.1) in that order. The combined effect of these factors is capable of affecting the economics of snail production by farmers. This finding agrees with that of Baba and Adeleke (2017) who reported that high cost of feed, lack of financial capital and scarcity of quality breeding stock were responsible for the low rate of snail production by snail farmers in Nigeria.

**Table 5 Mean distribution of respondents according to constraints**

| Constraint | Total score | Mean score | Decision |
|---|---|---|---|
| High cost of feeds | 131 | 2.62 | Accept |
| Low/lack of financial capacity for business expansion | 119 | 2.38 | Accept |
| Poor storage facilities | 108 | 2.16 | Accept |
| Scarcity of quality breeding stock | 106 | 2.12 | Accept |
| High cost of transportation | 105 | 2.1 | Accept |
| Lack of stable market for snail produced | 93 | 1.96 | Reject |
| Poor access to information relating to snail farming | 92 | 1.84 | Reject |
| Absence of strong cooperative society | 85 | 1.7 | Reject |
| Scarcity of land for pen construction | 82 | 1.64 | Reject |
| Problems of diseases infestation from Contamination | 82 | 1.64 | Reject |
| Low technical know-how in handling snail product | 82 | 1.64 | Reject |
| Religious or cultural belief against snail Consumptions | 80 | 1.6 | Reject |
| Insufficient labour | 78 | 1.56 | Reject |
| Source of water | 77 | 1.54 | Reject |

**Source:** Field survey, 2021

## Summary

This study examined the determinants of snail profit in Warri South Local Government Area of Delta state. The specific objectives were to; describe the socio-economic characteristics of snail farmers; identify snail production system/rearing techniques; determine the costs and return of snail farming; analyze the factors that could affect snail profit and identify constraints facing snail farming.

The study population consisted of all snail farmers in the study area; however, a sample of 50 snail farmers were purposively chosen from five communities within the L.G.A were used as respondents. Data collections were done through the use of structured questionnaire and direct observation. Data analysis was done using descriptive and inferential statistics. The summary of the finding include the following; the mean age of the respondents was 36.22 years. About 70% of the respondents were male and 30% were female, an indication that men were mostly involved in snail production in the study area. Average household size was 7 persons with majority (60%) having household whose sizes ranges from 6-10 person. Greater percentage (32%) had primary education and 18% of them had tertiary education level. Most (50%) of respondents had 11-20 years of snail farming experience with a mean of 10.9 years, indicating that most of the farmers had been in the business for a long time and were therefore conversant with the problems of snail production in the study area. About 60% of the respondents were married. 80% of the respondent used personal savings as seed money (capital). 70% of the snail farmers practiced intensive system because snail grows well under intensive system. 50% of the snail farmers practiced trench pens production techniques according to them; they obtained higher output using this method. 40% of snail farmers reared Archatinaarchatina, 32% reared Archatinamarginata, while 26% reared Archatinaarchatina and Archatinamarginata this is because it lays more egg and very affordable.

Average total cost of ₦43,164 was incurred by the respondents during the cropping season while total revenue of ₦96,288 was realized with a returning net farm income of ₦53,124 and the rate of return on investment of 1.99. This shows that snail farming is a very profitable venture to invest in.

The result of the multiple regression analysis showed a high coefficient of multiple determinations of 75% and F-stat significant at 99% level. The coefficient of stocking size and household size were positively and significantly related to profit at 99% and 95% levels respectively. Variable cost was negatively significant at 90% level showing inverse relationship with profit. Coefficients of level of education and cooperative membership were positively related to profit but not significant; lastly fixed cost and years of experience where negatively not significant to profit in snail profit.

The study also observed that high cost of feeds, lack of financial capacity for business expansion, poor storage facilities, scarcity of quality breading stock, high cost of transportation are the major problems faced by snail farmers in the study area. While Lack of stable market for snail produced, Poor access to information relating to snail farming, absence of strong cooperative society, Scarcity of land for pen construction, problems of diseases infestation from contamination, insufficient labour and source of water do not constitute a serious constraint

**Conclusion**

The incidence of Covid-19 increased hunger especially during the lock down as most farmers found it difficult going to their farms, there is however a need to diversify production for increased income and reduce hunger. Snail farming is a venture that can be undertaken in the farmer's immediate environment using just a small space. From the study, Snail farming in Warri South Delta State, Nigeria is a very profitable venture as justified by the net farm income generated by the farmers and high return on every one

naira spent, regardless of the constraints they face which includes; high cost of feed, low/lack of financial capacity for business expansion, poor storage facilities, scarcity of quality breeding stock, and high cost of transportation, snail farming is worth venturing into.

**Recommendations**

Based on the findings of this study, the following recommendations are made;

There is need for more people to go into snail family to bridge the gap between demand and supply. This will in turn create employment for the unemployed as return per naira invested on snail production is very high and alleviate poverty.

Farmers in Snail production should focus more on left overs' from the kitchen as source of feed to reduce variable cost.

Prices of feeds and access to feeds by snail farmers should be regulated by the state government in order to ameliorate the problems of high cost of feed/inadequate supply of feed to snail farmers in the state.

- There is need to sensitize people on the health benefits of snail as a better alternative to red meat to get the daily recommended protein intake.
- Government should be ready at all times to buy surplus production from snail farmers so that prices will not fall so low in the market thereby discouraging increased production subsequently.

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