

**ASSESSMENT OF PRODUCTION SYSTEMS OF  
SNAILS IN BENIN CITY**

**BY**

**Amasowomwan Daniel ORHUE  
AGR1500116**

**DEPARTMENT OF ANIMAL SCIENCE  
FACULTY OF AGRICULTURE  
UNIVERSITY OF BENIN  
BENIN CITY, NIGERIA.**

**AUGUST, 2021**

**ASSESSMENT OF PRODUCTION SYSTEMS OF  
SNAILS IN BENIN CITY**

**BY**

**Amasowomwan Daniel ORHUE  
AGR1500116**

**A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF  
ANIMAL SCIENCE, FACULTY OF AGRICULTURE, UNIVERSITY OF  
BENIN, BENIN CITY, IN PARTIAL FULFILMENT OF THE  
REQUIREMENT FOR THE AWARD OF BACHELOR OF  
AGRICULTURE (B. AGRIC) DEGREE.**

**AUGUST, 2021**

## ACKNOWLEDGEMENTS

I give God all the thanks for His faithfulness upon my life and for His exceeding grace for bringing me this far in my academic pursuit.

I want to appreciate my Head of Department who is also my wonderful supervisor, Prof. J.M. Omoyakhi for his supervision, understanding, support, guidance and advice throughout the period of my project work and also my study year. I also want to appreciate my co-supervisor, Dr. E. Okhale for his commitment, availability and guidance during the short period of time he spent working with me on my project. My gratitude also goes to all my Animal Science Lecturers, Prof. S.O. Nwokoro, Prof. J.O. Igene, Prof. U.J. Ikhatua, Prof. M.A. Bamikole, Prof. Imasuen, Dr. Mrs. B.J. Oyekun, Dr. P.A. Ebabhamiegbebho, Dr. G.I.O Odafe, Dr. N.C. Akaeze, Dr. Mrs. G.O. Egigba, Dr. W.O. Agbonghae, Mr. P. Aduba, Mr. E.S. Abel, Mrs. B. Issac, Mrs. Victoria, Dr. Bello and other lectures whom I failed to mention, who have one way or the other impacted more on me and guided me in several aspects of my life.

To all my friends that have been there for me in one way or the other giving your support, advice and love especially Asemota Pius Oghosa, Abdulkadiri Muhammed, Enuechusue George Onyekachi. I truly love you all and I thank God for bringing you all my way.

My warmest love, appreciation and gratitude goes to my family members who means everything to me. To my lovely parents (Mr. and Mrs. Orhue) and my siblings for their support, prayers, advice, love and care to help me carry on. My deepest appreciation to my beloved aunt (Mrs. Julie Osaremwinda) for your motherly love and for being the vessel God has used to make me what I am today.

## **CERTIFICATION**

This is to certify that this project work was carried out by:  
**Amasowomwan Daniel ORHUE** with Matriculation Number **AGR1500116** of the  
Department of Animal Science, Faculty of Agriculture, University of Benin, Benin  
City, Nigeria.

---

**PROF. J. M. OMOYAKHI**  
**(Project Supervisor)**

---

**DATE**

---

**PROF. J. M. OMOYAKHI**  
**(Head of Department)**

---

**DATE**

## **DEDICATION**

This work is dedicated to God Almighty who is the creator, the reason for my living and the source of knowledge. Also to my beloved parents (Mr. and Mrs. Orhue) and siblings whom are my source of inspiration and who have provided for me even in the time of lack, whose love, care and support have kept me.

## TABLE OF CONTENTS

|                                       | <b>PAGE</b> |
|---------------------------------------|-------------|
| Title page - - - - -                  | i           |
| Acknowledgements - - - - -            | ii          |
| Certification - - - - -               | iii         |
| Dedication - - - - -                  | iv          |
| Table of Contents - - - - -           | v-x         |
| List of Tables - - - - -              | xi          |
| List of Figures - - - - -             | xii         |
| Abstract - - - - -                    | xiii        |
| <br>                                  |             |
| <b>CHAPTER ONE</b>                    | <b>1</b>    |
| 1.0 Introduction - - - - -            | 1           |
| 1.1 Justification - - - - -           | 3           |
| 1.2 Objectives of the Study - - - - - | 3           |
| 1.2.1 Main Objective - - - - -        | 3           |
| 1.2.2 Specific Objectives - - - - -   | 3           |

|   |          |
|---|----------|
| <b>CHAPTER TWO</b>                                    | <b>4</b> |
| 2.0 Literature Review - - - - -                       | 4        |
| 2.1 Choosing a Site - - - - -                         | 4        |
| 2.1.1 General Considerations - - - - -                | 4        |
| 2.1.2 Temperature - - - - -                           | 5        |
| 2.1.3 Humidity - - - - -                              | 5        |
| 2.1.4 Wind Speed and Direction - - - - -              | 6        |
| 2.1.5 Light Intensity - - - - -                       | 6        |
| 2.1.6 Soil Characteristics - - - - -                  | 7        |
| 2.2 Constructing a Snailery - - - - -                 | 8        |
| 2.2.1 Choosing a System: The Options - - - - -        | 8        |
| 2.3.1 Types of Snailery - - - - -                     | 9        |
| 2.3.1.1 Car tyres, oil drums - - - - -                | 9        |
| 2.3.1.2 Advantages of car tyre, oil drum - - - - -    | 10       |
| 2.3.1.3 Disadvantages of car tyre, oil drum - - - - - | 10       |
| 2.3.1.4 Hutch boxes - - - - -                         | 10       |

|   |   |   |   |   |   |   |   |       |
|---|---|---|---|---|---|---|---|-------|
| 2.3.1.5 Advantages of hutch boxes                     | - | - | - | - | - | - | - | 11    |
| 2.3.1.6 Trench pens                                   | - | - | - | - | - | - | - | 11    |
| 2.3.1.7 Mini-paddock pens                             | - | - | - | - | - | - | - | 11    |
| 2.3.1.8 Free-range pens                               | - | - | - | - | - | - | - | 12    |
| 2.4 Management  | - | - | - | - | - | - | - | 12    |
| 2.4.1 Seasonal and Daily Management                   | - | - | - | - | - | - | - | 12    |
| 2.4.1.1 Seasonal management of snails includes        | - | - | - | - | - | - | - | 13    |
| 2.4.2 Daily management                                | - | - | - | - | - | - | - | 14    |
| 2.4.2.1 Daily management of snails includes           | - | - | - | - | - | - | - | 14    |
| 2.4.3 Management of Predators, Parasites and Diseases | - | - | - | - | - | - | - | 15    |
| 2.4.3.1 Predators                                     | - | - | - | - | - | - | - | 15    |
| 2.4.3.2 Management of predators                       | - | - | - | - | - | - | - | 16    |
| 2.4.3.3 Parasites and Diseases                        | - | - | - | - | - | - | - | 16-17 |
| 2.5 Economics of African Land Snails                  | - | - | - | - | - | - | - | 18    |
| 2.5.1 As a Food Source                                | - | - | - | - | - | - | - | 18    |

|                      |   |   |   |   |   |   |   |   |           |
|----------------------|---|---|---|---|---|---|---|---|-----------|
| 2.5.2                | Medicinal Uses                          | - | - | - | - | - | - | - | 18        |
| 2.5.3                | Formulations                            | - | - | - | - | - | - | - | 19        |
| 2.5.4                | Snail Cream                             | - | - | - | - | - | - | - | 20        |
| 2.5.5                | The Shell                               | - | - | - | - | - | - | - | 20        |
| 2.6                  | Constraints to Heliculture in Edo State | - | - | - | - | - | - | - | 20-21     |
| <b>CHAPTER THREE</b> |   |   |   |   |   |   |   |   | <b>22</b> |
| 3.0                  | Materials and Method                    | - | - | - | - | - | - | - | 22        |
| 3.1                  | Study Area and Scope                    | - | - | - | - | - | - | - | 22        |
| 3.2                  | Population of the Study                 | - | - | - | - | - | - | - | 23        |
| 3.3                  | Sampling Technique and Sample Size      | - | - | - | - | - | - | - | 23        |
| 3.4                  | Data Collection                         | - | - | - | - | - | - | - | 24        |
| 3.5                  | Method of Data Analysis                 | - | - | - | - | - | - | - | 24        |
| <b>CHAPTER FOUR</b>  |   |   |   |   |   |   |   |   | <b>25</b> |
| 4.0                  | Results                                 | - | - | - | - | - | - | - | 25        |
| 4.1                  | Socio-economic Characteristics          | - | - | - | - | - | - | - | 25        |
| 4.1.1                | Sex                                     | - | - | - | - | - | - | - | 25        |

|                     |                                      |   |   |   |   |   |   |   |              |
|---------------------|--------------------------------------|---|---|---|---|---|---|---|--------------|
| 4.1.2               | Age Distribution                     | - | - | - | - | - | - | - | 26           |
| 4.1.3               | Marital Status                       | - | - | - | - | - | - | - | 27           |
| 4.1.4               | Occupation                           | - | - | - | - | - | - | - | 28           |
| 4.1.5               | Educational Level                    | - | - | - | - | - | - | - | 29           |
| 4.2                 | Do you eat snails?                   | - | - | - | - | - | - | - | 30           |
| 4.2.1               | Years of Snailery Experience         | - | - | - | - | - | - | - | 31           |
| 4.3.1               | Production Characteristics           | - | - | - | - | - | - | - | 32-36        |
| 4.4.                | Management Characteristics           | - | - | - | - | - | - | - | 37-40        |
| <b>CHAPTER FIVE</b> |                                      |   |   |   |   |   |   |   | <b>41</b>    |
| 5.0                 | Discussion                           | - | - | - | - | - | - | - | 41-42        |
| <b>CHAPTER SIX</b>  |                                      |   |   |   |   |   |   |   | <b>43</b>    |
| 6.0                 | Conclusion and Recommendation        | - | - | - | - | - | - | - | 43           |
| 6.1                 | Conclusion                           | - | - | - | - | - | - | - | 43           |
| 6.2                 | Recommendation                       | - | - | - | - | - | - | - | 43-44        |
| <b>REFERENCES</b>   |                                      |   |   |   |   |   |   |   | <b>45-49</b> |
| <b>APPENDIXES</b>   |                                      |   |   |   |   |   |   |   | <b>50</b>    |
|                     | Appendix I (Research Questionnaire)- | - | - | - | - | - | - | - | 50-52        |

Appendix II (List of Plates) - - - - - 53

## LIST OF TABLES

|          |  |   |   |   |   |   | <b>PAGE</b> |
|----------|--|---|---|---|---|---|-------------|
| Table 1: | Sampling distribution of the respondents | - | - | - | - | - | 24          |
| Table 2: | Do you eat Snails                        | - | - | - | - | - | 30          |
| Table 3: | Production Characteristics               | - | - | - | - | - | 32-36       |
| Table 4: | Management Characteristics               | - | - | - | - | - | 37-40       |

## LIST OF FIGURES

|           |                                      |   |   |   |   | <b>PAGE</b> |
|-----------|--------------------------------------|---|---|---|---|-------------|
| Figure 1: | Sex of the respondents               | - | - | - | - | 25          |
| Figure 2: | Age Distribution of the respondents  | - | - | - | - | 26          |
| Figure 3: | Marital Status of the respondents    | - | - | - | - | 27          |
| Figure 4: | Occupation of the respondents        | - | - | - | - | 28          |
| Figure 5: | Educational Level of the respondents | - | - | - | - | 29          |
| Figure 6: | Years of Snailery Experience         | - | - | - | - | 31          |

## **ABSTRACT**

Edible land snails are commonly called “Congo meat” and are one of the most popular delicacies in Nigeria. The edible portion of the snail meat is high in protein (12-16%), iron (45-50mg/kg) and low in fat (0.05-0.08%) and its protein was reported to contain all the essential amino acids such as leucine, phenylalanine, lysine and isoleucine needed by the body for its metabolic activities.

The study on the Assessment of Production Systems of Snails in Benin City was carried out in five markets and data were collected through a one on one interview guide. Fifty (50) respondents were randomly selected and interviewed from the various locations. Data obtained were analyzed using Descriptive Statistics on the production and management of snails and Bar-charts on the socio-economic characteristics of the respondents.

The results showed that 32% respondents were male while 68% were females. 34% respondents were within the age group of 26-35 years. In terms of educational status, 20% had primary certificate, 14% secondary certificate, 40% tertiary certificate and 26% informal. Also 30% of the respondents were traders and farmers respectively.

## CHAPTER ONE

### 1.0 INTRODUCTION

The African edible land snail, *Archachatina marginata* (Swainson) is land shelled Mollusca in the class gastropoda (Akinnusi, 1998). The pulmonate gastropoda are hermaphrodites with no tenidium, but the mantle cavity is vascularized and converted into a lung for breathing air. The genus *Archachatina* belong to the family *Archatinade*, sub-family *archatinidae* which are characterized with large shell.

Heliculture, which is the process of farming or raising snails, has become very important in recent times because of increased animal protein storage. Also, the availability of some edible snails in Nigeria, their popularity, acceptability nationwide and the potential for export including the emerging technologies for their production have largely contributed towards the present renewed interest in snail farming (Amusan and Omidiji, 1998). *Archachatina marginata* is the second largest gastropod among the giant African land snails (CAB, 2003; Venette *et al.*, 2004), but the most popular breed of snail kept and reared in Nigeria. They are small in size, easy to manage, require limited land to establish, and noiseless (Ejidike *et al.* 2004). Snails have high prolific fecundity compared with other livestock and are capable of continuous egg laying several times over a period after single mating.

The snails feed on large variety of plants, mainly fruits (Akinnusi, 1998). Plants included in the diets of snails are bananas, pawpaw and peas, lettuce etc., some of which are important crops in certain economy. The success in snail production involves among other things proper nutrition and housing. Nutrients such as energy, protein and minerals should always be provided. Snail production holds lots of potentials in the Nigerian livestock industry and can serve as a means to alleviate the acute protein shortage and it is also rich in iron (up to 50%) which helps to treat iron deficiency anemia which is common among people in tropical countries (Ajayi, 1980).

There are different varieties of snails and are however not all suitable for consumption. The meat is a rich source of protein to man. Snail is low in fat, rich in iron and also rich in calcium (Imevbore and Ademosun, 1988). Edible land snails are commonly called “Congo meat” and are one of the most popular delicacies in Nigeria. The edible portion of the snail meat is high in protein (12-16%), iron (45-50mg/kg) and low in fat (0.05-0.08%) and its protein was reported to contain all the essential amino acids such as leucine, phenylalanine, lysine and isoleucine needed by the body for its metabolic activities (Baba and Adeleke, 2006). Edible land snails range in size from about 1mm long to the Giant African snails which can grow up to 312mm long (Van and Appleton, 1999).

## **1.1 Justification**

The purpose of this study is to know how snails can be assessed and the different production systems that can be engaged in snail farming in Benin City. Adequate understanding to this will help the farmers to know the type of production system to engage in and the various housing systems used when raising snails. Assessment of the production of snails requires vital information such as sources of breeding stock (snail source), the different production systems, the different housing systems, challenges to snail farming and economic importance.

## **1.2 Objectives of the Study**

### **1.2.1 Main Objective**

The main objective of the study is to assess the snail production systems in Benin City.

### **1.2.3 Specific Objectives**

The specific objectives were to

1. Identify the various production systems of snails in Benin City
2. Identify the various housing systems of snail production in Benin City
3. Identify the challenges of snail farming in Benin City
4. Evaluate snail economic return

## **CHAPTER TWO**

### **2.0 LITERATURE REVIEW**

#### **2.1 CHOOSING A SITE**

##### **2.1.1 General Considerations**

Snails are adept at escaping from enclosures. A priority in setting up a productive snail farming ventures therefore is to construct escape-proof housing. There are several types of snail housing (snaileries) to choose from, depending on the size of the venture. The first thing however in choosing a snaileries is to select an appropriate site (Akinnusi, 1998).

The main factors to consider in site selection are the following;

- i. Temperature
- ii. Humidity
- iii. Wind speed and direction
- iv. Light intensity
- v. Soil characteristics
- vi. Safety, protecting the snails from diseases, predators and poaches.

Optimal site selection helps to prevent, or at least reduce, dormancy. Factors such as temperature and humidity and soil characteristics that influence snail survival and growth are discussed.

### **2.1.2 Temperature**

Temperature is a major factor that influences the activities of snails. Snail requires lower and moderate temperature for normal feeding and body functions. Temperature ranges of between 23 - 28°C are suitable for snails' growth and development. During hotter periods with high ambient environmental temperature, snails may experience heat stress. Heat stress poses a serious economic threat to snail's population and snails under domestication. The effect of heat occasioned by high temperatures on snails could be in the form of reduced feed intake and utilization, reduced egg production, reduce growth rate, low body weight, poor hatchability and fertility. Okafor (2001) stated that snails aestivate especially during dry hot unfavorable seasons. Air, environmental and noise pollutions affects snails (Ebenso and Ologhobo, 2009).

### **2.1.3 Humidity**

Snails enjoy moist and cooler environments, which is usually achieved when it rains, the atmospheric air become moist with high relative humidity. Snails are active at a relative humidity of between 70 - 90%. However acidic rains in some areas caused by

high air pollutants adversely affect snails' population (Ojiako, 2006). If the air is drier and hot, for longer periods, snails may dry up and die or hibernate. Snail pens and the top soils should be sprinkle with water regularly during hot periods especially in the dry seasons to maintain adequate damp environment (Ikechukwu, 2012).

#### **2.1.4 Wind Speed and Direction**

This is another climatic factor that may result in severe dehydration in snails and may cause them to retract into their shells, rather than feeding to gain weight and to breed. Prolong periods may cause the snails to go into aestivation which is a period of inactivity or dormancy in the life of snails (Okafor 2001).

To prevent snails from drying out, snaileries should be situated in a sites that are protected from the wind. Downhill sites are usually the most suitable, preferably those with good tree cover to reduce wind impact. Planting(fruit) trees around snail pens will help to reduce wind speed and improve the micro-climate. It will also protect the snail from scorching sun or torrential rain (Okafor 2001).

#### **2.1.5 Light Intensity**

Snail requires light for their activities such as feeding and breeding. Though snails are nocturnal animals, however they require light for some photo-biological processes essential in the energy level and food chain e.g. cellular digestion and photosynthesis.

Day light is usually from the sun, longer periods of light stimulate and prompt snails into reproduction under favorable conditions (Ikechukwu, 2012).

#### **2.1.6 Soil Characteristics**

Snails depend very much on the soil for their food and reproduction e.g. egg laying. They can hardly survive or thrive effectively in the absence of a suitable soil-type. They require moist, aerated, easily drained, non-waterlogged and non-acidic soils. Soil rich in minerals contents and organic matters are good as too soil for snail farming after being sterilized to kill pathogens in the soils (Ikechukwu, 2012).

Soil is a major part of a snail's habitat. Soil composition, water content and texture are important factors to consider in site selection for the following reasons;

- a) The snail's shell is made up mainly of calcium derived from the soil and from feed
- b) Snail derive most of their water requirements from the soil
- c) Snails dig in the soil to lay their eggs and to rest during the dry season.

For all these reasons it is essential that the soil is loose and that its calcium and water content is high.

## **2.2 CONSTRUCTING A SNAILERY**

### **2.2.1 Choosing a System: The Options**

The type and dimensions of snailery or snaileries depend obviously on the snail growing system and on the quantity of snails intend to produce. As far housing is concerned, snail farm could be extensive, semi-intensive, or intensive, in increasing order of complexity, management and financial inputs. Three options might be considered;

- i. Extensive system: outdoor, free-range snail pens
- ii. Semi-intensive system: egg laying and hatching occurs in a controlled environment; the young snails are then removed after 6-8weeks to outside pens for growing fattening or both
- iii. Intensive system: closed systems, for example plastic tunnel houses, green houses and buildings with controlled climate (Akinbile, 1999).

Regardless of the size and type of a snail farm, the housing system must meet the following conditions. It must be;

1. Escape-proof: snails are master escapists and unless prevented from doing so they will quickly wander all over your garden or house

2. Spacious: in accordance with the growing stage of the snails (hatchlings, juveniles, breeding snails, or mature snails fattened for consumption).
3. Climate friendly
4. Free from predators
5. Covered with fruit trees etc., (Cobbinah, 1993).

Different materials can be used for building snaileries, depending on price and availability.

- i. Sandcrete blocks, or mudbricks
- ii. Chicken wire, for protection
- iii. Mosquito nets or nylon mesh, for covering the pens as protection against insects.
- iv. Galvanized sheets, polythene sheets
- v. Second-hand materials, like car tyres, oil drums and old water tanks (Joseph, 1993).

## **2.3 TYPES OF SNAILERY**

### **1. Car tyres, oil drums**

Discarded tyres or oil drums may serve as relatively cheap snail pens. Three or four tyres are placed on top of each other, with chicken wire and mosquito mesh between the topmost tyre and the second one from the top.

Oil drum should have some holes in the bottom for drainage, be filled with good soil to a depth of 7-10cm, and be fitted with wire plus mosquito mesh on top. Such pens are suitable for keeping a few snails (up to about four mature snails in each container) close to the house, for private use (Sheldon, 1988).

#### **Advantages of car tyre, oil drum**

1. They are less expensive and are readily available in urban areas
2. It is preferable for those who want to rear snails in their backyard

#### **Disadvantages of car tyre, oil drum**

1. It has poor ventilation.

2. They can only be used in small scale production.

## **2. Hutch boxes**

Hutch boxes are square or rectangular, single or multi-chamber wooden boxes with lids, placed on wooden stilts above the ground at a suitable height for easy handling. In the floor of the box are a few holes through which excess water can drain out. The boxes are filled with sieved black soil to a depth of 18-25cm. The boxes should obviously be well protected from scorching sun or torrential rain.

Hutch boxes are useful in a semi-intensive snail breeding system. They are very suitable as hatchery and nursery pens because eggs and young snails can be easily located and observed (Omole, 2007).

### **Advantages of hutch boxes**

1. They can be placed close to the farmer's house, ensuring good supervision and protection

2. The height of the hutch boxes makes it comfortable to work on and facilitates feeding and handling of the snails.

### **3. Trench pens**

Trench pens are adjoining snail pens of 0.6 x0.6m to 1 x1m, either dug into the ground (which must be well drained) or raised 40-50cm above the ground. The pens are filled with suitable soil to a depth of 10-15cm.

Trench pens are suitable in semi-intensive to intensive snail growing ventures. They can be used as hatchery, nursery or fattening pens, with the number of stock being adapted to the size of the snails in each case (Taiwo, 2007).

### **4. Mini-paddock pens**

Mini-paddock pens are small square or rectangular pens, usually within a larger fenced area. They are built of bamboo and nylon mesh or of timber, chicken wire and nylon mesh. The walls should be some 50cm high and be dug at least 20cm into the ground.

Mini-paddock pens, like free-range pens, are suitable as fattening pens, where snails that are no longer needed for breeding are allowed to put on weight before being collected for consumption or sale (Duah, 2001).

### **5. Free-range pens**

Essentially, free-range pens are large mini-paddock pens: a fenced area of up to 10-20m, planted with plants, shrubs and trees that provide food and shelter from wind, sun and rain. Free-range pens may serve as the sole snail enclosure in an extensive snail farming system, or as growing and fattening pens in a semi-intensive one.

In the extensive snail farm the entire life cycle of the snail develops within the open pen: mating, egg laying, hatching, hatchling development, and growth of the snails to maturity. In a semi-intensive snail farm the free-range pen serves as a growing and fattening pen for adult snails, which were raised through the egg-hatchling-juvenile stages in hutch boxes or trench pens (Duah, 2001).

## **2.4 MANAGEMENT**

### **2.4.1 Seasonal and Daily Management**

As in any livestock farming operation, good management practices are the key to success. Seasonal management activities of *Archachatina marginata* whether in semi-intensive or intensive snail farming, hatchlings, growers, and breeding are done in separate pens, and/or hutch boxes (Akinnusi, 1998).

#### **2.4.1.1 Seasonal management of snails includes;**

- 1. Hatchlings:** hatchlings require more humid conditions than adult snails. They should be fed tender leaves, such as pawpaw and/or cocoyam, and a calcium

supplement for good shell development. The soil in their pen should be fitted with small gauze wire mesh or nylon, otherwise the snails will escape. Hatchlings and juvenile may be kept at a density of around 100/m<sup>2</sup>

2. **Growers:** growers should be transferred to separate pens at around 3months of age, at a stocking density of 30-40snails/m<sup>2</sup>. For fast growth, they might be given compound feed, rich in crude protein, calcium and phosphorus, besides their normal diet.
3. **Breeders:** breeders start to lay eggs at sexual maturity, at the age of 10-12 months. They are transferred to boxes or pens at a density of 10-15snails/m<sup>2</sup>. Soil should be loosened to facilitate egg laying. Any eggs found on the surface must be buried promptly to a depth of 1-2cm. the breeder's ration must be rich in crude protein and calcium. To avoid cannibalism, the breeders must be removed to their growing pens soon after the hatchling emerge (Cheney and Thompson, 2006).

## 2.4.2 Daily management

### 2.4.2.1 Daily management of snails includes;

1. **Feeding:** snails should be fed after sunset. The feed must not be stale or mouldy. Leftovers should be removed the following morning. Water should be replenished
2. **Housing:** check whether wire mesh and mosquito netting are intact; repair where necessary. Clean the pens. Keep doors or cover of the snail pens closed and locked.
3. **Soils:** keep the soil moist by mulching and watering if necessary in the dry season. Never add fresh poultry droppings to the soil. Change soil in the pens every three months.
4. **Hygiene:** check pens for any dead snails; remove them immediately. Do not use insecticides or herbicides in your snailery. Handle your snails carefully and wash them with water from time to time.
5. **Recording:** record inputs and outputs of your snail farm daily. Include your own labour or that of family members, and inputs, like food or repairs to the pens (Mariska, 2005).

### **2.4.3 Management of Predators, Parasites and Diseases**

Snail farmers must be aware of several predators, parasites and diseases if mortality rates are to be kept to a minimum.

#### **2.4.3.1 Predators**

Giant African land snails are faced with the challenge of predator in their natural wild habitat, these predators pose a great danger to their normal growth and reproduction of snails, if not checkmated may lead to the decline in population of snail biodiversity or extinction of various snail species in nature. Predators mostly depend on their prey as a source of food for survival in the ecosystem. Snail predators feed on the snail species at their various stages of growth and maturity. According to Akinnusi (2014), snail predators includes: Arthropods –Insects (termites, beetle, mites, moth, driver ants, carabid beetles, cockroaches and soldier ants); Crustaceans: – Millipedes, Centipedes, Cricket, Crabs and Forest Spider; Reptiles:- Lizards and Snakes, Amphibians:- frogs, turtles and toads; nematodes, Rodents: - mice and rats; Aves:- birds, crows, ducks and turkeys as well as Mammal:- man (Ikechukwu, 2012).

#### **2.4.3.2 Management of predators**

In areas with high bird predation, it is necessary to place cover nets over the pens. Keeping some other predators out may require building fences around the pens (15-30cm high).

Leftover food should be removed daily from pens because some predators particularly rats and field mice, are attracted by the uneaten food (Cheney and Thompson, 2006).

#### **2.4.3.3 Parasites and Diseases**

The common diseases affecting snails either in their wild or in their cultured environments includes:

Fungal diseases mainly *Fusarium Spp* affects indigenous snail species native to West African region. They are susceptible this diseases causing agent. These diseases are commonly referred to as rosy eggs disease and the affect eggs turns reddish brown and die off (Akinnusi, 2014).

Parasites such as *Alluaudihella Flavicornis* are diseases vectors to snails both in their wild and under domestication.

Bacterial diseases caused by *Pseudomonas Spp* especially *Pseudomonas aeruginosa* causes intestinal infections in snails. This disease affects snail's normal growth and development processes.

Deficiency diseases, it occurs mostly in domesticated snails with poor feeding, as a result of lack of minerals nutrients especially calcium and phosphors. The affected snail's shell turns white as a result of deficiency of calcium in their feeds over a longer period of time (Akinnusi, 2014).

**Cannibalism:** This mostly occurs in domesticated snails housed in pens. Older snails can eat, break the shells or fed on hatchlings as a source of nutrients especially calcium and water to avoid dehydration and for their survival. This occurs where snails are overcrowded and there is increased competition for food and space (Ikechukwu, 2012).

According to Okafor, (2001) and Akinnusi (2014), they stated that predators of snails inflict havoc on the snails by either breaking their shells, biting or sting the snails or eat them as food both their eggs and juvenile snails e.g. frogs and reptiles (Akinnusi, 2014). Snail predators adversely affect the population of the native Giant African Land Snail species of West African origin and its biodiversity.

Generally maintaining of high hygienic standards in snail farms will reduce the incidence of diseases and spread of diseases in the snail farms. According to Walker et al., (1999), snails ingest micro-organisms e.g. bacteria from the soil and their environment, poor hygiene may predispose the snails to diseases and pathogens, which will affect their growth and reproduction.

## **2.5 Economics of African Land Snails**

### **2.5.1 As a Food Source**

Giant African Land snails has been very useful in menu of many African tribes and beyond as they act as a fairly cheap source of protein. The Giant African snail is one of the largest land snails in the world growing up to 8 inches in length and 4.5 inches in diameter. After a single mating session, each snail can produce 100 to 400 eggs. Thus keeping them as a food source is quite lucrative (CADEV, 2006).

### **2.5.2 Medicinal Uses**

The products from many mollusks have been said to be very useful in medical practice. The land helix, or snail, has been used in medicine since antiquity and prepared according to several formulations. This historical report traces the understanding of their properties from the time of Hippocrates, who proposed the use of snail mucus against protocle and Pliny who thought that the snail increased the speed of delivery and was “a sovereign remedy to treat pain related to burns, abscesses and other wounds”, Gallen recommended snails against hydrops foetails.

In the 18<sup>th</sup> century, various snail “preparations” were also recommended for external use with dermatological disorder and internally for symptoms associated with tuberculosis and nephritis. Snail water is also present in the *Universal Pharmacopoeia*, written by Lemery in 1738, in France.

Generally, the following may be the therapeutic uses of snail.

- i. Whooping cough can be treated by snail meat
- ii. Hypertension can also be cure by fluid produced by snails
- iii. The snail meat is also recommended for treatment of ulcer and asthma
- iv. Consumption of snails reduces the deficiency of iron in the body
- v. It helps to reduce constipation
- vi. It is used in treatment of poor eye-sights
- vii. Eating of snail meat regularly can also prevent heart problems (Eze, 2006).

### **2.5.3 Formulations**

Mucin extracted from the Giant African Land snail has been proved to be very effective as a wound healing agent. Other products have also been derived from the mucin such as its cross-links with agarose and other polysaccharides to produce artificial glycoproteins for use in bioadhesive and mucoadhesive drug delivery (Monney, 1994).

### **2.5.4 Snail Cream**

- i. Soothes irritation and slight injuries to the skin caused by shaving, and has also shown to be effective in removing skin warts
- ii. Softens a large percentage of stretch marks
- iii. Eliminate acne scars
- iv. Powerful natural anti-wrinkle action
- v. Eliminates marks and skin diseases
- vi. Removes burn scars and birthmarks (Eze, 2006).

### **2.5.5 The Shell**

The shell of the GALs is rich in calcium and when properly processed may be of value in drug formulation as a direct compression excipient. It can be activated using heat and the particular size can be controlled (Sheldon, 1988).

## **2.6 Constraints to Heliculture in Edo State**

There are some constraints that militate against good performance of snails: - genetic constituent, hormonal influence, environmental factors, rearing pattern and inefficient use of resources available to the farmer (Akintomide, 1997). Several projects which has been embarked on by the government in Nigeria failed due to inadequate and untimely release of funds, exclusion of farmers from project decision processes. One

of the reasons why snail farming fails is snail diseases, but more often the snails gets out of control, in some cases the snails escape and in these regions they are now the biggest pest there is for gardeners and farmers (Mariska, 2005). In spite of the potentials and disadvantages of snail farming, widespread participation in its production by farmers has not been achieved in Nigeria (Edo State in particular). One of the important alternative sources of animal protein, which has received relatively scanty attention in Nigeria, is snail (Olayide and Heady, 1981). Snail farmers in Edo State are only few. They start in a small scale. The reason is because the awareness is yet to be created (ENADEP, 2009). The present number of farmers cannot meet the demand because they pursue traditional snail farming. Generally, the problem facing traditional method of snail farming includes;

1. Hatching the snail eggs. Formulation of the best feed for snails at whatever stage of growth
2. The best technical knowledge to management of farms to reduce mortality rate to zero level. (Azeez, 2010; ENADEP, 2009). To scientist and researchers, snail farming is still a virgin field in Nigeria (Azeez, 2010).

## **CHAPTER THREE**

### **3.0 MATERIALS AND METHOD**

#### **3.1 Study Area and Scope**

The study was conducted in Benin City, Edo State, Nigeria. Benin City is situated at 6.334986 latitude, 5.603746 Longitude and 87.889 elevation above the sea level (National Population Commission (NPC), 2006). Benin City is a very large town in Nigeria, having about 1,125,058 inhabitants (National Population Commission (NPC), 2006). The area partly falls within the humid tropical rainforest zone and partly within the mangrove swamp. It has an annual rainfall ranges from 1150mm-2000mm in the South and 1020mm-1270mm in the North. The State lies roughly between Longitudes  $5^{\circ} 37' 32.70''$  E and Latitudes  $6^{\circ} 20' 17.34''$  N of the Equator. The state is bounded in the North by Kogi State, on the West by Ondo State, on the South by Delta State, in the East by Anambra State. The state has an estimated population of about 3,926,587 million people using the projected annual growth rate of 2.7% National Population Commission (NPC, 2006). It has a landmass of 19,794Km<sup>2</sup>, with a population density of 121 people per square Kilometer. It has a tropical climate characterized by two distinct seasons; the dry and wet seasons. The wet season occurs between April and

October with break in August, and average rainfall ranging from 150cm, 59' in the extreme North of the State to 250cm, 98' in the South. The dry season lasts from November to April with a cold harmattan spell between December and January. The climate is humid-tropical in the South and sub-humid in the North.

### **3.2 Population of the Study**

The population for this study were snail farmers in Benin metropolis.

### **3.3 Sampling Technique and Sample Size**

The sampling technique used for this study were the two-stage random sampling technique. A total of fifty (50) snail farmers were randomly selected for the study. The first stage involved the simple random selection of five (5) markets from the study area. Thus, five markets namely Uselu Market, Ogiso Market (New market), Ekiosa Market, Oba-Market and New Benin Market were selected for this study. From the five (5) markets, ten (10) respondents were selected using simple random sampling, giving a total of fifty (50) respondents that were used for the study.

**Table 1: Sampling distribution of the respondents**

| <b>Markets</b>   | <b>Respondents</b> |
|------------------|--------------------|
| Uselu            | 10                 |
| Ogiso            | 10                 |
| Ekiosa           | 10                 |
| Oba-market       | 10                 |
| New Benin market | 10                 |
| <b>Total</b>     | <b>50</b>          |

### **3.4 Data Collection**

Data collected for this study were from both primary and secondary sources. The primary data for this research were collected through interviews and observations using a well-structured questionnaire. were by means of a well-structured questionnaire. Secondary data were obtained from books, journals, internet etc.

### **3.5 Method of Data Analysis**

**Objective One:** Socio-economic characteristics was achieved using bar-chart. It involves knowing the percentages of the socio-economic characteristics of snail farmers obtained from the data.

**Objective Two:** Was achieved using descriptive statistics. Descriptive statistics involves the use of frequency distribution table, percentage and cumulative percentage.

## CHAPTER FOUR

### 4.0 RESULTS

A total of fifty (50) questionnaire were administered and retrieved. The results of the analysis of the data and discussions are presented in this chapter.

#### 4.1 Socio-economic Characteristics

##### 4.1.1 Sex of the Respondents

From the figure below, it was discovered from the study that 68% of snail farmers are females and 32% males.

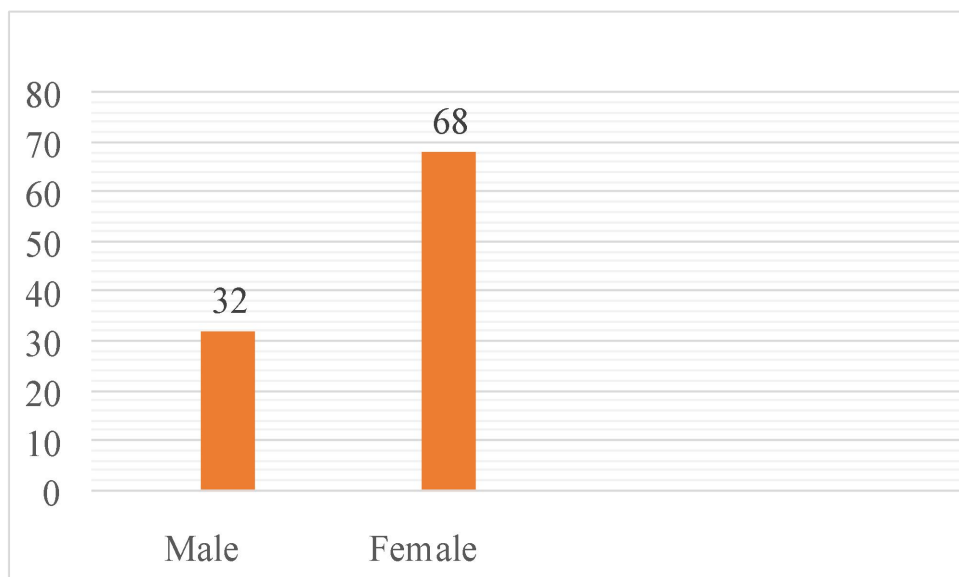


Figure I: Socio-economic Characteristics of Snail Farmers in Benin City.

Source: Field Survey 2021.

#### 4.1.2 Age Distribution of the Respondents

The age distribution of the respondents is as follows; 18-25 years having 22%, 26-35 years 34%, 36-45 years 28% and 46 and above having 16% respondents. It can be seen that more snail farmers fall between the age of 26-35 years.

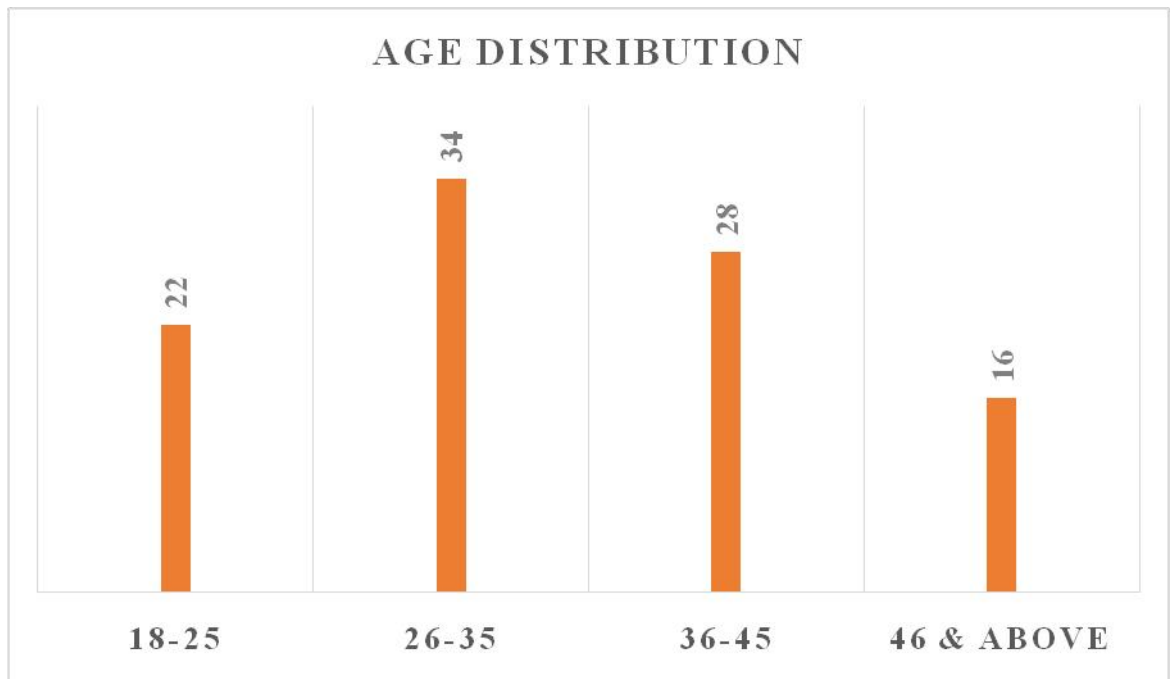


Figure 2: Socio-economic Characteristics of Snail Farmers in Benin City.

Source: Field Survey 2021.

### 4.1.3 Marital Status of the Respondents

40% of snail farmers are single, while 48% are married and 6% are either divorced or widowed.

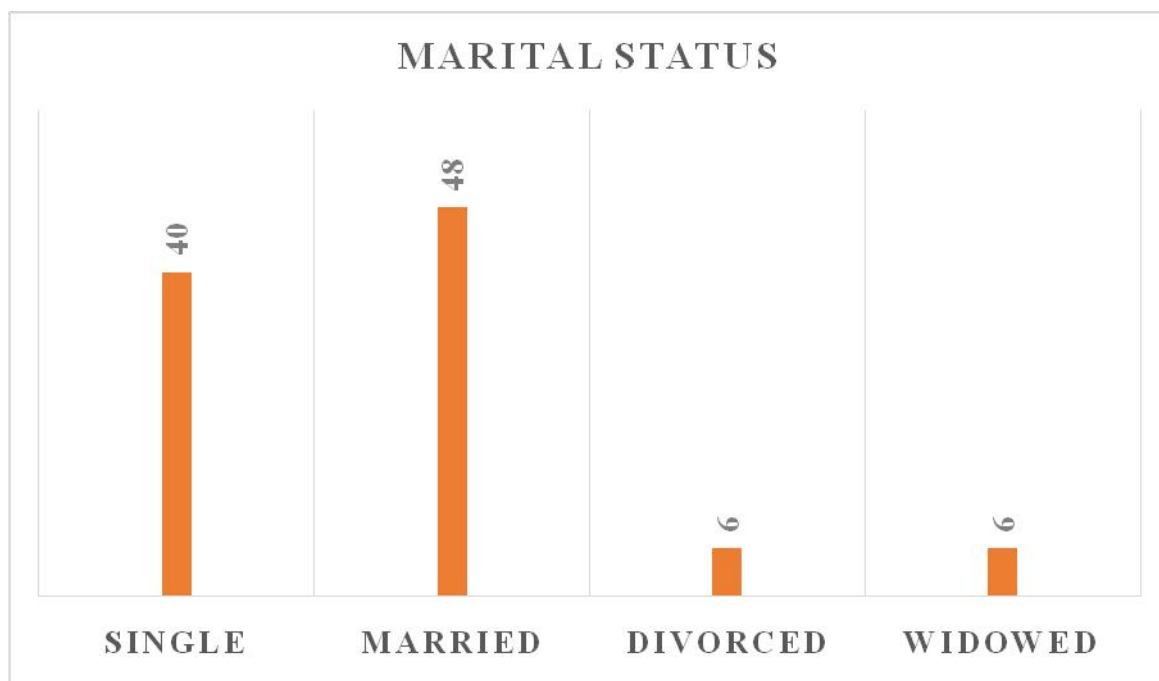


Figure 3: Socio-economic Characteristics of Snail Farmers in Benin City.

Source: Field Survey 2021.

#### 4.1.4 Occupation of the Respondents

From the Chart below it can be seen that 30% of snail farmers are either traders or full time farmers, with 14% being civil servants and 26% are into other occupations



Figure 4: Socio-economic Characteristics of Snail Farmers in Benin City.

Source: Field Survey 2021.

#### 4.1.5 Educational Level of the Respondents

The chart below shows the educational level of the respondents.

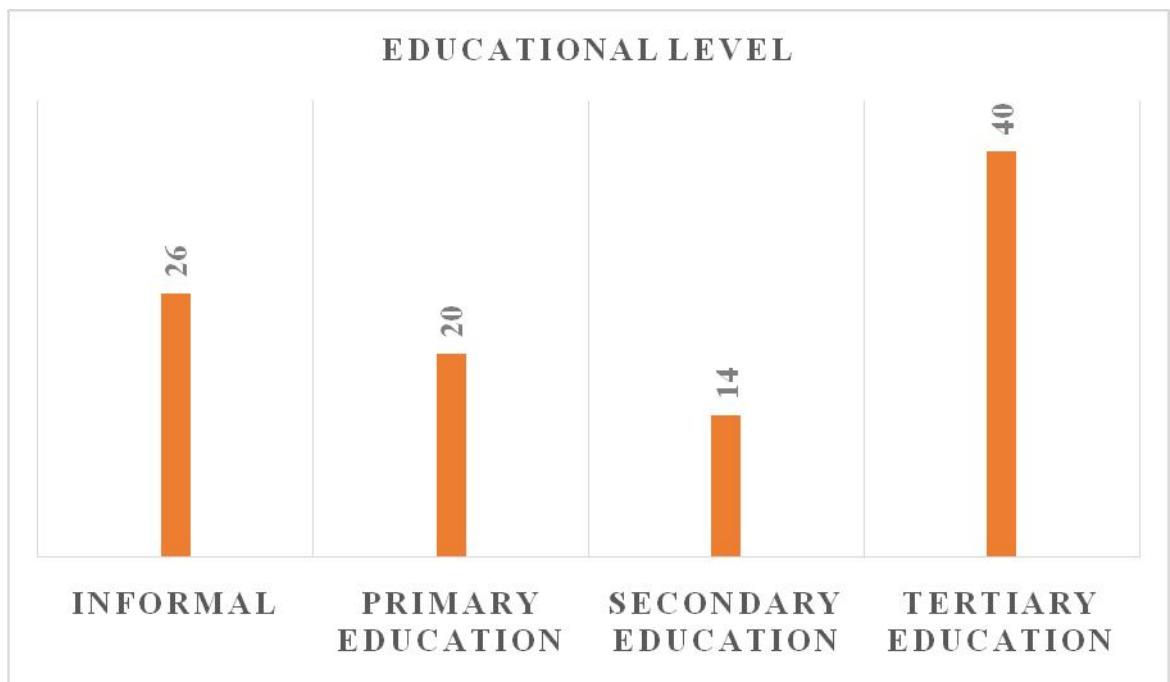


Figure 5: Socio-economic Characteristics of Snail Farmers in Benin City.

Source: Field Survey 2021.

**Table 2**

**4.2 Do you eat snails?**

| Do you eat snails | Frequency | Percentage (%) |
|-------------------|-----------|----------------|
| Yes               | 45        | 90             |
| No                | 5         | 10             |
| Total             | 50        | 100            |

Source: Field Survey, 2021.

#### 4.2.1 Years of Snailery Experience

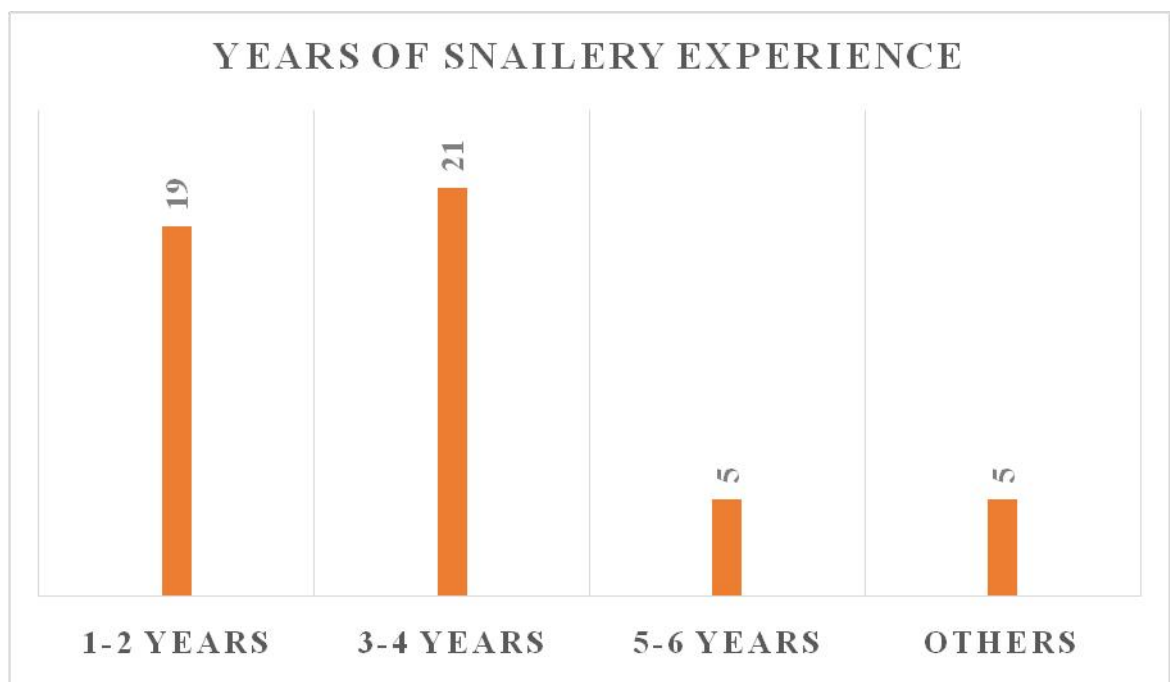


Figure 6: Production Characteristics of Snail Farmers in Benin City.

Source: Field Survey, 2021.

#### 4.3.1 PRODUCTION CHARACTERISTICS

4.3 Table 3:

| Characteristics                           | Frequency | Percent (%) | Cumulative percent |
|---|-----------|-------------|--------------------|
| <b>Species of snail reared</b>            |           |             |                    |
| <i>Archachatina fulica</i>                | 7         | 14          | 14                 |
| <i>Archachatina marginata</i>             | 19        | 38          | 52                 |
| <i>Archatina archatina</i>                | 2         | 4           | 56                 |
| <i>Both a. archatina and a. marginata</i> | 22        | 44          | 100                |
| Total                                     | 50        | 100         |                    |
| <b>Type of rearing method operated</b>    |           |             |                    |

|          |    |     |     |
|----------|----|-----|-----|
| Growers  | 30 | 60  | 60  |
| Breeders | 13 | 26  | 86  |
| Others   | 7  | 14  | 100 |
| Total    | 50 | 100 |     |

---

**Table 3 Contd.**

| <b>Characteristics</b>         | <b>Frequency</b> | <b>Percent (%)</b> | <b>Cumulative<br/>percent</b> |
|--------------------------------|------------------|--------------------|-------------------------------|
| <b>Housing system operated</b> |                  |                    |                               |
| Trench pens                    | 7                | 14                 | 14                            |
| Basket                         | 16               | 32                 | 46                            |
| Car Tyres                      | 10               | 20                 | 66                            |
| Hutch Boxes                    | 13               | 26                 | 92                            |
| Free –range                    | 3                | 6                  | 98                            |
| Others                         | 1                | 2                  | 100                           |
| Total                          | 50               | 100                |                               |
| <b>Stocking Density</b>        |                  |                    |                               |

|             |    |     |     |
|-------------|----|-----|-----|
| < 50        | 3  | 6   | 6   |
| 50-100      | 11 | 22  | 28  |
| 101-150     | 12 | 24  | 52  |
| 151-200     | 8  | 16  | 68  |
| 200 & above | 16 | 32  | 100 |
| Total       | 50 | 100 |     |

---

**Table 3 Contd.**

| <b>Characteristics</b>                       | <b>Frequency</b> | <b>Percentage</b> | <b>Cumulative<br/>Percentage</b> |
|--|------------------|-------------------|----------------------------------|
| <b>Where do your source for your snails?</b> |                  |                   |                                  |
| Raining season                               | 48               | 96                | 96                               |
| Dry season                                   | 2                | 4                 | 100                              |
| Total  | 50               | 100               |                                  |
| <b>Where do you source your snails?</b>      |                  |                   |                                  |
| Wild   | 24               | 48                | 48                               |
| Local Markets                                | 22               | 44                | 92                               |
| Research Institute                           | 4                | 8                 | 100                              |
| Others                                       | -                |                   |                                  |

|                                 |    |     |     |
|---------------------------------|----|-----|-----|
| Total                           | 50 | 100 |     |
| <b>Mode of snail collection</b> |    |     |     |
| Proper searching                | 30 | 60  | 60  |
| Targeting active periods        | 16 | 32  | 92  |
| Use of baits                    | 4  | 8   | 100 |
| Total                           | 50 | 100 |     |

---

**Table 3 Contd.**

| <b>Characteristics</b>    | <b>Frequency</b> | <b>Percentage</b> | <b>Cumulative<br/>Percentage</b> |
|---------------------------|------------------|-------------------|----------------------------------|
| <b>Rate of collection</b> |                  |                   |                                  |
| Daily                     | 6                | 12                | 12                               |
| Weekly                    | 23               | 46                | 58                               |
| Forth nightly             | 21               | 42                | 100                              |
| Total                     | 50               | 100               |                                  |
| <b>Size collected</b>     |                  |                   |                                  |
| Adult only                | 12               | 24                | 24                               |
| Medium                    | 10               | 20                | 44                               |
| Any size                  | 28               | 56                | 100                              |

|                               |    |     |     |
|-------------------------------|----|-----|-----|
| Total                         | 50 | 100 |     |
| <b>Availability of Snails</b> |    |     |     |
| Abundant                      | 9  | 18  | 18  |
| Readily available             | 24 | 48  | 66  |
| Scarce                        | 17 | 34  | 100 |
| Total                         | 50 | 100 |     |

---

**Table 3 contd.**

| <b>Characteristics</b>                              | <b>Frequency</b> | <b>Percentage</b> | <b>Cumulative<br/>Percentage</b> |
|---|------------------|-------------------|----------------------------------|
| <b>What system of operation do you<br/>Operate?</b> |                  |                   |                                  |
| Semi-intensive                                      | 18               | 36                | 36                               |
| Intensive   | 32               | 64                | 100                              |
| Total   | 50               | 100               |                                  |
| <b>Chain of Production</b>                          |                  |                   |                                  |
| Fattening   | 8                | 16                | 16                               |
| Wholesale   | 27               | 54                | 70                               |
| Retail  | 14               | 28                | 98                               |

|        |    |     |     |
|--------|----|-----|-----|
| Others | 1  | 2   | 100 |
| Total  | 50 | 100 |     |

---

Source: Field Survey, 2021.

#### 4.4. MANAGEMENT CHARACTERISTICS

4.4 Table 4

| Characteristics                                       | Frequency | Percentage | Cumulative<br>Percentage |
|---|-----------|------------|--------------------------|
| <b>What type of feed do you feed<br/>your snails?</b> |           |            |                          |
| Vegetable Plants                                      | 34        | 68         | 68                       |
| Fruits Peels  | 11        | 22         | 90                       |
| Concentrates  | 4         | 8          | 98                       |
| Others  | 1         | 2          | 100                      |
| Total   | 50        | 100        |                          |
| <b>Reason for the type of feed used</b>               |           |            |                          |

|                                  |    |     |     |
|----------------------------------|----|-----|-----|
| Cost                             | 26 | 52  | 52  |
| Availability                     | 19 | 38  | 90  |
| Accessibility                    | -  | -   |     |
| Nutritional requirement of snail | 5  | 10  | 100 |
| Total                            | 50 | 100 |     |

---

**Table 4 Contd.**

| <b>Characteristics</b>                  | <b>Frequency</b> | <b>Percentage</b> | <b>Cumulative<br/>Percentage</b> |
|---|------------------|-------------------|----------------------------------|
| <b>How often do you feed your snail</b> |                  |                   |                                  |
| Once a day                              | 29               | 58                | 58                               |
| Twice a day                             | 20               | 40                | 98                               |
| Others                                  | 1                | 2                 | 100                              |
| Total                                   | 50               | 100               |                                  |
| <b>Do you water the snail pen?</b>      |                  |                   |                                  |
| Yes                                     | 48               | 96                | 96                               |
| No                                      | 2                | 4                 | 100                              |
| Total                                   | 50               | 100               |                                  |

**Source of water used in the farm**

|                |    |     |     |
|----------------|----|-----|-----|
| Well           | 11 | 22  | 22  |
| Supplied water | 30 | 60  | 82  |
| Others         | 9  | 18  | 100 |
| Total          | 50 | 100 |     |

---

**Table 4 Contd.**

---

| <b>Characteristics</b> | <b>Frequency</b> | <b>Percentage</b> | <b>Cumulative<br/>Percentage</b> |
|------------------------|------------------|-------------------|----------------------------------|
|------------------------|------------------|-------------------|----------------------------------|

---

**Reason for giving selected water**

|               |    |     |     |
|---------------|----|-----|-----|
| Availability  | 40 | 80  | 80  |
| Affordability | 6  | 12  | 92  |
| Water quality | 4  | 8   | 100 |
| Total         | 50 | 100 |     |

**How often do you water the****snail pen**

|        |    |    |    |
|--------|----|----|----|
| Daily  | 40 | 80 | 80 |
| Weekly | 7  | 14 | 94 |

|        |    |     |     |
|--------|----|-----|-----|
| Others | 3  | 6   | 100 |
| Total  | 50 | 100 |     |

---

**Table 4 Contd.**

| <b>Characteristics</b>                             | <b>Frequency</b> | <b>Percentage</b> | <b>Cumulative<br/>Percentage</b> |
|--|------------------|-------------------|----------------------------------|
| <b>What is the cause of death<br/>in your farm</b> |                  |                   |                                  |
| Unknown cause                                      | 24               | 48                | 48                               |
| Pests  | 15               | 30                | 78                               |
| Hot weather  | 7                | 14                | 92                               |
| Predators  | 4                | 8                 | 100                              |
| Total  | 50               | 100               |                                  |

**What are your major constraints  
in snail farming**

|                     |    |     |     |
|---------------------|----|-----|-----|
| Pests and Diseases  | 5  | 10  | 10  |
| Cost                | 11 | 22  | 32  |
| Sourcing the snails | 30 | 60  | 92  |
| Transportation      | 1  | 2   | 94  |
| Others              | 3  | 6   | 100 |
| Total               | 50 | 100 |     |

---

Source: Field Survey, 2021.

## **CHAPTER FIVE**

### **5.0 DISCUSSION**

From the study, females were the major respondents having 68% out of 100% of the total respondents due to the fact that males rarely engage in snail farming and rarely do males sell snails in the market. This agrees with the findings of (Ebewore and Achoja, 2013) who reported that majority of snail marketers were women in Delta State. Furthermore, most of the respondents were relatively in their middle age (26-35 years) which is 34%. This is because, this age group have come to understand the profitability and ease of farming snails. This finding disagrees with the report of (Akinyemi *et al.*, 2003) that economically productive age of snail farmers had mean age of 54.9 years. This implies that people who engage in snail farming were within the adult population. Also, the higher percentage of respondents had tertiary education

(40%). This means that education may add value to the operation of the business. This agrees with (Yussuf, 2002) who reported that majority of the marketer in Ibadan were educated. It shows in table 1 that 90% of the respondents consumed snails. This study shows that there is a high rate of consumption of snail meat in the area with little taboo against its intake (Agbogidi and Okonta, 2011). Agbogidi and Okonta (2011) stated that in Nigeria, the Hausa speaking majority does not eat snails because they consider them to be originated from ghostly existence (dodo). They view snail consumption as abominable and a taboo.

Majority of the snails were sourced from both wild and local market having 48% and 44% respectively. The study therefore, shows that few farmers were into snail breeding and fattening which from the data, showed that majority of the snails obtained were either sold directly as wholesale (54%) or as retail (28%), while 16% of snail farmers were into fattening. From the species of snails reared, *Archachatina marginata* (38%) and both *Archatina archatina* and *A. marginata* (44%) were preferred by the respondents and were readily available and accessible in Benin City and were also acceptable by most consumers.

The study also shows that in sourcing for snails, size was not a major factor as 56% of the respondents collected any size of snails during sourcing. Table 2 shows the production characteristics of snail farming and the response (%) by the respondents.

This shows the type of housing system operated by the respondents of which 32% of the respondents used Baskets in housing their snails. Table 3 also shows the management characteristics of snail farming and the response (%) by the respondents. This study shows the various management system engaged by the snail farmers and 68% of the respondents says they fed their snails on vegetable plants. Reasons is because it is cheap, available and accessible and also majority of the snail farmers are not into large scale farming (Okpeze, 2007).

## **CHAPTER SIX**

### **6.0 CONCLUSION AND RECOMMENDATIONS**

#### **6.1 Conclusion**

Raising snails requires minimal resources including less time commitment, little capital, and no special feeds compared to other animals that are raised for food. The snail market in Benin City will have great impact on poverty alleviation particularly among the youths.

The level of profitability can however be increased if there are other sources of collecting snails rather than from the wild and local markets. The snail marketers in Benin City can also rear snails at household level, practice/establish snail farms on small, medium or large scale in order to increase the level of production.

## **6.2 Recommendations**

Based on the findings of this study, the following recommendations are proffered:

- i. Snail farming should be encouraged by educating the public (in Benin City) through seminars and conferences on production systems of snails and adequate knowledge of return on investment.
- ii. Low sourcing of snails from the wild are product of continuous bush burning, deforestation and continuous application of chemicals to farms. These factors can be addressed by farmers in Benin City engaging more on snail production (rearing and breeding of snails) which will help in reducing the extinction and low availability of snails and also helps to alleviate poverty.

## REFERENCES

- Agbogidi, O.M; Okonta, B.C. and Ezeani, E.L. Effects of two edible fruits on the growth performance of African giant land snail. (*Archachatina marginata* Swainson). *Journal of Agriculture and biological Science*.
- Ajayi, S.S., Tewo, S.O., Milligan, J.K., 1980. Influence of Seasonality, on aestivation and behavior of the forest African giant land snail (*Archachatina marginata*). *East African Wildlife Journal* 4: 85-95.
- Akinbile S.M., 1999 (1<sup>st</sup> publ.) Snail Rearing. Erodise Business Networks, Ibadan, Nigeria. A simple booklet on giant African land snail farming.
- Akinnusi O. (1998). Introduction to Snail Farming, Omega Publisher Lagos Nigeria Pp 70
- Akinnusi, O. 2004. Introduction to snails and snail farming. Triolas Exquisite Venture. Abeokuta. Nigeria.
- Akintomide, T.O. The African Giant Snail, It's caring and production. Ibadan: Alamsak press Ltd. (1997).
- Akinyemi O, Adebayo O, Usman J.M, Kehinde A.S, Ojo M.O., 2003. An analysis of snail marketing in Ibadan Oyo State, Nigeria. Proceeding of 28<sup>th</sup> Annual Conference of the Nigeria Society of Annual Production.
- Amusan, J.A. and Omidiji, M.O. 1998. Edible land snail. A technical guide to snail farming in the tropics. Variety Printers Limited. Ibadan.

- Appleton, C.C. and Van, T.D. 1999. In: Proceedings of a Workshop on Medical Malacology in Africa (H. Madsen, C.C. Appleton and M. Chimbari, eds), 43-56. Danish Bilharziasis Laboratory, Copenhagen.
- Azeez, A.I. Income opportunities in snail farming. The managing consultant. Available at [www.theconsulting.com](http://www.theconsulting.com) (last accessed 16<sup>th</sup> October, 2012).(2010).
- Baba, K.M. and Adeleke, M.T. (2006). Profitability of Snail Production in Osun State, Nigeria, Journal of International Scientific Publication.
- CAB (2003). Crop Protection Compendium: Global Module Commonwealth Agricultural Bureau International, Wallingford UK.
- CADEV (Community Action for Development), 2006. Snail farming as a source of employment. See: [www.postnewsline.com/2006/09/snail-farming](http://www.postnewsline.com/2006/09/snail-farming)
- CADEV, 2006. From a taboo to a delicacy: the evolution of eating snail meat in Bakossi (Cameroon). Non-wood News no. 15. FAO.
- Cheney, S. and Thompson, R. Revised 2006. Raising Snails. Special Reference Briefs (National Agricultural Library SRB 96-05. Updates SRB 88-04). Beltsville, Maryland, USA: United States Department of Agriculture (USDA).
- Cobbinah, 1993. Snail Farming in West Africa: A Practical Guide. ISBN 9789290811022.
- Dr. Joseph R. 1993. Snail Farming in West Africa: A Practical Guide. ISBN 9789290811022.

- Duah, O.A. and K.A. Monney (Dept. of Zoology, University of Cape Coast, Ghana), 2001. Snail farming: Snail collection and small-scale production in Africa and Europe. In: African Journal of Ecology.
- Ebenso, I.E. and Ologhobo, (2009). Nutritive potentials of white snails (*Archachatina marginata*) in Nigeria. Discov. Innov. 15(3/4): 156-158.
- Ebewore S.O, Achoja F.O., 2013. Economics of snail marketing implication for extension services delivery in Delta State, Nigeria. Experimental Agriculture and Horticulture.
- Ejidike B.N. A Folayan T.A. and Alokun, J.A. (2004). Observations On Some Climatic Variables and Dietary (*Archachatina marginata*): Notes and Records. Parkistan Journal of Nutrition 3(6) 362-364
- Enugu State Agricultural Development Programme (ENADEP) (2009) Snail Rearing: Seminar Paper-Block Extension Agents. Enugu: Enugu State Agricultural Development Programme.
- Eze, C.C., D.O. Ohajianya and N.N.O. Oguoma (Dept. of Agricultural Economics, Fed. Univ. of Technology, PMB 1526, Owerri, Nigeria) 2006. Analysis of land snail marketing in Owerri agricultural zone of Imo State, Nigeria. In: Animal Production Research Advances 2 (2): 94-99, 2006.
- Ikechukwu, J., 2012: Cowpea hulls as potential feedstuff for broilers. Master of sciences, Animal Nutrition and Biochemistry, University of Nigeria.
- Imevbore, E.A., and A.A., Ademosun, 1988. The nutritive value of the African giant land snail, *Archachatina marginata*. J. Anim. Prod. Res., 8:76-87.

- Lemery, N. 1738. Pharmacopée Universelle. Charles Maurice d'Houry, Paris, 757-8.
- Mariska Leeftang, Januari 2005. Snail Farming. AgroBrief-Series No 3, 6 pages, Agromisa, Netherlands.
- Money K.A., 1994. Notable note on giant African snails. In: Snail Farming Research.
- National Population Commission (NPC). Provisional Figures for 2006 Nigeria's Census. National Population Commission. <http://www.nigerianmuse.com> Commission. (last accessed October 16, 2016). (2006).
- Ojiako, F.O., 2006. Nursery and Field establishment of Moringa Oleifera: The Federal University of Technology Owerri experience. Int'l Journal of Agric. and Rural Dev. 14(2): 589-594.
- Okafor. F.U. (2001). Edible land snails: A Manual of Biological Management and Farming of Snails. Splendid Publishers, Lagos
- Okpeze C.N., 2007. Effects of feeding adult snails *Stylosanthes guianensis*, *Lablab purpureus* as substitute for pawpaw leaf. *African Journal of Biotechnology*.
- Olayide, S.O. and E.O. Heady (1981). Introduction to Agricultural Production Economics. Ibadan: University Press Ltd. Pp.80-89.
- Omole, A.J., A.A. Taiwo. and J.A. Amusan, 2007. Practical Snail Farming. Institute of Agricultural Research and Training (IAR&T). Obafemi Awolowo University, Ibadan, Nigeria.

- Sheldon, C. 1988. Raising Snails. Special Reference Briefs (National Agricultural Library SRB 88-04). Beltsville, Maryland, USA: United States Department of Agriculture (USDA).
- Swainson, 1821. United States Department of Agriculture. USDA/APHIS. Retrieved October 29, 2015.
- Taiwo, A.A. 2007. Technical guide/bulletin. Practical snail farming. Institute of Agricultural Research and Training, Moor Plantation. Ibadan, Nigeria.
- Venette, R.C., & Larson, M. (2014). Mini Risk Assessment, Giant African snail, *Achatina Fulica* (Bowdich) (gastropods:*Archatinidae*), Department Of Entomology University Of Minnesota, St Paw, MN55108, Pp 1-30.
- Warker, A.J., 1999. Bacteria associated with the digestive system of slug *deroceras reticulatum* are not required for protein digestion. *Soil Biol. Biochem.* 31:1387-1394.
- Yussuf O.A., 2002. Economics analysis of snail production and marketing in Ibadan metropolis Unpublished B.Tech Project, Department of Agricultural Economics and Extension Ladoke Akintola University of Technology Ogbomoso, Oyo State, Nigeria.

## APPENDIXES

### APPENDIX 1: RESEARCH QUESTIONNAIRE

DEPARTMENT OF ANIMAL SCIENCE, FACULTY OF AGRICULTURE  
UNIVERSITY OF BENIN, BENIN CITY, NIGERIA

Dear Respondents,

I am an undergraduate student of the aforementioned department and institution carrying out project on the **assessment of production system of snails**.

I therefore implore you to kindly assist in this research by responding to the questions raised in the questionnaire. Your responses will strictly be used for research purpose only and will be treated with utmost confidentiality.

Thanks in anticipation for your cooperation

Yours faithfully.

*Researcher.*

**INSTRUCTION: Please tick (✓) in the boxes below and write where applicable.**

**SECTION A: SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS**

1. Sex: Male ( ) Female ( )
2. Age: 18-25 ( ) 26-35 ( ) 36-45 ( ) 46 & above ( )
3. Marital Status: Single ( ) Married ( ) Divorced ( ) Widowed ( )
4. Occupation: Trader ( ) Civil Servant ( ) Farmer ( ) Others ( )
5. Educational Level: Informal ( ) Primary Education ( ) Secondary Education ( )  
Tertiary Education ( )

**SECTION B**

1. Do you eat snails? Yes ( ) No ( )
2. At what season do you source for your snails? Raining season ( )  
Dry season ( )
3. Mode of snail collection? Proper searching ( ) Targeting active periods ( )  
Use of baits ( )
4. Rate of collection? Daily ( ) Weekly ( ) Forth nightly ( )
5. Size Collected? Adult only ( ) Medium ( ) Any size ( )
6. Availability of snails? Abundant ( ) Readily available ( ) Scarce ( )
7. What system of operation do you operate? Semi-intensive ( ) Intensive ( )

8. What type of rearing method do you operate? Growers ( ) Breeders ( )  
Others ( )
9. Years of snailery experience? 1-2 years ( ) 3-4 years ( ) 5-6 years ( )  
Others ( )
10. Housing system operated? Trench pens ( ) Basket ( ) Car tyres ( ) Hutch  
boxes ( ) Free-range ( ) Others ( )
11. Chain of production operated? Fattening ( ) Wholesale ( ) Retail ( )  
Others ( )
12. Where do you source your snails? Wild ( ) Local markets ( ) Research  
Institute ( ) Others ( )
13. Species of snail reared? *Archachatina fulica* ( ) *Archachatina marginata* ( )  
*Archatina archatina* ( ) *both archatina and archachatina* ( )
14. Stocking density? <50 ( ) 50-100 ( ) 101-150 ( ) 151-200 ( )  
201 and above ( )
15. What are your major constraints in snail farming? Pests and Diseases ( )  
Cost ( ) Sourcing the snails ( ) Transportation ( ) Others ( )
16. What type of feed do you feed your snails? Vegetable plants ( ) Fruit peels ( )  
Concentrates ( ) Others ( )
17. Reason for the type of feed used? Cost ( ) Availability ( ) Accessibility ( )  
Nutritional requirement of snail ( )

18. How often do you feed your snails? Once a day ( ) Twice daily ( ) Others ( )

19. Do you water the snail pens? Yes ( ) No ( )

20. How often do you water the snail pens? Daily ( ) Weekly ( ) Others ( )

21. Source of water used in the farm? Well ( ) Supplied water ( ) Others ( )

22. Reason for giving snail selected water type? Availability ( ) Affordability ( )  
Water quality ( )

23. What is the cause of snail death in your farm? Unknown cause ( ) Pests ( )  
Hot weather ( ) Predators ( )

## APPENDIX II: LIST OF PLATES



Plate 1: Free-Range System  
Source: ReadkonG.com



Plate 2: Trench Pens  
Source: University of Benin Project Farm



Plate 3: Hutch Boxes  
Source: Agro4africa



Plate 4: Intensive Housing System of Snails  
Source: Touchstone Snails