Snail Farming in West Africa

Joseph R. Cobbinah

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CTA
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Preface

The writing of this manual was inspired by many people from all walks of life who have called on me for scientific information on snail farming (heliculture). Their inquiries began following an award I received from the Italian Snail Farmers Association in 1988 for my paper published in the Snail Farming Research Journal. My own view prior to this time was that there was insufficient information on the biology, behaviour, genetics and nutritional requirements to support the farming of the African giant snail, Achatina achatina, in West Africa. With the growing interest in snail farming and the threat posed by such practices as pesticide use, slash-and-burn agriculture and deforestation, I decided to gather whatever information was available, with a view to publication. During this process it became clear, however, that there are many aspects of heliculture which need further investigation. If this manual inspires other researchers to conduct such investigations and motivates anyone to start raising snails, I will have achieved my objective in writing it.

The manual has been written with the prospective snail farmer in mind. It discusses the major aspects of snail production and provides basic information on the selection of sites for raising snails, housing, feeding and breeding them, natural enemies and diseases, and general management. The snail farmer will need to experiment with many options, however, as there are many gaps in our knowledge of farming snails in an African environment.

Joseph R. Cobbinah
Introduction

Snail meat has been consumed by humans throughout the world since prehistoric times. It is high in protein (12-16%) and iron (45-50 mg/kg), low in fat (0.05-0.8%) and contains almost all the amino acids needed by humans. In addition to the nutritional value of snail meat, a recent study has shown that the glandular substances from edible snails cause agglutination of certain bacteria; this could be of value against a variety of ailments, including whooping cough.

Edible snails also play an important role in folk medicine. In Ghana, the bluish liquid obtained from the shell when the meat has been removed is believed to be good for infants’ development. The high iron content is considered important in the treatment of anaemia; in the past, it was recommended as a means of combatting ulcers and asthma. At the Imperial Court in Rome, snail meat was thought to contain aphrodisiac properties and was often served to visiting dignitaries in the late evening.

There is a flourishing international trade in snails in Europe and North America. In France the annual requirement is about 5 million kg, over 60% of which is imported; the estimated annual consumption in Italy is 306 million snails.

In West Africa, snail meat has traditionally been a major ingredient in the diet of people living in the high forest belt (the forested area other than the savanna forest). In the Côte d’Ivoire, for example, an estimated 7.9 million kg are eaten annually; in Ghana, although the consumption figures are not available, it is clear that demand outstrips supply.
In spite of the considerable external and local demand, commercial snail farms such as those in Europe, South-East Asia and the Americas do not exist in West Africa. In Ghana, Nigeria and Côte d'Ivoire, where snail meat is particularly popular, snails are gathered from the forest during the wet season. In recent years, however, wild snail populations have declined considerably, primarily because of the impact of such human activities as deforestation, pesticide use, slash-and-burn agriculture, spontaneous bushfires, and the collection of snails before they have reached maturity. It is therefore important to encourage snail farming (heliculture) as a means of conserving this important resource.

The growing interest in snail farming has created a pressing need for more information on the biology, genetics, nutritional requirements, aestivation and general husbandry of snails. Using the information currently available, our studies have confirmed the technical feasibility of establishing snail farms in West Africa, although it must be emphasized that they should be seen as only one component in a diversified farming venture. Snails are slow-growing animals and as such do not represent a way of making money quickly. With patience, good management and careful integration into existing farming activities, however, snail farming will bring substantial rewards in the longer term.
Chapter 1

Selecting suitable species

Snails belong to a group of invertebrate animals known as molluscs. Most molluscs carry a shell. Other members of this group include slugs, mussels, squids and cuttlefish.

Biology of snails

Essentially, a snail consists of two parts, the body and the shell. The body is divided into three parts — the head, the foot and the visceral mass.

The head is not well demarcated and carries two pairs of retractable tentacles. One pair of tentacles is far longer than the other and contains the eyes in the knobbed end. The long, muscular foot occupies almost the entire ventral surface and, like the head, is not clearly demarcated from the rest of the body. There is a shallow longitudinal groove along the centre of the foot. The visceral mass is housed in the shell above the foot. It is hump-shaped and contains the digestive, reproductive and respiratory organs.

The skin over the visceral hump secretes a large calcareous shell (98% of the shell is in the form of calcium carbonate). In most species the shell accounts for about a third of the body weight. It is the snail’s protective casing. Whenever danger threatens, the snail withdraws its body into the shell.
Figure 1: The main anatomical features of a typical snail

View from above

Shell

Body

Side view

Foot

Head

Eyes

Tentacles

Mouth

Although snails are hermaphrodites (that is, they have both male and female parts), the individuals will mate with each other before laying eggs. However, the African giant snail *Achatina achatina* reproduces
by self-fertilization. Unlike many species, reproduction is not preceded by coupling, although it is not unusual to find two snails in close proximity. Laying usually takes place in the late evening and night. On warm humid days, however, egg-laying may occur during the day.

Eggs are deposited in dug-out holes about 4 cm deep. When small clutches of eggs are laid, a second laying and sometimes a third laying is indicated. Usually, the eggs hatch 2-3 weeks after laying. *A. achatina* has high hatchability; 100% hatchability is not uncommon.

The baby snail possesses a thin shell membrane which calcifies progressively. Although this period is characterized by rapid growth, the snails are able to survive the first few days (5-10 days) after hatching without food. This is perhaps an evolutionary adaptation for an organism with poor mobility.

The juvenile phase covers the period between 1 and 2 months to the stage of sexual maturity (14-20 months). During this period, the snail accepts a much wider range of food. At the end of this period, the shell is well formed and the snail weighs between 100 g and 450 g. Differences in growth rates of the various ecotypes are very evident during this period.

The adult phase starts when the snail reaches sexual maturity. Not all adult snails lay eggs each season. Some individuals on our farm have not laid eggs for three successive seasons. Whether this is due to infertility or growth aberrations is not known. An average life expectancy is 5 to 6 years, although there are reports of snails surviving up to 9 or 10 years.

**Recommended species for snail farming**

A list of all edible snail species, of both African and European origin, is provided overleaf. In Europe and North America there are over 20 edible species, of which the most popular are petit-gris or the small
grey snail, *Helix aspersa*, the Burgundy snail, *H. pomatia*, and escargot ture or the snail of Turkey, *H. lucorum*.

The most popular edible snails in West Africa are the giant snail, *Achatina achatina*, and the big black, *Archachatina marginata*. The local names for these species are given in the list of edible species. Most of the studies conducted on snails in West Africa have concentrated on these two species and on the garden snail, *Achatina fulica*.

**Edible snail species of African origin**

*Achatina achatina*
Common name: the giant snail
Local names: nwapa (Akan, Ghana), abobo (Ewe, Ghana), krekete (Hausa, Ghana), elonkoe (Nzima, Ghana), waa (Ga, Ghana), welle (Dagarti, Ghana), honuldu (The Gambia), dain (Nano, Liberia), drainn (Gio, Liberia), konk (Sierra Leone), katantawa (Hausa, Nigeria), konokono (Swahili, East Africa)

*Achatina fulica*
Common name: the garden snail or the foolish one (sometimes also called the giant African snail)
Local names: Nwa (Akan, Ghana), kamniyo (Luo, Kenya), ekhumuniu (Luhya, Kenya), kreteke (northern tribes of Ghana, Togo, Nigeria and Burkina Faso), konokono (Swahili, East Africa)

*Archachatina ventricosa*

*Archachatina marginata*
Common name: the big black
Local names: pobere (Akan, Ghana), egbun (Yoruba, Nigeria), proli (Kpelle, Liberia)

*Archachatina degneri*

*Limicolaria martensis*

*Macrochilamys indica*

In most cases, the local name refers to all edible snail species in the country.
Edible snail species of European origin

*Helix aspersa*
   Common name: petit-gris (the small grey snail)

*Helix pomatia*
   Common name: the Burgundy snail

*Helix lucorum*
   Common name: escargot turc (the snail of Turkey)

*Helix cibucta*

*Helix adanensis*
   Common name: the snail of Adana

*Helix anctostoma*

*Helix melanostoma*

*Helix melanonixia*

*Helix thiessiana*

*Helix nucula*

*Helix aperta*
   Common name: the burrowing snail

*Iberus alonensis*
   Common name: Spanish cabaret

*Arianta arbustorium*

*Cepaea nemoralis*
   Common name: the wood snail

*Cepaea hortensis*
   Common name: the garden snail

*Theba pisana*
   Common name: the banded snail

*Otala puntata*
   Common name: Vaqueta

*Otala lactea*

*Perforatella incarnata*

*Sphincterochila candidisma*
   Common name: Cagol mangeta

This book focuses mainly on *A. achatina*, a widely distributed species in West Africa (particularly Benin, Côte d’Ivoire, Ghana, Liberia, Nigeria, Sierra Leone and Togo) which can be considered a good candidate for snail farming in most areas of West Africa.
Figure 2: The giant snail, *Achatina achatina*, and its known distribution in the region
There are several ecotypes (locally adapted populations) of *A. achatina*, showing differences in growth rates, size, aestivation patterns, colour and even flavour. The differences in size may be explained partly by differences in the length of the aestivation period; the shorter the aestivation period, the longer the feeding period and the larger, therefore, the ecotype.

**Figure 3:** Two ecotypes of the giant snail, *Achatina achatina*, found in Ghana

In Ghana, a study of the three ecotypes, known as Donyina, Apedwa and Goaso, showed significant differences. The Apedwa snails had the shortest aestivation periods, the Donyina snails the longest. The Apedwa snails were the largest of the three ecotypes; in some cases they were twice the size of Donyina snails. In Ghana, this ecotype would be recommended as the best candidate for snail farming.
Chapter 2

Choosing a site

Snails are adept at escaping from enclosures. A priority in setting up a productive snail farming venture, 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 step, however, is to select an appropriate site.

There are a number of factors to consider in site selection. The main ones are wind direction, soil characteristics and microclimate.

Wind speed and direction

Wind accelerates moisture loss in snails. To prevent snails from drying, therefore, snaileries should be situated in sites which are protected from the wind. Downhill sites, preferably where there is good enough tree cover to reduce the impact of the wind, are usually the most suitable.

Soil characteristics

Soil is a major part of a snail’s habitat, and soil composition, water content and texture are important factors to consider in site selection. The shell of a snail is made up mainly of calcium, most of which is derived from the soil. Snails also derive most of their water requirements from the soil. They dig in the soil to lay their eggs and to rest
during the dry season. It is essential, therefore, that the calcium and water content of the soil is high and that the soil is loose. Heavy clayey soil that becomes waterlogged in the rainy season and compacts during the dry season is not desirable. Very sandy soil, with a low water-holding capacity, is also unsuitable, and acidic soils should be avoided.

**Figure 4:** General view of a snail farm, with multistorey tree cover acting as a windbreak and reducing loss of water from the soil surface

Soils with high organic matter support the growth and development of snails. In general, if a soil supports good growth of cocoyam, tomatoes and leafy vegetables, it is suitable for snail farming. Before introducing snails to the site, the soil should be loosened by tilling.

**Temperature and humidity**

Snails are cold blooded and therefore sensitive to changes in atmospheric humidity and temperature. They thrive best in areas which have
moderate temperatures and high humidity. In the West African region, temperatures in the areas where most edible species are found do not fluctuate greatly. However, there are significant fluctuations in humidity, which have a pronounced effect on *A. achatina*.

When humidity falls below 75%, as is the case during the dry season (October to mid-March), *A. achatina* becomes inactive, seals itself into its shell with a white, calcareous layer and aestivates in order to prevent loss of water from the body.

**Figure 5:** Aestivating snail sealed into its shell by a calcareous layer

This reaction is typical of all snail species; whenever conditions are not to their liking, they go into dormancy. This behaviour is most common in the dry season, but snails will also aestivate if dry spells occur during the wet season. For the snail farmer, aestivation means the loss of valuable growing time. More investigation is needed to see if it would be possible to eliminate (or at least reduce) aestivation from the
A. achatina cycle. As noted earlier with reference to ecotypes, there appears to be a correlation between length of aestivation and size of the snail.

Clearly, it is not possible to control temperature and humidity in outdoor situations. However, the magnitude of temperature and humidity fluctuations is reduced in areas of relatively undisturbed forest or fairly dense vegetation cover. Sites with these characteristics should be selected in preference to open grassland or farmland areas.
Chapter 3

Constructing a snailery

There are several different types of snaileries that can be constructed. Factors which determine the type chosen include the scale of the snail farming enterprise, the snails’ stage of development and the snails’ habits. The most important features of any snailery are that it is escape-proof, it keeps predators out, and that it allows easy access to tend the snails.

Broadly, the materials required for building snaileries are: decay- and termite-resistant timber, such as *Milicia excelsa* (local name — odum; trade name in West Africa — iroko), *Nauclea diderrichii* (local name — kusia; trade name — opepe) and *Lophira alata* (local name — kaku; trade name — ekki); sandcrete blocks; mosquito nets or nylon mesh; and polythene sheets. The materials needed for each type of snailery are listed in Appendix 3, with an estimate of the costs of construction.

**Hutch boxes**

These pens are square or rectangular, single or multichamber wooden boxes with lids. The boxes are placed on wooden stilts above the ground. In the middle of the lid is an opening covered with wire netting or nylon mesh. 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 18-25 cm. The procedure involved in building a hutch box is shown in Figure 6 (overleaf).
Figure 6: Sequence of building a single chamber hutch box

1. Dimensions: 60 cm x 30 cm x 60 cm

2. Components:
   - Wire netting
   - Hinges
   - Timber
   - Wooden board
   - Holes for drainage

3. Additional features:
   - Nylon mesh
   - Soil

4. Support:
   - Timber stilts
Hutch boxes are ideal as hatchery and nursery pens as the eggs and young snails can be easily located and observed. Mature snails in larger types of snaileries should be transferred to hutch boxes when they start making holes to lay eggs. The soil must be changed occasionally as an accumulation of droppings will increase the chances of disease development. A soil change every 3 months is adequate.

**Figure 7:** Snails in one of the chambers of a double chamber hutch box

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**Trench pens**

Trench pens can also be used as hatchery and nursery pens. They are a little more difficult to use than hutch boxes because one has to stoop or kneel down to tend the snails. Building a trench pen involves digging a
square or rectangular hole in the ground, about 50 cm deep, and then dividing it up into pens (see Figure 8). The sides of the trench pens are built of sandcrete blocks and the bottom covered with loose soil. The pens are covered with nylon mesh nailed to wooden frames.

**Figure 8:** A trench pen
Mini-paddock pens

These small square or rectangular pens are usually erected within a larger fenced area. They are built of timber or bamboo, with wire netting or nylon mesh. The sequence for building a mini-paddock using bamboo is shown in Figure 9. A mini-paddock built of timber and netting is shown in Figure 10 (overleaf). The walls of a mini-paddock should be about 50 cm high and dug at least 15 cm into the ground. To prevent snails from escaping, horizontal wooden frames are attached to the top of the fence and covered with the mesh.

**Figure 9:** Sequence of building a mini-paddock pen using bamboo and nylon mesh
**Figure 10:** A mini-paddock pen built of timber, wire netting and nylon mesh

Mini-paddock pens are ideal as fattening pens. Within the paddock should be plants which provide shelter or are a source of food. Appropriate plants for West Africa which provide shelter as well as food include cocoyam, paw paw, banana, oil palm, fluted pumpkin, sweet potato (the wild type), fig, cassava and African spinach.

Experience has shown that rectangular pens are easier to use than square pens. They allow the farmer access to the whole area of the paddock without needing to enter it, in order to carry out such tasks as distributing food, collecting uneaten food, inspecting snails, and replanting food and shelter plants.

In addition to the natural shelter provided in mini-paddock pens and in moveable and free-range pens, it is advisable to provide other forms of
shelter to ensure that the snails are not exposed to too much heat. For example, concave tiles or split bamboo can be placed on the stones on the ground, with the concave side facing downwards. Large leaves spread in the pens will serve the same function. On very hot days, the soil can be cooled by using palm fronds to spread water on the surface.

**Moveable pens**

These pens are suitable as fattening pens and for housing mature snails. They can also be used as exhibition pens. They consist of wooden frames covered with nylon mesh on the sides; the mesh extends over most of the top, leaving an opening for access. A fold of mesh suspended from the roof prevents the snails from escaping. Moveable pens should always be placed on a flat surface.

**Figure 11:** Sequence of building a small moveable rectangular pen
The main attribute of these pens is that they can be moved from one site to another, as long as the framework is strong. The main disadvantage is that small snails are likely to escape because the base of the pen is not buried in the ground.

**Free-range pens**

For this type of snailery, an area of about 18 x 12 m is planted with food and shelter plants and surrounded by a fence. The snails are allowed to move over the entire area. Although free-range pens are easier to construct than other types of snaileries, because of their large size there are some disadvantages; these include the difficulty in locating eggs and small snails and in keeping predators out.
Chapter 4
Food and feeding

Snails are vegetarian and will accept many types of food. The types of food favoured by the most studied African species, *Achatina achatina*, and the diet recommended to farmers rearing this species, are described here.

Types of food

Investigations have shown that *A. achatina* is capable of utilizing a remarkably wide range of food items. However, it feeds mainly on green leaves, fruits, tubers and flowers. Unlike other snails, it prefers leaves and fruits which are detached from the main plant. It also seems to prefer wet rather than dry leaves and appears to thrive on prunings of the food plants grown in pens.

The following food items are recommended:

*Leaves:* cocoyam, kola, bokoboko (*Talinum triangulare*), paw paw, cassava, okra, eggplant, loofa, centrosema, cabbage and lettuce

*Fruits:* paw paw, mango, banana, eggplant, pear, oil palm, fig, tomato and cucumber
Tubers: cocoyam, cassava, yam, sweet potato and plantain

Flowers: oprono (Mansonria altissima), odwuma (Musanga cecropoides) and paw paw

Recommended diet

Providing *A. achatina* with a mixture of foods, rather than only one or two items, will enhance its growth. The attractiveness of food is also important in the nutrition of this species. If the food is appetising or contains a feeding stimulant, the snails will eat a lot and grow fast. Paw paw is a good example of a food which stimulates feeding. If food is unattractive or lacks a stimulant, however nutritious it may be the snails will not eat much of it. Snails also avoid hairy plants or plants such as physic nut (*Jatropha curcas*) that produce defensive chemicals.

From the studies conducted to date on *A. achatina*, it appears that baby snails thrive best on leafy vegetables. At all other stages, a diet made up of the following ingredients is recommended:

— *Cocoyam*. Cocoyam leaves contribute fairly high amounts of protein (2.9%), calcium (60 mg/kg) and phosphorus (52 mg/kg), and moderate amounts of thiamine (vitamin B1) and riboflavin (vitamin B2).

— *Paw paw*. Paw paw fruit provides moderate amounts of carbohydrates and high amounts of ascorbic acid (which for many plant-feeding animals, including snails, is a feeding stimulant).

— *Bokoboko*. Also known as the flameflower plant, bokoboko provides fairly high amounts of protein (2.4%), phosphorus (67 mg/kg) and iron (5 mg/kg), and moderate amounts of ascorbic acid and riboflavin.
— **Oil palm.** The mesocarp (fleshy layer) of the oil palm is high in carbohydrates, fats and palmitate (vitamin A).

— **Supplementary vitamins.** Other food plants known to contain moderate amounts of vitamins D, E and K should be added: examples are sunflower and copra cake (vitamin D), wheat germ, lettuce and other vegetables (vitamin E), cabbage and African spinach (vitamin K).

— **Supplementary calcium.** If the soil is not high in calcium, supplementary calcium will be needed. This can be provided by sprinkling powdered oyster or snail shells or ground limestone onto leafy vegetables.

— **Supplementary minerals.** Other minerals can be provided by placing licking stones containing the mineral in the pen.
Clean water should be available to the snails at all times. For mature snails, it should be provided in shallow containers; if the containers are too deep, the snails will not be able to crawl out of them and will drown. For baby snails, a piece of sponge or cotton wool soaked in water will do.

Older snails should be fed on the same items given to them as immature snails. If a change in the diet has to be made, the new food items should be introduced gradually.

Studies have been carried out on the growth rate of snails fed on different diets but the findings are inconclusive. More rigorous experiments from which one can make direct comparisons need to be conducted. Some studies do suggest, however, that growth rates are influenced by the genetic make up of snails; generally, the offspring of the larger ecotypes have faster growth rates.

As land pressures force people to move from extensive farming, where natural foods are abundant, to semi-intensive farming, it may become necessary to introduce formulated feeds. Studies in Ghana in which poultry feed was used in snail farming showed that this formula had good potential. In France, a compound feed commonly used for *Helix* species contains calcium, phosphorus, sodium chloride and vitamins A, B1, D, E and K. This sort of feed, formulated to meet the snail’s specific nutritional requirements, has the effect of considerably reducing the growth period. Formulated food for *H. aspersa*, for example, reduced the growth period from hatching to harvest by 10 months (from 27 to 17 months).
Chapter 5
Breeding and management

The aestivation period of *Achatina achatina* in West Africa lasts from October to March. The active period can be divided into three phases:

— *Pre-spawning phase.* This is the phase immediately after aestivation. It lasts from March to April. The snails are fairly active during this phase and food consumption is quite high.

— *Spawning phase.* This phase lasts from April to July and is characterized by egg laying. Food consumption is reduced for egg-laying snails.

— *Post-spawning phase.* Lasting from July to October, this is the phase during which food consumption is very high as snails start storing reserves for the dormancy period ahead.

**Selecting breeding stock**

Until snail farms become self-sustaining, farmers may have to collect young snails from the wild or buy them cheaply in the peak season and fatten them in captivity in the off season. In the relatively undisturbed forest areas snails can be collected in large numbers on days following rains. They are active at night and on cloudy or foggy mornings. During the day they tend to keep well hidden, so it is best to collect them early in the morning when the sun is low and the humidity high.
Farmers purchasing young snails from snail gatherers to stock their farms should expect a fairly high level of mortality as a result of poor handling and the adjustment to different foods.

Once the snail farm is established, the farmer should select breeding stock from his/her own snails. Breeding stock must be selected in the wet season preceding aestivation. The selection should be based on the following attributes:

- *Fecundity* (expected number of eggs, based on numbers laid in previous seasons)
- *Hatchability* (percentage of eggs likely to hatch out of the total number laid)
- *Establishment rate* (percentage of snails likely to survive after hatching)
- *Growth rate*

Simple records kept by snail farmers can provide all this information. As a general rule, the fastest growers with the strongest shells should be selected as breeding stock. The stronger the shell, the more protection the snail has against predators.

**Nursery**

Snails selected as breeding stock are placed in hutch boxes. The boxes should contain feed and water troughs. Some farmers let snails lay eggs in the grower pens, and then transfer the eggs to the boxes, but this is not an easy task. It may be difficult to locate the eggs, and the eggs may be physically damaged during the transfer.

A breeding snail may lay one to three egg masses per season. The number of breeding snails placed in a hutch box depends on the fertility of the group and on the number of young snails required. The latter
depends on the pen space available. After egg laying, the parent snails should be returned to their pens.

In *A. achatina*, there are large differences in egg production both within and between populations. The average egg mass produced by the various ecotypes studied in Ghana, for example, ranged from 38 to 563. Generally, snails lay between 100 and 400 eggs.

The eggs are elliptical and measure about 5 mm long. They are usually laid in round-shaped holes dug 2-5 cm deep in the soil (see Figure 13). Occasionally they are laid on the soil surface or at the base of plants. Snail eggs require a certain amount of warmth to induce hatching. They usually hatch 12-20 days after laying.

**Figure 13:** Eggs laid in a hole dug in the soil

In *A. achatina*, the baby snails have light brown shells with black stripes. They should be kept in the boxes and fed on vegetable leaves (preferably bokoboko, cocoyam and paw paw leaves), fruits (preferably
paw paw), powdered oyster shells and water until they are big enough to move to grower pens. Young snails do best if they are kept with snails of the same size.

**Rearing density**

Density affects the growth and breeding capacity of snails. High density populations tend to grow slowly, develop into smaller adults, and lay fewer clutches of eggs and fewer eggs per clutch. If the snails are very densely packed, they may not breed at all. The accumulating slime suppresses reproduction. Other disadvantages of high density are the high parasitism rates and ease of transmission of diseases.

In terms of snail weight, the recommended density is 1-1.5 kg per square metre (for *Achatina*, this would be about 15 to 25 snails per square metre). When starting up a snail farm, it is best to start with as low a density as possible. As the farmer becomes more familiar with snail habits and with managing the enterprise, the numbers could be increased.

**Figure 14:** Giant snails, *Achatina achatina*, at various stages of development crawling up the wall of a pen
Management calendar

As in any livestock farming operation, good management practices are the key to success. The recommendations given here provide a basic guide to the types and timing of management practices which should be adopted by snail farmers in West Africa. Obviously, as farms become established and farmers gain experience, some elements of this management regime can be changed according the farmer’s particular circumstances and the scale of the enterprise.

August-September
Breeding stock for the following season is selected (in the case of first-time snail farmers, breeding snails should be obtained in March or April).

January
The farm site is selected. The main criteria determining selection should be high calcium and water content of the soil, loose soil texture, suitability of the land for growing vegetables, and good tree cover to reduce impact of the wind and loss of soil water.

February-March
The land is cleared and the soil turned over. A fence is put up, and the pens required (from those which act as nurseries to those intended for housing mature snails) are constructed. The number of hutch boxes or trench pens and the size of the fattening pens are determined by the number of snails the farmer intends rearing. Fast-growing food and shelter plants should be planted in the growing pens and paddocks.

March-April
The breeding snails are placed in the hutch boxes or trench pens, preferably in the evening when it is cool. Where there is a
possibility of low hatching rates, soils in these boxes or pens should have been sterilized by heating. Water and food is put into the boxes or pens; farmers should note that if dry food (such as formulated feed) is provided, the snails will require extra water.

April-July

Egg laying starts. About 3 weeks after egg laying, the soil on top of the clutch should be removed carefully to allow uniform emergence.

July

Breeding snails are returned to the fattening pens. Newly hatched and young snails should be given tender foliage, plenty of water and, if necessary, supplementary calcium. Excreta and left-over food should be removed daily.

August-September

Growing snails are removed from the hutch boxes or trench pens to the fattening pens, where they remain until ready to be marketed.
Chapter 6
Predators, parasites and diseases

There are a number of predators, parasites and diseases which snail farmers must be aware of if mortality rates are to be kept to a minimum.

Predators

The major predators of snails are field mice, rats and shrews, frogs and toads, thrushes, crows and domesticated birds such as ducks and turkeys, lizards and snakes, drilid and carabid beetles, and millipedes and centipedes. The frogs tend to take only the young snails, while the reptiles eat both the eggs and the snails.

In areas with high bird predation, it is necessary to use cover nets over the pens. Keeping some of the other predators out may require building fences, between 15 and 30 cm high and dug well into the ground, around the pens. It is also advisable to set bait or traps outside the snail farm area.

Left-over food should be removed regularly from pens because some predators, particularly rats and field mice, are attracted by the uneaten food. These predators can decimate a farm in a few days.
The main predators, however, are humans. A snail farmer must introduce any measures he or she considers necessary to protect the farm against poachers.

**Parasites**

In the studies carried out in Ghana, the major parasite on snails was found to be a fly, *Alluaudiella flavicornis*. This species belongs to the same family as the housefly and the adult resembles the adult housefly.
*A. flavicornis* lays 20-40 eggs in the snail shell or on the snail. The eggs hatch in about 1 week and the small, cream-coloured worms start feeding on or in the body tissue. They feed until the body is reduced to a putrefying mass, and then pupate within the shell. After a 10-day incubation period, the adults emerge. The best protection against these flies is to cover the pens with nylon mesh.

**Figure 16:** Life cycle of *Alluaudihella flavicornis*, a parasite of *Achatina achatina*

The entire life cycle of *Alluaudihella flavicornis* takes 25-40 days.
Ectoparasitic mites are sometimes found on the snails in hutch boxes. They appear to be secondary parasites, usually occurring on inactive snails.

Some nematodes are known to attack European species of edible snails. However, there are no reports of nematodes parasitising *A. achatina*.

**Diseases**

Little is known of the diseases which attack *A. achatina* in West Africa. As snail farming increases in popularity it is likely that more research will be conducted in this area. The main disease which has been reported to date is a fungal disease, spread through physical contact by the snails licking slime from each other’s bodies.

It is possible that the two major diseases affecting European species also affect African species because the causal organisms of these diseases do occur in the natural range of *A. achatina*. The first disease is a bacterial disease, caused by *Pseudomonas*; it leads to intestinal infections which may spread rapidly amongst dense populations of snails. The second disease is caused by the fungus *Fusarium*, which parasitises the eggs of *Helix aspersa*. The affected eggs turn reddish-brown and development stops. This disease is commonly referred to as ‘rosy eggs disease’.

Basic hygiene will prevent the spread of diseases. Pens should be cleaned out regularly to remove excreta and uneaten food, as well as any other decaying matter that may serve as substrate for pathogenic organisms. It is also advisable to sterilize the soil in hutch boxes.
Chapter 7
Markets

Snails may take up to 2 years to reach the size which meets local consumer preferences. The marketable size required for export is slightly smaller.

Local markets

In the high-altitude forest areas of West Africa, particularly in Ghana, Nigeria and Côte d’Ivoire, snail meat forms a substantial part of the meat in the diet of the local people. Snails are gathered in the wild, packed into bags, wooden crates or baskets and transported to selling points along main roads or to urban centres (see Figure 17).

Figure 17: Types of containers used to transport snails to markets
In urban areas the gatherers may sell the snails directly to consumers or to wholesale traders or retailers. Snails can be smoked and stored for sale during the off season when prices are highest.

In some areas of West Africa, snail meat has never been part of the local diet. In the predominantly Muslim northern areas of West Africa, snail meat is not consumed for religious reasons.

**Export markets**

There is a growing international trade in snails. France plays a central role in this trade. Some of the snails imported into France are processed and exported to other European countries or to North America. The USA alone imports about US $200 million worth of snails annually. Other important markets are Germany, Belgium, Netherlands, Canada, Switzerland, Japan, Sweden, Austria, Denmark and South Africa. Among the major suppliers to these markets are Greece, Turkey, Rumania, Algeria, Tunisia, Thailand and China.

Most countries supply the European snail species *Helix aspersa*, *H. pomatia* and *H. lucorum*. Thailand and China supply *Achatina achatina*. The snails are supplied fresh, frozen or canned. The African species fetch about one third of the price of the European species. This is mainly because, compared to the European species, the meat of the African species is considered to be rather rubbery and the shell less suitable for presentation of the final product. European consumers generally prefer snails served in the shell.

However, recent studies conducted by the Ministry of Agriculture, Fisheries and Food in the United Kingdom have shown that juvenile *A. achatina* snails are meatier and more tender than the more favoured European species, and it is hoped that this finding will increase demand for the African species. For West African producers, this will mean not only a bigger market for their product but also reduced costs of production because of the shorter growing period required. However,
it will take some time before the long-standing prejudices in continental Europe against the African snail species are overcome.

**Snail consumption in West Africa**

Snails are used to prepare a variety of meals. These include soups, sauces and kebab. In Ghana the big snails locally referred to as ‘atope’ are preferred for soups. These range in weight from 120 g to 450 g. However, juvenile snails referred to as ‘nwawaa’ in Ghana, weighing between 20 g and 40 g, are preferred for sauces.

The meat is removed from the shell and the tubular appendages attached to the mantle are cut off. The meat is washed to remove slimy substances and dirt. It is then put in a saucepan, with enough water to cover it, and boiled. The water is then drained and the meat is washed a second time in cold water. Snail kebabs are made from spiced boiled or fried snails.

For preparing light soup (Ghana) and pepper soup (Nigeria), already cooked snail meat is added to a variety of meats (for example, beef, mutton or fish) and sliced onions, and then steamed for about 10-15 minutes. Water is added to the steamed meat and brought to the boil. A blended vegetable mixture (including peppers and tomatoes) and salt are added, and the mixture is cooked until it thickens slightly. The soup can be served with such foods as fufu, rice, kenkey (corn dough), yam and bread. Other soups, such as palm-nut soup, groundnut soup and cocoyam leaf soup, also known as ‘green green’ in Ghana, can be prepared in a similar manner.

For preparing sauces, the snail meat is washed with lime to remove the slime. It is then seasoned with garlic, a stock cube, salt and other spices and boiled for about 20 minutes and/or fried in oil. Sliced onions, peppers, tomato puree and herbs are fried and the stock added. The sauce is allowed to simmer over a low heat until smooth and thickened, stirring constantly. The fried snail meat is added and cooked gently on a
low heat. This can be served with such foods as rice, yam, potatoes, plantain and kenkey.

A survey conducted in Côte d'Ivoire in 1986 revealed that the markets in Abidjan alone sold 830 000 kg of fresh snails that year and 69 000 kg of smoked snails. In Ghana and Côte d'Ivoire, snail meat constitutes about 10% of the trade in game meat. In Nigeria, it is estimated that the number of snails collected per farmer per month from the deciduous and rain forest regions is 36 and 17, respectively. Most of the chopbars (traditional restaurants) in Ghana serve snail meat during the peak snail season. The prices are often higher than those charged for beef or mutton. The high prices are partly attributable to transportation and processing (when smoked). However, high prices are due primarily to increasing consumer demand and dwindling supplies.

The most common species sold at the roadside in West Africa are snails, duikers, brush-tailed porcupines, hares and grasscutters. Snails and grasscutters fetch the highest market prices per kilogram.
APPENDIX  1

Glossary

aestivation  the state of dormancy during the dry season (warm season)

agglutination  the state of being clumped together, as if glued

aphrodisiac  a substance (food or drug) that stimulates sexual desire

clutch  number of eggs produced or incubated at the same time

cold-blooded  having a body temperature that varies according to the external climate

defensive chemicals  chemicals in a plant that protect it from attack by other organisms

deforestation  the act of cutting down or clearing trees from a forest

ecotype  a population of any species of plant or animal with inherited characteristics that enable it to survive in a particular habitat

ectoparasite  a parasite that lives externally on its host

extensive farming  a farming system (always outdoors) in which the natural elements (plants, soils, weather, etc) play a dominant role, requiring minimal financial input
feeding stimulant  a food component that induces feeding

heliculture  a system of raising snails in enclosures, indoors or outdoors (derived from *Helix*, the genus to which many species of European origin belong)

hermaphrodite  an organism which has both male and female reproductive organs

humidity  dampness, particularly of the air

incubation period  time between the laying and hatching of eggs

intensive farming  a farming system (indoor or outdoor) in a highly controlled environment, requiring high capital input

mollusc  an invertebrate animal which usually has a shell

mortality  frequency of deaths in proportion to population

parasite  an organism (usually small) that grows, feeds and is sheltered on or in a particular organism (its host) but contributes nothing to its host’s survival

pesticide  a chemical used to kill pests of animals or plants

predator  an animal that preys on other animals

putrefy  decay or decompose with a fetid (foul) smell

secondary parasite  a parasite that lives on a host weakened by another organism or by unfavourable environmental conditions

snailery  enclosure or pen in which snails are reared

tentacles  a retractable structure in animals, bearing sense receptors and used to obtain food

viscera  the soft, internal organs of the body
APPENDIX  2

Sources of Information on Snail Farming

Publications

*Snail Farming Research Journal.* This biennial journal is published by the scientific committee of the Snail Farmers Association in Italy. Topics covered by the papers include taxonomy, biology, behaviour, nutrition and husbandry.

*Journal of Molluscan Studies.* Published three times a year in the United Kingdom, this journal includes articles on research on molluscs and related organisms.


Herb, F. (unpublished) Raising snails for food. This manuscript provides an overview of techniques developed for farming *Helix aspersa* in California, USA.

National associations

Brazilian Snail Producers  
c/o T. Behr  
Cara and Col Company  
Brasilia  
Brazil

Confederation Française de la  
Conserve-Groupe Escargots  
3 rue de la Logelbach  
35017 Paris  
France

The Italian Snail Farmers Association  
Via Vittorio Emmanuele  
103-12062 Cherasco (CN)  
Italy

Britsnail Gastropod Growers  
Co-operative  
c/o G. Pinkney  
Hall Farms  
Daventry  
UK

The Snail Club of America  
c/o R. Tucker  
The Upper Crust  
4909 N. Seventh Avenue  
Fresno  
California 93726  
USA

Commercial operations in France

Processors of snails

Escargot de France  
BP 16, Quartier Tet-Noire  
13340 Rognac

Escargots Lorrain  
Charmon-sous-Barbuise  
10150 Pont Ste Marie

Generale des Conserves  
225 rue St Honore  
75039 Paris

Gillet Conserves  
Vallentigny  
10500 Brienne-le-chateau

Menetrel et Cie SA  
Fouherans BP 398  
39106 Dole

Importers of frozen snails

Antigel SA  
29 rue Casimir Perier  
69002 Lyon

Ortiz  
Rue Lamartine  
52100 Saint Dizier

SECA  
7 rue de l’Admiral Courbet  
94610 Saint Mande

Sogeviandes  
11 rue de Normande  
94150 Rungis

Volimex  
35 rue Berger  
75009 Paris
Importers of canned snails

ALMA (Ste)
13 rue Nicholas Robert
93600 Aulnay-sous-Bois

CTC
41 rue Reamur
75003 Paris

Indeco
Av. de Versailles
Gare Routiere Sogaris
94153 Rungis

Intersud
40 rue de Westermeyer
92400 Ivry

Soric
18 bd. de Vintimille
13005 Marseille

Retail organizations

Auchan
200 rue de la Recherche
59650 Villeneuve d’Asig

Casino-Epargne
24 rue de la Montat
42008 St Etienne Cedex

Addresses of individuals/institutions in West Africa interested in snail farming

Benin

K. Aziadomi, Directeur, Centre National d’Agro-pedologie, BP 988, Cotonou

M. Ehouinsou, Researcher, Ministère du Développement Rural et de l’Action Coopérative, Direction de la Recherche Agronomique, BP 884, Cotonou

J.T. Codjia, Faculté des Sciences Agronomiques, BP 2759, Cotonou

Cameroon

G. Agbede, Ferme d’application, Centre Universitaire de Dschang, BP 96, Dschang

J. Tchoumboue, Département de Zootechnie, Centre Universitaire de Dschang, BP 110, Dschang
Côte d’Ivoire

A. Depelchin, Service ‘Utilisation secondaire des plans d’eaux, de la pisciculture et des petits élevages’, SODEPRA-Nord, BP 745, Korhogo
D. Zongo and M. Coulibaly, LACENA, 06 BP 353, Abidjan 06
Lab. de Pathologie Animale, Ministère de la Production Animale, SODEPRA-Centre, BP 1366, Bouaké

Ghana

J.R. Cobbinah, Forestry Research Institute of Ghana, Kumasi
J.K.M. Hodasi, Department of Zoology, University of Ghana, Legon
L. Sawyer, Food Research Institute, P.O. Box M 20, Accra

Nigeria

M.O. Awesu, Department of Biology, Kwara State Polytechnic, P.O. Box 1375, Ilorin
S.O. Esobe, Ejinaka and Thornber Ltd, PMB 7138, Aba, Nigeria
M.A.J. Fayese, Executive Secretary, Cooperative Federation of Nigeria Ltd, P.O. Box 5101, Ibadan
M.O. Sikominu, Directeur, Basic Agro-Tech Nigeria Ltd, P.O. Box 374, Agege, Lagos
APPENDIX 3

Costs of Constructing Snaileries

The costs of construction in each case must take into account the transportation charges.

Hutch box (single chamber; 60 x 60 x 30 cm; suitable for 10-85 adult snails)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Price (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 x 7 x 488 cm timber (iroko)*</td>
<td>1</td>
<td>2.66</td>
</tr>
<tr>
<td>2</td>
<td>2.5 x 30 x 366 cm wooden board</td>
<td>2</td>
<td>18.33</td>
</tr>
<tr>
<td>3</td>
<td>Nylon mesh</td>
<td>0.45 m</td>
<td>0.50</td>
</tr>
<tr>
<td>4</td>
<td>Wire net</td>
<td>0.45 m</td>
<td>0.50</td>
</tr>
<tr>
<td>5</td>
<td>Nails (2.5 and 7.5 cm)</td>
<td>0.5 kg</td>
<td>0.66</td>
</tr>
<tr>
<td>6</td>
<td>8 cm hinges</td>
<td>2</td>
<td>0.50</td>
</tr>
<tr>
<td>7</td>
<td>Labour</td>
<td>1 person-day</td>
<td>4.20</td>
</tr>
</tbody>
</table>

Total: 27.25

* Iroko is the trade name for odum wood

To build a double chamber hutch box, double the quantities of items 2, 3, 4, 5 and 6. Item 1 should be replaced by 2 x 4 x 16 timber.
Trench pen (90 x 90 x 50 cm; suitable for 20-25 adult snails)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Price (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sandcrete blocks 46 x 23 x 15 cm</td>
<td>22</td>
<td>4.40</td>
</tr>
<tr>
<td>2</td>
<td>Cement</td>
<td>1 bag</td>
<td>4.67</td>
</tr>
<tr>
<td>3</td>
<td>Nylon mesh</td>
<td>4.5 m</td>
<td>5.00</td>
</tr>
<tr>
<td>4</td>
<td>2.5 x 5 x 366 cm timber (iroko)</td>
<td>2</td>
<td>2.30</td>
</tr>
<tr>
<td>5</td>
<td>Nails (5 cm)</td>
<td>0.5 kg</td>
<td>0.50</td>
</tr>
<tr>
<td>6</td>
<td>Labour (digging and laying blocks)</td>
<td>2 person-days</td>
<td>6.66</td>
</tr>
<tr>
<td>7</td>
<td>Labour (making cover)</td>
<td>1 person-day</td>
<td>4.16</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td><strong>27.69</strong></td>
</tr>
</tbody>
</table>

Trench pen

Moveable pen

Mini-paddock pen
### Moveable rectangular pen (small)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Price (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 x 5 x 366 cm timber (iroko)</td>
<td>9</td>
<td>15.00</td>
</tr>
<tr>
<td>2</td>
<td>1.5 x 5 x 366 cm timber (iroko)</td>
<td>1</td>
<td>1.33</td>
</tr>
<tr>
<td>3</td>
<td>Nylon mesh (1.8 x 12 m)</td>
<td>22 m</td>
<td>20.83</td>
</tr>
<tr>
<td>4</td>
<td>Nails (5 and 7.5 cm)</td>
<td>1 kg</td>
<td>2.00</td>
</tr>
<tr>
<td>5</td>
<td>Labour</td>
<td>1 person-day</td>
<td>6.67</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>45.83</td>
</tr>
</tbody>
</table>

### Mini-paddock pen (600 x 150 x 50 cm; suitable for more than 200 adult snails)

<table>
<thead>
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<th>Item</th>
<th>Description</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Nylon mesh</td>
<td>18 m</td>
<td>16.66</td>
</tr>
<tr>
<td>2</td>
<td>5 x 5 x 366 cm timber (iroko)</td>
<td>3</td>
<td>5.00</td>
</tr>
<tr>
<td>3</td>
<td>Nails (4 cm)</td>
<td>0.75 kg</td>
<td>0.75</td>
</tr>
<tr>
<td>4</td>
<td>Nails (1.5 cm)</td>
<td>0.5 kg</td>
<td>0.50</td>
</tr>
<tr>
<td>5</td>
<td>Labour</td>
<td>2 person-days</td>
<td>6.67</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>29.58</td>
</tr>
</tbody>
</table>

The costs of a mini-paddock pen built with bamboo depend upon the source of the bamboo and/or the transportation charges.