ASSESSMENT OF CURRENT INNOVATIONS IN SNAIL REARING AND MAINTENANCE FOR COMMERCIAL PURPOSE

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ABSTRACT

Snail rearing involves the controlled management and breeding of snails in a suitable environment to ensure their growth and reproduction, which ultimately leads to the production of snails for consumption, pharmaceuticals, or other purposes. The study assessed current innovations in snail rearing and maintenance for commercial purposes. The paper revealed climate-controlled systems, Feeding Optimization, automation, and Monitoring, and integrated farming systems to be the current innovations in snail rearing. Creating a conducive habitat with appropriate temperature, humidity, and shelter ensures the well-being and growth of the snails. The study concluded that there is a growing interest in snail rearing as a viable commercial venture due to its low capital requirement, potential for high returns, and increasing demand for snail products in the market. The study indicates that current innovations in snail rearing and maintenance for commercial purposes have created a favorable environment for entrepreneurs to enter the industry. With technological advancements, sustainable practices, and market opportunities, snail farming presents a promising avenue for profitable agribusiness ventures. One of the recommendations made was that Snail farmers should engage with experts in the field of snail rearing, agricultural extension officers, and researchers who specialize in snail farming. Interviews with these experts can provide valuable insights into the latest innovations and best practices.

KEYWORDS: Current Innovations, Snail Rearing, Maintenance, and Commercial Purpose

INTRODUCTION

Heliciculture has emerged as a promising venture for commercial purposes due to its economic viability and ecological sustainability. With a rising global demand for snail-based products, farmers and entrepreneurs are continually seeking innovative methods to optimize snail rearing and maintenance practices. This assessment aims to explore the innovations in snail farming and their potential benefits for commercial production. Snails are a valuable source of protein and essential nutrients, attracting interest from the food industry as well as the cosmetics and pharmaceutical sectors. Their ability to thrive in controlled environments with minimal resources makes them an attractive option for sustainable food production.

Establishing and running a successful commercial snail raising company involves careful planning and effort. To begin, selecting the appropriate snail species for the local climate and market need is critical. Providing a suitable environment with proper temperature, humidity, and shelter guarantees the snails' well-being and growth. It is critical for their health and production to implement adequate feeding practices and disease control methods. Efficient breeding and reproduction control lead to a consistent supply of commercial snails. Keeping accurate records and obtaining professional assistance can aid in making educated decisions and maximizing the business. The nutritional benefits of snails, their low environmental effect, and the economic prospects offered by commercial farming are significant elements boosting snail farming's importance. Snails have been shown in research to be a good source of protein, iron, and vital amino acids (Igiehon and Adesola, 2020). Furthermore, as compared to conventional animal farming, snail farming has a lower carbon footprint and requires less land and water (Ademosun et al., 2019). As the demand for snail-based goods grows, adopting novel approaches in snail raising and management is critical for long-term commercial production. By understanding and implementing the latest advancements in the industry, snail farmers can maximize their productivity while minimizing their environmental impact, creating a win-win situation for both producers and consumers.

CONCEPT OF CURRENT INNOVATION

The phrase "Current Innovation" refers to the most recent innovations, advancements, and breakthroughs in technology, science, business, and several other sectors. These innovations are new ideas, processes, goods, or services that push the boundaries of what was previously conceivable and have the potential to have a large beneficial influence and change. Innovative ideas and techniques that address difficulties, increase efficiency, generate new possibilities, and improve the overall quality of life for people and society as a whole are examples of current innovations. They frequently entail the use of developing technology, scientific discoveries, and innovative problem-solving

to address complicated issues and propel development. Current innovations are the product of forward-thinking and innovative individuals, researchers, scientists, engineers, entrepreneurs, and organizations who attempt to push the limits of what is possible. It entails open cooperation and the sharing of knowledge. Open-source efforts, hackathons, and crowdsourcing problem-solving have resulted in several successes. These innovations frequently solve existing difficulties, enhance current processes, and generate new possibilities, with the potential to have a large influence on society, the economy, and different facets of human existence.

Current inventions are significant and relevant answers to real-world issues and requirements. They have the potential to alter industries, improve quality of life, and positively impact society's future. To make an impact, ideas must be embraced and properly applied. Overcoming hurdles, addressing regulatory issues, and assuring scalability and practicability are all part of this process. A user-centric approach is widely used to create successful innovations, taking into consideration end-user wants, preferences, and feedback. Understanding user experiences and incorporating input aids in the refinement and improvement of inventions. Advances in technology are frequently used as facilitators. Emerging technologies such as artificial intelligence, the Internet of Things, block chain, biotechnology, nanotechnology, and quantum computing act as catalysts for transformative ideas. In today's interconnected world, innovations can have far-reaching consequences beyond national borders. They can spur economic growth, facilitate cross-border collaboration, and address global challenges like climate change, healthcare disparities, and poverty. With the acceleration of technological advancements and global connectivity, the pace of innovation is faster than ever before. Keeping up with the rapid rate of change requires adaptability and a willingness to embrace new ideas.

Current Innovations" are the latest and most relevant advancements that shape our world and have the potential to bring about positive transformation. These innovations arise from diverse disciplines, are user-centric, and leverage emerging technologies to address challenges and opportunities across various domains. It is essential for progress, economic growth, and addressing global challenges. Governments, industries, research institutions, and individuals all play a role in fostering and supporting innovation to create a better future. As time progresses, the innovations of today become the foundation for the next wave of advancements, creating a continuous cycle of progress and improvement.

CONCEPT OF SNAIL

A snail is a small mollusk with a spiral-shaped shell. Snails are famous for moving very slowly and for leaving a trail of slime behind them. If you see snails on a restaurant menu, they're more likely to be listed as escargot, or "edible snail" in French

(Vocabulary.com, Inc., 2023). According to Wikipedia, the free encyclopedia (2023), a snail is a shelled gastropod. The name is most often applied to land snails, terrestrial pulmonated gastropod mollusks. However, the common name snail is also used for most of the members of the molluscan class Gastropods that have a coiled shell that is large enough for the animal to retract completely into. When the word "snail" is used in this most general sense, it includes not just land snails but also numerous species of sea snails and freshwater snails. Gastropods that naturally lack a shell or have only an internal shell been mostly called slugs, and land snails that have only a very small shell (that they cannot retract into) are often called semi-slugs.

Image of a snail

Mollusca (snails) are the animal kingdom's second-largest phylum, accounting for a significant portion of the world's fauna. The Gastropods are the only mollusks to have successfully inhabited land. Gastropods are a large part of the phylum Mollusca and the most diverse class in the phylum. They consist of about 65,000 to 80,000 species. Gastropod structure, behavior, feeding, and reproductive adaptations differ greatly from one group to the next. When the term "snail" is used in this broad sense, it refers not only to land snails but also to a variety of sea and freshwater snail species. Slugs are also gastropods that don't have a shell or have just an internal shell. On the other hand, snails have a hard shell, and this is what differentiates them from slugs. Gastropods inhabit various places like woodland, gardens, mudflats, mountains, sandy subtidal, estuaries, lakes, hydrothermal vents, and many more. Some of them also have parasitic features (Vedantu.com, 2023). The snail is a small, slow-moving mollusk belonging to the class Gastropods. These creatures are characterized by their spiral-shaped shells and muscular feet used for locomotion. Snails are found in various habitats, including land, freshwater, and marine environments. They are remarkable for their unique reproductive and feeding strategies, as well as their ability to retract into their shells for protection. Symbolically, snails are often associated with patience, perseverance, and a slow but steady approach to life. They have been used as metaphors in literature, art, and cultural expressions to represent qualities such as resilience and the value of taking one's time (Encyclopedia Britannica, 2023).

CONCEPT OF SNAIL REARING

According to Olufunmilayo Ibiyosola (2022), Snail farming is a branch of agriculture called Heli-culture. Snail farming is, simply put, the cultivation and rearing of snails for domestic and commercial purposes with a high yield guaranteed. Heliciculture describes the process of raising snails for consumption. Each snail has female and male reproductive organs to procreate fertile eggs. Hence, it is safe to say that snails are Hermaphrodites. As for the nutritional benefits, snails are a vital source of calcium, phosphorus, iron, and protein. Heliciculture, commonly known as snail farming, is the process of raising edible land snails, primarily for human consumption or cosmetic use. The meat and snail eggs, a.k.a. white caviar, can be consumed as escargot and as a type of caviar, respectively (Wikipedia, the free encyclopedia, 2023).

Snail rearing, also known as Heliciculture, refers to the practice of breeding and raising snails for various purposes, primarily for commercial or culinary use. This activity involves the controlled management and breeding of snails in a suitable environment to ensure their growth and reproduction, which ultimately leads to the production of snails for consumption, pharmaceuticals, or other purposes, (Guglielmi, S., Iacumin, L., Kostanjšek, R., Tavčar-Kalcher, G., & Čandek-Potokar, M. 2018). Snail rearing is an ancient practice that has gained popularity in recent years due to the increasing demand for snail products, especially in the food industry. Snails are considered a delicacy in many cultures and are rich in protein, low in fat, and a good source of essential nutrients, making them a sought-after food item. The process of snail rearing typically involves creating a suitable habitat for the snails, providing them with appropriate food and water, and ensuring favorable environmental conditions for their growth and reproduction. Various species of snails can be reared, depending on the intended purpose and geographical location, (Aygun, A., & Gokalp, B. 2020). According to Mollusks in Agriculture (2021). The business of snail rearing can be financially rewarding and environmentally sustainable when managed properly. However, it requires specific knowledge and expertise as snails are sensitive to their surroundings, and their growth rate can vary based on factors like temperature, humidity, and food availability.

CURRENT INNOVATIONS OF SNAIL REARING

Snail rearing and maintenance for commercial purposes have not undergone significant changes in terms of revolutionary innovations. However, there have been some advancements and best practices that have gained traction and improved the efficiency and profitability of snail farming. Here are some of the notable innovations:

- **Controlled Environment Systems:** Some commercial snail farms have adopted advanced technologies like climate-controlled systems. These systems

allow farmers to regulate temperature, humidity, and lighting more precisely, creating optimal conditions for snail growth and reproduction regardless of external weather variations.

- **Feeding Optimization:** Research and development efforts have focused on formulating cost-effective and nutritious snail feed. This helps improve the growth rates and overall health of the snails, leading to better yields and reduced expenses.
- **Automation and Monitoring:** Technology has been introduced to automate certain tasks, such as feeding and watering the snails, thereby reducing labor costs and ensuring consistent care. Additionally, sensors and remote monitoring systems allow farmers to track environmental parameters and the health of snails more efficiently.
- **Integrated Farming Systems:** Some commercial snail farms have adopted integrated farming systems, combining snail rearing with other agricultural activities. For example, snails can be raised in conjunction with poultry or fish farming, utilizing waste products from one system as feed for another, creating a more sustainable and efficient farming model.

MITIGATION AGAINST ATTACK ON SNAILS

The maintenance strategies to prevent attacks on snails for commercial purposes involve implementing various preventive measures to protect snail populations from predators. These strategies aim to ensure the successful growth and profitability of commercial snail farming ventures. The key aspects of the maintenance of snails for commercial purposes can be summarized as follows:

- **Physical Barriers:** Fencing and netting systems are employed to create protective barriers around snail enclosures, preventing predators from accessing the snails. Studies have demonstrated the effectiveness of these physical barriers in excluding potential attackers.
- **Chemical Repellents and Deterrents:** Natural repellents, such as plant extracts and bioactive compounds, and chemical repellents are utilized to deter predators from targeting snails. Safety and environmental impact considerations are essential when using chemical repellents.
- **Biological Control:** Natural predators of snail predators are introduced to the farming environment to create predator-prey relationships, reducing the number of attackers targeting the snails. Beneficial microorganisms, such as probiotics, may also play a role in protecting snails from predators.

- **Habitat Management:** Providing suitable shelters and hiding places within snail enclosures enhances predator avoidance. These structures offer protection to snails, minimizing their vulnerability to attacks.
- **Camouflage and Mimicry:** Snails utilize their natural camouflage abilities and mimicry tactics to resemble unpalatable or harmful organisms, discouraging potential predators from attacking them.

By implementing these maintenance strategies, snail farmers can significantly reduce the risk of attacks on their snail populations, promoting their health and longevity. Ensuring a safe and secure environment for commercial snails contributes to the success and sustainability of the farming venture, leading to increased productivity and profitability.

PREVENTION OF DISEASE IN SNAILS

According to Samuel Ekwu (2016), 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 diseases causing agent. These diseases are commonly referred to as rosy eggs disease and the affect eggs turns reddish brown and die off.
- **Parasites:** 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
- **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.
- **Quarantine Practices:** Implementing strict quarantine measures for new snail stock helps prevent the introduction of diseases into the farm. Isolating new snails for a period before integrating them with the existing population can help identify and address potential health issues.

- **Disease Identification and Diagnosis:** Regular monitoring and timely diagnosis of diseases in snails are essential for early intervention and containment. Proper identification of diseases allows farmers to implement appropriate treatment measures.
- **Hygiene and Sanitation:** Ensuring clean and hygienic farming conditions can significantly reduce the risk of disease transmission among snails. Regular cleaning of enclosures and removal of waste are important preventive measures.
- **Water Quality Management:** Maintaining good water quality in snail habitats is critical for their health and disease prevention. Regular monitoring of water parameters and maintaining proper filtration systems are essential.
- **Nutrition and Immune Support:** Providing snails with a balanced and nutritious diet helps bolster their immune systems, making them more resistant to diseases. Proper nutrition contributes to overall snail health.
- **Medication and Treatment:** When disease outbreaks occur, timely and appropriate medication or treatment should be administered under the guidance of a veterinary professional to control and manage the spread of the diseases.

MAINTENANCE FOR PROMOTION OF LIFE SPAN OF SNAILS

Maintenance strategies to increase the lifespan of snails for commercial purposes are essential for ensuring the long-term health, productivity, and profitability of snail farming ventures. Here are some key maintenance practices to enhance the lifespan of snails in commercial settings:

- **Optimal Environmental Conditions:** Provide snails with a suitable habitat that includes the right temperature, humidity, and soil quality. Maintaining appropriate environmental conditions ensures that snails can thrive and live longer.
- **Nutritional Balance:** Offer a well-balanced diet that meets the nutritional requirements of snails. Ensure the availability of essential nutrients, vitamins, and minerals to support their growth, reproduction, and overall health.
- **Water Management:** Provide access to clean and fresh water for the snails. Proper water management is crucial for hydration and overall well-being.
- **Disease Prevention:** Implement disease prevention measures, such as quarantine practices for new snails, regular health monitoring, and maintaining hygienic farming conditions.

- **Predator Control:** Employ effective strategies to prevent attacks from predators. Fencing, netting, and other physical barriers can help protect snails from potential threats.
- **Stress Reduction:** Minimize stress factors, such as handling and transportation, as stress can negatively impact snail health and reduce their lifespan.
- **Husbandry Practices:** Proper handling, stocking density management, and shelter construction are important aspects of husbandry that can positively influence snail lifespan.
- **Genetic Selection:** Consider selecting and breeding snails with desirable traits, such as increased resistance to diseases and improved longevity. By implementing these maintenance strategies, commercial snail farmers can create an environment that promotes the longevity of their snail populations, leading to improved productivity and sustainable farming practices.

ECONOMIC BENEFITS OF SNAIL REARING

Rearing, also known as snail farming or Heliciculture, can offer various economic benefits to individuals and communities. The economic benefits of snail rearing include the following:

- **Income Generation:** Snail farming can be a profitable venture, providing a source of regular income for farmers. Snails can be sold as a high-value product to local markets, restaurants, or exported to international markets.
- **Employment Opportunities:** Snail farming can create job opportunities, especially in rural areas where unemployment may be a concern. It can help to alleviate poverty by offering employment to individuals involved in snail production, processing, and marketing, (Ibiyosola, 2022).
- **Low Start-up Costs:** Compared to some other livestock farming ventures, snail rearing requires relatively low initial investment and operational costs. It is possible to start small and gradually scale up the business. Most livestock take up at least 70% of the expenses for feeding. It is not so with snails because snails are very small and they feed mostly on vegetables. You don't need to employ so many people to manage the farm. One to four labours will be more than enough, depending on the scale of the snail farm, (Agro4africa 2023). This is why you can be sure of making so much profit from snail farming compared to other animals.
- **Fast Growth and Reproduction:** Snails are known for their rapid growth and high reproductive rate. Under proper conditions, they can reach maturity and produce offspring quickly, leading to a faster return on investment

- **Environmental Sustainability:** Snail rearing is considered a sustainable and eco-friendly practice. It has a lower environmental impact compared to some conventional livestock farming methods, as snails do not produce greenhouse gases or require large amounts of feed.
- **Diversification of Income Sources:** Snail farming can serve as an alternative or complementary income source for farmers, providing diversification and risk reduction in their overall agricultural activities. Okonkwo et al., (2013) opined that snail contains a relatively high amount of protein and iron and a low amount of fat. Given that snails are of small sizes, are quiet moving creatures, and are simple to raise as against other livestock, they can be raised in urban areas without encroaching and disturbing the neighbourhood.
- **Revenue generation:** Snail farming can generate foreign revenue. Snails and its byproducts are in high demand and this makes them a source of generating foreign earnings through exportation. Some countries however have ban placed on the importation and or rearing of snails. The weather of some countries also does not favour snail farming and this is an advantage for Nigerians to meet their demand for snails, (Ibiyosola, 2022).
- **Medicinal Purpose:** The Medicinal uses of the African Giant snail among rural people, is due to its usefulness in soup form for correcting these anomalies, Suppression of hypertension, Curtailing aggression and Malformation of bone structure, Nourishment of lactating mothers, Promotion of easy child labour, Cure of anemia, Suppression of convulsion, whooping cough, The fluid Stops bleeding from cuts, Treatment of eye problems, Circumcision of male children, Suppression of small pox, and being Anti-rheumatic. Ika weekly (2019) The other medicinal value of snail meat includes treatment of whooping cough, anemia, asthma, and high blood pressure due to their relatively low cholesterol level but high mineral content, as they form an essential component of both the nucleus and cell protoplasm and are found in most extracellular animal tissue fluid. Proteins are known, among other functions, to repair worn out tissues and may account for it being used by traditional people to enhance the healing of wounds and cuts.

METHODS OF SNAIL REARING PRACTICE

Snail rearing, also known as Heliculture, can be a profitable venture when done correctly. Always adapt your practices based on your specific location and available resources. It's essential to continuously educate yourself on snail rearing and keep up with the latest research and best practices in Heliculture. Here are some of the methods and strategies of snail rearing practices. Happy snail farming!

- **Species selection**

Choose a snail species that is well-suited for commercial rearing. Some common snail species for heliculture include Helix aspersa (common garden snail), Helix pomatia (Roman snail), and Achatina fulica (giant African land snail). Each species has different growth rates, reproductive capacities, and environmental requirements, FAO (2023).

- **Farm Housing and environment**

Create a suitable snailery with adequate space, ventilation, and protection from predators and extreme weather conditions. Snails prefer a humid environment, so maintain the right moisture level (around 80-90%) to prevent dehydration and promote optimal growth, (NAERLS 2012). Design a snail farm with appropriate shelter to protect snails from extreme weather conditions and predators. Provide a suitable substrate, such as soil mixed with organic matter, for snails to lay eggs and bury themselves during unfavorable conditions, (Igene and Atama 2017).

- **Feeding and nutrition**

Provide a balanced diet for the snails, including fresh vegetables, fruits, and other organic including material calcium supplements to support shell development. Avoid feeding them toxic or harmful plants. Calcium supplementation is crucial for snail shell development, (Egonmwan and Airhomwanbor 2016).

- **Breeding and reproduction**

Understand the reproductive cycle of your chosen snail species. Provide suitable conditions to encourage mating and egg-laying. Monitor the egg-laying process and protect the eggs from predators and extreme weather. Ensure proper incubation conditions for eggs and protect them from predators, (Ejide et al., 2018).

- **Pest and disease management**

Implement measures to prevent and control pests and diseases that could affect the snails. Quarantine new snails to prevent introducing diseases to the farm. Avoid the use of harmful chemical pesticides to maintain snail health and minimize environmental impact, (Ejide and Owolabi 2018)

- **Marketing and sales**

Harvest mature snails at the right size and weight for the market. Develop marketing strategies to sell snail products, such as fresh snails, processed snail meat, and snail-based products, (Adeyemo 2020). Develop a marketing strategy to sell your snails and snail-based products. Establish contacts with potential buyers, restaurants, markets, and retailers. Explore value-added products such as snail caviar, snail-based cosmetics, and gourmet snail dishes.

AVAILABLE FACILITIES FOR SNAIL REARING

- **Snail Pens or Enclosures**: Snails can be reared in specially designed pens or enclosures that provide a controlled environment for their growth and reproduction. These pens may be made of wood, bamboo, or other materials and are designed to offer protection from predators and adverse weather conditions.
- **Shade Houses:** Shade houses provide protection from direct sunlight and extreme weather conditions. They are often used in tropical or subtropical regions to create a suitable microclimate for snail rearing.
- **Greenhouses:** In colder climates or areas with extreme weather conditions, greenhouses can be used to maintain a more stable temperature and humidity for snail farming.
- **Plastic Tunnels:** Similar to greenhouses, plastic tunnels offer a controlled environment for snail rearing, particularly in regions with fluctuating weather patterns.
- **Substrate Beds:** Snails need a suitable substrate to lay eggs and burrow. Substrate beds, made of soil or a mixture of soil and other organic matter, provide an ideal environment for snails to lay eggs and reproduce.
- **Hiding Spots and Shelters**: Snails require hiding spots and shelters to protect themselves from predators and harsh environmental conditions. These may include artificial shelters made of materials like coconut shells or clay pots.
- **Water Sources:** Access to clean and fresh water is essential for snail health and well-being. Water sources like shallow ponds or small containers are typically provided within the rearing facility.

SAFETY/SECURITY OF SNAILS

Snail safety is based on their ability to produce mucus. Snails secrete a slimy mucus that serves multiple functions, including lubricating their movements and protecting them from desiccation. This mucus can act as a deterrent to predators by making it difficult for them to get a firm grip on the snail's slippery surface. It also demonstrates behavioral adaptations that contribute to their safety. Many snail species are nocturnal, which means they are more active during the night when predators are less abundant. This behavior allows them to reduce their exposure to potential dangers during daylight hours. Furthermore, snails often prefer secluded habitats such as leaf litter or burrows, which provide them with additional protection and concealment from predators.

The safety and security of snails in their natural environment is a fascinating aspect of their biology. One of the primary defense mechanisms of snails is their shell, which acts as a protective barrier against potential threats. The shell not only provides structural

support but also allows snails to retract inside when they sense danger, offering them a degree of safety from predators and harsh environmental conditions (Barker, 2001). The most prominent feature is their spiral-shaped shell, which not only provides structural support but also acts as a protective shield against predators and harsh environmental conditions. When threatened, snails can withdraw into their shells, making them less susceptible to harm. Some snail species have evolved defensive mechanisms such as the secretion of mucus, which helps deter predators and aids in movement. Snails also exhibit behaviors that enhance their safety and security; their nocturnal habits and preference for secluded habitats, such as leaf litter or burrows, help reduce their exposure to potential dangers during daylight hours. Moreover, they are known to be highly resilient creatures, capable of surviving in various ecological niches and adapting to changing environments. Their slow and steady movement allows them to be cautious and avoid potential hazards efficiently. It also has the ability to aestivate, which is a state of dormancy during periods of extreme heat or drought, enabling it to conserve energy and survive unfavorable conditions.

Regarding reproduction, snails are known for their high reproductive output. They lay numerous eggs multiple times a year, which helps offset losses due to predation and ensures a steady population size. This prolific breeding strategy is an essential aspect of their survival and contributes to their long-term security in the ecosystem. While snails have developed these defense mechanisms and adaptations over time, they are still vulnerable to human-induced threats, such as habitat destruction, pollution, and climate change. Human activities can significantly impact snail populations, leading to habitat loss and declining numbers in some regions (Cazzaniga, 2019).

The safety and security of snails are the result of a combination of their unique adaptations, defensive behaviors, and high reproductive output. Their shells, mucus secretion, nocturnal habits, and preference for secluded habitats all play crucial roles in protecting them from potential dangers in their natural environments (Chase, 2002). However, as with many other organisms, human activities can pose significant threats to their survival, which highlights the importance of conservation efforts to protect these fascinating gastropods.

TYPES OF FEED FOR SNAILS

According to NG Snails (2023);

- **Healthy, Fleshy Fruits**

A variety of accessible fruits like Pawpaw, Mango, Cucumber, Water Melon, Soursop, Banana, Cherries etc. are rich in vitamins and minerals that are essential nutrients for your snail's growth.

- **Clean Leaves and Vegetables**

Snails love leaves and vegetables, as they benefit richly from vitamins, protein, and calcium for stronger and healthier shells from consuming them. Leaves without spikes and sharp blades should be carefully selected for your snails. Examples of edible leaves you can give your snails are pawpaw leaves, Cocoyam leaves, Potato leaves, Moringa leaves, Okra leaves, etc. You can also give them vegetables such as carrots, cabbages, Jute, lettuce, pumpkin, etc.

- **Tubers**

Snails do need some amount of carbohydrates and you can get them easily from yam, sweet potatoes, cocoyam, and cassava too. But with cassava though, you have to be very careful, make sure the ones you get contain a low level of cyanide (the higher the cyanide content, the bitter the cassava tastes). It can be a bit tricky, so we'll suggest you

take cassava off your snail's diet, especially if you're not sure of the cyanide content. On the contrary, you need to watch the number of carbs you give your snails as too much of carbohydrate intake may cause bloating in your snails.

- **Calcium Supplements**

The Snail shell is what protects it from predators. Calcium helps build and repair the shell. Where then should you get your calcium supplements from? Eggshells, Snail shells (yes, you read this right, snail shells have a high content of calcium), Oyster shells, and Bone meals. All the listed should be in the powdery form. They can easily be purchased at a trusted feed store near you.

- **Shellof**

Shellof is a plant-based snail feed that is specially formulated for snails by the research team of NGsnails. Most people love to call it "The Jollof for Snails" because it helps your snails to grow better and produce much more. With Shellof, you do not need to worry about your snail growth or what your snails will eat.

According to Wikibooks (2021), Snails of the same species collected from different regions may have different food preferences. Some foods that snails eat are: Alyssum, fruit and leaves of apple, apricot, artichoke (a favorite), aster, barley, beans, bindweed, California boxwood, almost any cabbage variety, chamomile, carnation, carrot, cauliflower, celeriac (root celery), celery, ripe cherries, chive, citrus, clover, cress, cucumbers (a favorite snail food), dandelion, elder, henbane, hibiscus, hollyhock, kale, larkspur, leek, lettuce (liked, and makes good snails), lily, magnolia, mountain ash, mulberry, mums, nasturtium, nettle, nightshade berries, oats, onion greens, pansy, parsley, peach, ripe pears, peas, petunia, phlox, plum, potatoes (raw or cooked), pumpkins, radish, rape, rose, sorrel, spinach, sweet pea, thistle, thorn apple, tomatoes (well liked), turnip, wheat, yarrow, zinnia. They will eat sweet lupines, but will reject bitter lupines and other plants with high quinolizidine alkaloids. Snails also avoid plants that produce other defensive chemicals, defensive stem hairs, etc.

Feeding snails properly is essential for their growth and health. Snails are generally herbivores and feed on various types of plant materials. Here are some common types of feed for snails:

- **Leafy Greens:** Snails thrive on leafy green vegetables such as lettuce, kale, spinach, and cabbage. These greens provide essential nutrients and moisture for the snails.

- **Carrot:** Carrots are rich in vitamins and minerals and can be a good addition to the snail's diet. They can be grated or sliced for easier consumption.
- **Cucumber:** Cucumber slices are another suitable option for snail feeding, as they provide hydration and are easy for snails to eat.
- **Zucchini:** Zucchini is a popular choice among snail keepers as it contains essential nutrients and has a soft texture, making it easy for snails to consume.
- **Sweet Potato:** Cooked and mashed sweet potato can be offered to snails, providing them with valuable nutrients.
- **Fruit:** Snails can also enjoy small amounts of fruits like apples, pears, and strawberries. However, fruits should be given sparingly due to their higher sugar content.
- **Commercial Snail Feed:** There are specially formulated snail feeds available in the market that cater to the nutritional requirements of snails. These feeds often contain a balanced mix of ingredients to support snail growth and health.

HARMFUL FEEDS FOR SNAILS

- Avoid giving your Snails Salty Foods
- Avoid giving your Snails Contaminated Foods
- Avoid Starchy Foods
- Avoid Chlorinated Water

WAYS OF SNAIL REARING PRACTICE FOR COMMERCIAL PURPOSE

Here are some specific ways of snail rearing practice for commercial purposes,

❖ **Intensive Snail Farming**

Image of an intensive snail system

In this method, snails are reared in controlled environments, such as greenhouses or confined spaces, to maximize production and minimize risks associated with external factors (Ofoefule et al., 2016). It involves providing artificial lighting, temperature control, and regulated feeding to promote rapid growth and reproduction. Intensive snail farming, also known as commercial or large-scale snail farming, involves maximizing snail production in a controlled environment to meet high market demands. This approach requires careful planning, specialized facilities, and efficient management practices. Intensive snail farming requires well-designed snaileries that provide an optimal environment for snail growth and reproduction. Intensive systems utilize small spaces, making them ideal for people with little space within or around their houses. Examples of intensive housing systems are cages, hutch-boxes, fenced pens, trench pens, drums, or tires, but they are not really recommended, though some people use them.

- **Semi-Intensive Snail Farming**

Image of a Semi-intensive snail system

This method involves a combination of controlled and natural conditions for snail rearing. Snails are kept in enclosures with partial access to the natural environment, allowing them to forage and exhibit natural behaviors to some extent (Agbogidi and Enujeke 2018). Semi-intensive snail farming falls between extensive (free-range) and intensive (controlled environment) systems. In semi-intensive snail farming, snails are partly confined within designated areas but are allowed some degree of freedom to graze on natural vegetation.

- **Extensive Snail Farming:**

In this method, snails are reared in open spaces, such as large paddocks or free-range areas. The snails have access to a natural environment with minimal human intervention, relying on natural food sources and climate conditions (Atata 2016). It

involves raising snails in an open environment without the use of enclosures or controlled housing. In this system, snails are allowed to roam freely and graze on natural vegetation, similar to how they would in their natural habitat.

Image of an extensive farming system

- **Polyculture**

Polyculture involves integrating snail farming with other agricultural practices, such as fish farming or vegetable cultivation. (Olugbemi et al., 2020), this approach allows for efficient resource utilization and creates symbiotic relationships between different components of the farming system. It is a farming practice that involves cultivating multiple plant or animal species together in the same area, promoting biodiversity, increasing productivity, and reducing risks associated with monoculture. It fosters ecological balance, enhances soil health, and provides a sustainable and resilient farming system.

- **Recycling of Organic Waste:**

Recycling organic waste involves converting biodegradable materials like food scraps, yard trimmings, and agricultural residues into compost or biogas through natural processes. Snails can be fed with a variety of organic waste materials, such as kitchen scraps, agricultural residues, and plant trimmings. Recycling organic waste as snail feed not only reduces feed costs but also contributes to waste management and sustainability, (Adeduntan et al., 2018). This sustainable practice reduces landfill waste, enriches soil fertility, and generates renewable energy, contributing to a more environmentally friendly and resource-efficient system.

SPECIES OF SNAILS

Snails are a diverse group of gastropod mollusks that can be found in a variety of habitats, including terrestrial, freshwater, and marine environments. Some of the well-known snail families and species include:

Land Snails

- Helix pomatia (Roman snail): This species is a large, edible snail native to Europe. It has a distinctive yellowish-brown shell with dark brown bands and can grow up to 1.3 inches (35 mm) in height.
- Achatina fulica (Giant African land snail): Achatina fulica is one of the largest land snail species, originating from East Africa. It has a conical shell that can reach lengths of up to 7.8 inches (20 cm) or more.
- Cornu aspersum (Brown Garden snail): Commonly known as the brown garden snail, this species has a rounded, globular shell with brown and yellow bands. It is one of the most widespread garden snails.

Freshwater Snails

- Planorbidae family (Ramshorn snails): Ramshorn snails have coiled shells that resemble a ram's horn. They are common in freshwater habitats and come in various colors, such as red, brown, and blue.
- Physidae family (Bladder snails): Bladder snails are small, freshwater snails with elongated shells and pointed spires. They are adapted to living in stagnant or slow-moving water.
- Pomacea canaliculata (Golden apple snail): This species, also known as the golden apple snail, is an aquatic snail with a large, bright yellow to dark brown shell. It can be found in various freshwater habitats.

Marine Snails

- Conus species (Cone snails): Cone snails are marine gastropods with intricately patterned shells. They are predatory snails, equipped with venomous harpoons that they use to capture their prey.
- Naticidae family (Moon snails): Moon snails have large, spherical shells with a smooth surface. They are commonly found in sandy marine habitats and are known for their drill-like tongue used to bore into the shells of other mollusks.
- Strombidae family (True conchs): True conchs have large, spiral-shaped shells with prominent spines. They are often found in warm tropical waters and are known for their beautiful and sturdy shell.

CONCLUSION

The study concluded that there is a growing interest in snail rearing as a viable commercial venture due to its low capital requirement, potential for high returns, and increasing demand for snail products in the market. The study indicates that current innovations in snail rearing and maintenance for commercial purposes have created a favorable environment for entrepreneurs to enter the industry. With technological advancements, sustainable practices, and market opportunities, snail farming presents a promising avenue for profitable agribusiness ventures. However, continuous research, training, and market awareness are crucial for the long-term success and sustainability of the snail farming sector. The most common species for commercial snail farming include Helix aspersa (common garden snail) and Achatina fulica (African giant snail).

RECOMMENDATIONS

- Snail farmers should engage with experts in the field of snail rearing, agricultural extension officers, and researchers who specialize in snail farming. Interviews with these experts can provide valuable insights into the latest innovations and best practices.
- Different snail species have varying growth rates and environmental requirements. Therefor snail farmers should research and choose a species that is well-suited to their climate and market demand.

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