


**BINDURA UNIVERSITY OF SCIENCE EDUCATION**

# UNLOCKING THE ADOPTION OF COMMERCIAL AFRICAN CATFISH (CLARIAS GARIEPNUS) PRODUCTION BUSINESS MODEL. A CASE STUDY FOR SHAMVA DISTRICT IN MASHONALAND CENTRAL PROVINCE, ZIMBABWE.

**BY**

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**BINDURA, ZIMBABWE**

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**DECLARATION**

I, CHIVERENGO JULIET Student Reg. Number B1541403, do hereby declare that this dissertation is a result of my own investigation and research, except to the extent indicated in the acknowledgments, bibliography, references, and comments included in the body of the report, and that it has not been submitted in part or in full for any other degree to any other university.

**STUDENT SIGNATURE**  **DATE: 10/06/2024**

## DEDICATION

This work is dedicated to my family (husband and Children) for their generous support.

**ACKNOWLEDGEMENTS**

My deepest thanks go to God for giving me life, health, and everything worthwhile in my existence. My project supervisor, Dr. J Mwenje, has my sincere gratitude as well. Throughout the research process, her excellent and continuous direction allowed me to produce a readable piece of work. I owe a great deal to my son Rueben for giving up a lot of his parenting time to help me with my coursework. Without expressing my gratitude to the Shamva Community for helping me gather both qualitative and quantitative data for the study project, my statement would be incomplete. Additionally, I would like to express my gratitude to the veterinary personnel for their invaluable information that I used in my research and anyone, I will not name, but who will stay silent and unsung in the background. Without their exceptional, one-of-a-kind, and prompt support, this study effort would not have succeeded; may they all be blessed.

## ABSTRACT

Unlocking the adoption of commercial catfish production business in Zimbabwe was studied taking the Shamva District as a case study. The study seeks to design a commercial Catfish production business model, imparting the model knowledge to farmers and assess the interest level of adoption of Catfish production business by also identifying commonly applied Catfish management models, and also assess the challenges being faced by the Catfish farmers in Shamva District on the adopted and commonly applied management models which are limiting also the adoption of new models. Agbeko et al, 2016) alludes that, the African catfish is a fast growing farmed fish species and it has got a high demand especially in dried form, but most farmers however fail because of several reasons like poor farm siting and facility design, poor investment plan, irregular and improper feeding and poor market and marketing strategies. List of targeted farmers were obtained from Veterinary and AGRITEX Services and sample was calculated as 50. The survey was carried out using a structured questionnaires to farmers and non-participatory observations and focused group discussions during March and May 2024. It has been found out that 40% of the respondents are involved in mixed-breed fish farming thus including catfish but under natural reservoirs, thus it shows interest of the fish farmers to venture into catfish farming and capability of adopting new model however lacking information of knowledge on the improved models. It has also been found that 80% of the catfish farmers have limited access for Catfish seed (fingerlings), which they highlighted as from other natural dam harvests, with only 20 % having little access on those hatchery systems only for where they can acquire catfish seed. Moreover, most of the respondents (67%) have fish farming as their major occupation however on Extensive basis that mixed breed basis with less labor and inputs, followed by a 33% who are under Intensive Catfish farming with high inputs and management which validates the prospects available in the enterprise and willingness and interests of individuals to invest in Catfish. Respondent farmers highlighted the main constraints which they are facing in adopting and partaking Catfish farming as a business which include production costs, lack of access to necessities and poor markets amount others. It has been then concluded basing on the findings that there is need for adequate record keeping by farmers so that extension agents or trainers can properly assess the farm's operation and advise accordingly. Farmers have to venture into the construction of nursery ponds that they may produce fingerlings, which are raised to their quality expectation.

Keywords: Catfish production, Veterinary, AGRITEX, Shamva District, Zimbabwe

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# CHAPTER ONE

# INTRODUCTION

## 1.1 Introduction

In this Chapter the background of the study has been outlined. The problem statement is formulated and objectives of the study, hypothesis, and research questions which are lenient on covering the research gap that is the stated problem has been also stated. The justification of the work is discussed while the assumptions, significance and the purposes of the Study are outlined. The delimitations of the study are then then addressed at the end of the chapter.

## 1.2 Background of the Study

Aquaculture in general is that component of agriculture which entails rearing of fish and other aquatic organisms in man-made ponds, reservoirs, cages, tanks or other enclosures in lakes and coastal waters, requiring a certain degree of attention that is if its profit motive (Essien, 1981). This practice allows feeding, breeding, growing and harvesting of fish in a well-planned manner. The contribution of aquaculture to meet the much-needed fish for domestic production and export to the overall animal protein supply of the country sustainably cannot be over-emphasized. According to Ugumba and Chukwuji, (2010), awareness on the potential of aquaculture to contribute to domestic fish production has continued to increase in the country. Therefore, the importance of the fishing industry to the development of the fish industry will increase local production of fish and save much of the foreign exchange being used for fish importation hence, it has a special role of ensuring food security, alleviating poverty and provision of animal protein in the country and mainly the rural communities who are capable of producing it.

African Catfish *(Clarias gariepinus)* one of the resilient and fast-growing fish species in the world. It is also known as the mud catfish, and is a good candidate species for culture to boost fish production for both domestic and global markets, which will improve human nutrition and food security in Africa, (Olaganju, 2020). It is less demanding on habitat conditions, feeds, mostly desirable for its Disease resistance and less predators' vulnerability. This means that, it is capable

much to be grown here in Zimbabwean communities as how it is being done in Nigeria and Ghana, ( Olaganju, 2020 and WRCF Report, 2016).

According to The Aquaculture Development Strategy, 2016, In Zimbabwean provinces, there is strong interest in aquaculture development, based on robust and growing domestic markets, and an increasing gap between fish supply and demand, resulting in high real prices. This maybe mainly because the area had large tracts of marginal lands that had the potential of supporting aquaculture production. However, rural farmers in Zimbabwean communities have gone into aquaculture as a means to diversify their sources of income away from the core farm production systems of cultivating cash crops such as Tobacco, cotton, soybean and others and they are much into Tilapia and Bream Species. Production output and profitability have been a pace they have set, but on the turning point being jeopardized by several factors such as poor facility design, irregular and improper feeding, lack of technical knowhow on models and poor market plan among others.

Compared to tilapia. The demand for Cat fish is very high in Zimbabwe, especially the dried form. Unfortunately, research on commercial production of African Catfish business model is absent and needed in Zimbabwe, leading to depends on natural water body production alone. This research then focuses on modern fish production regimes applicable and compatible with the Zimbabwean scenario, particularly in Shamva District. It will focus on existing and interested fish farmers with the aim of imparting knowledge on the most effective African catfish production business model which boosts production and profitability and finally assess acceptance or adoption on the innovation.

### 1.3 Statement of the problem

Shamva district has a lot of farmers ventured into aquaculture, however mostly into Tilapia and Bream breeds and the adoption of African Catfish species is very less. Some decline in the number of Catfish farmers whom has adopted the venture due to poor business-oriented management skills and commercial models being employed in the sector. The Aquaculture Development Strategy, 2016, People have gone into the Catfish production with the idea that as it is a native species to the African waters, they are just reared in the natural waters, no any management operation to be undertaken thus doing it naturally, (According to Klimkowski, (1993), many people think that all they have to do is throw Catfish in the constructed dams, later on harvest them, and then make

money. On the other hand, WRCF Report, (2016) avers that, this jeopardized the adoption of Catfish farming by most farmers and poor growth to those who are in the field. However, to enhance profitability and productivity, catfish farming requires intensive management and quick adoption of commercial models. Shamva district has a small number of catfish farmers compared to other districts, but these farmers manage to stay in business. Little is known about their actual management procedures and better commercial business methods to upgrade Catfish Farming.

### 1.4 Research objectives

- To design a commercial Catfish production business model compatible particularly with Shamva District, imparting the model knowledge to farmers so as to assess its uptake for recommendations on subject matter but with least technology.
- To assess the interest level of adoption of Catfish production business, identifying also commonly applied Catfish management models, by the farmers particularly under Shamva district
- To assess the challenges being faced by the Catfish farmers in Shamva District basing on the adopted, commonly applied management models which are limiting also the adoption of new models.

### 1.5 Research questions

1. What is the number of farmers who already existing in the catfish business; and those who are no longer in the catfish business but are raising other types of fish particularly in Shamva district?

2. Which are the commonly applied Catfish management models, including those dealing with stocking, feeding, water quality, diseases, harvesting, record keeping, housing and management being practised by the farmers Under Shamva district?

3. What are the modern Catfish farming innovated models which are compatible and applicable particularly in Shamva District?

4. What are the Challenges being experienced by Shamva Catfish farmers basing on the adopted and commonly applied management models which are also limiting adoption of new models?

### 1.6 Research assumptions

For the purpose of this study, the following assumptions are to be accepted:

1. Catfish acreage figures are to be estimated by farmers and ranchers;

2. The instrument (questionnaire) was used to elicit accurate responses from the catfish farmers;

3. The catfish farmers of Shamva would be present for an interview or have access to a telephone; and

4. Some of the catfish farmers in the population are able and adopted the modern models of catfish farming.

### 1.7 Justification of the study

The study on Unlocking the adoption of commercial Catfish production business is justified mainly because of the need for knowledge and the ambition by involved farmers to commercialize their Catfish farming business. This research focuses on modern fish production regimes applicable and compatible with the Zimbabwean scenario, particularly in Shamva District. It will go a long way with a focus on existing and interested fish farmers with the aim of imparting knowledge on catfish production business model and finally assess acceptance or adoption on the innovation being brought into adoption. Since the demand for catfish is very high in Zimbabwe especially the dried form, recommendations of this research will enhance positively the adoption of commercial catfish production thereby increasing supply to the market demand, thus enhancing protein nutrient security.

### 1.8 Purpose of the study

The main aim of this study was to research on the modern catfish production regimes applicable and compatible with the Zimbabwean scenario particularly in Shamva District, imparting knowledge on Catfish production business model, also assessing level adoption on the innovation by the farmers.

### 1.9 Significance of the study

The significance of this study can be justified much by several facts since it was linked to the production of most desirable protein source of all times. As it has been aim of bringing innovation to the farmers involved in the production of catfish, it has to upraise the commercialization of

catfish farming, thus enhancing the growth of the venture. To the Shamva community, this research has created business and money-making opportunities since it imparted knowledge on the commercial innovations and the importance of Catfish. According to Ugumba and Chukwuji (2010), awareness on the potential of aquaculture to contribute to domestic fish production has continued to increase in the country. Therefore, the importance of the catfish farming to the development of the fish industry increased local production of fish and save much of the foreign exchange being used for fish importation due to the recommendations and knowledge systems being imparted through this study.

### 1.10 Delimitations of the study

The study focused on modern fish production regimes applicable and compatible with the Zimbabwean scenario, aiming at imparting knowledge on the most effective African catfish production business model which boosts production and profitability and finally assess acceptance or adoption on the innovation with assessment on its limiting factors and challenges. The research study was confined in Shamva District of Mashonaland Central Province.

### 1.11 Organization of the study

The organization of the study outlines the steps that were to be taken by the researcher in the study. The structure of the study is divided into five chapters as follows: Chapter 1 introduces as it covers the background of the Catfish farming, statement of the problem, research objectives, research questions and justification of the study, assumptions, significance and purpose of the study as well as delimitation of the study. Chapter 2 is a review of concepts and previous research relating to catfish farming. Chapter 3 presents and explains the methods applied by the author in conducting the research. It describes the methods used in order to achieve the objectives of the research and justifies the choice of research design adopted in this research. Chapter 4 is the presentation, interpretation and analyses of the findings. The research findings are presented according to the research questions and objectives which guided the study. The findings are also in line with the research problem. The findings have been presented in the form of tables and graphs using as they have been analyzed through SPSS. Chapter 5 then discusses, concludes and outlays recommendations based on the findings. The discussion of findings was done with reference to the previous studies on the phenomenon under investigation.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.0 Introduction

The main aim of this Chapter is to review related literature on unlocking the adoption of commercial catfish production business. The essence of this research is to identify and review commonly applied catfish management models, including those dealing with stocking, feeding, water quality, diseases, harvesting, record keeping, and marketing, also to research deep on the innovated commercial management models in African Catfish production which enhance profitability, productivity and upgrade the venture into a commercial business oriented and further on to deliver and impart knowledge to the already existing and interested farmers on effective Morden innovated Catfish production business models which are compatible and applicable as well as checking their adoption. Farmers partaking the commercial production of Catfish suffers a lot in as much as upgrading productivity and profitability is concerned and this has been the drawbacks of the enterprise expansion and it has been shunned by little knowledge on the Morden models which are economic viable. As this Chapter unfolds a theoretical framework, conceptual framework, and the literature on models of commercial catfish production as a business are provided.

## 2.2 Theoretical Framework

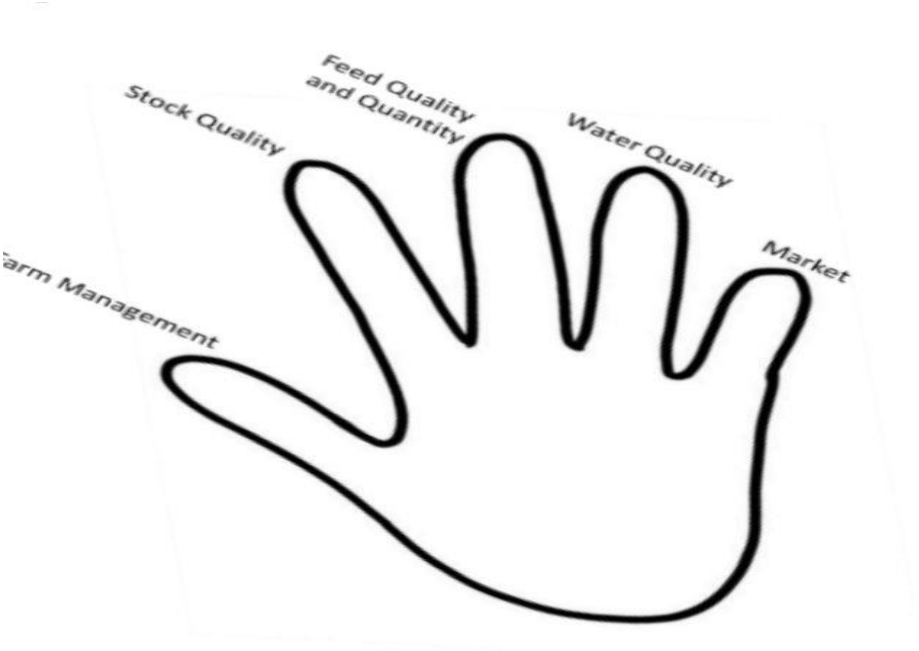
The research examines the theory or theories that are considered to underpin the theory or practice of unlocking the adoption of commercial catfish production and that bear relationship to its conceptual background.

### 2.2.1 African catfish farming as a business

Agbeko et al, 2016, alludes that, The African catfish is a fast growing farmed fish species. It is native to most water bodies in Africa and scientifically known as *Clarias gariepinus*. The external noticeable features of the African Catfish are presence of barbells, lack of scales, presence of one long dorsal fin, and dark grey in color with a white ventral section. According to WRCF, (2016), catfish should be kept commercially as it would bring profits since its will be mostly desired for its general characteristics like good feed conversion ratio (FCR: 1.2), external air breathing

abilities, relative tolerance of below average (sub optimal) water quality conditions, high survival rate after the fingerling stage, adaptable to poly culture with Nile tilapia based farming systems, good flesh quality, and low in lipid (fat) and high in protein. Agbeko et al, (2016) propounded that, most farmers however fail because of several reasons like poor farm siting, poor farm and facility design, poor investment plan, irregular and improper feeding and poor markets.

**Figure 2.1 below According to Training Manual for African Catfish farming in Western Region, Ghana, (2016), provides an easy way to remember important steps or processes for a successful fish farming enterprise as indicated, (Adapted from.)**




According to Agbeko et al, 2016 Catfish are greatly affected by the environment in which they are grown. As per how it has been defined, an aquatic ecosystem is extremely dynamic, changing with nutrient inputs, weather and season. The temperature of the environment directly influences all of their bodily functions. Thus, while the markets determine aquaculture opportunity, the ecological and economic principles determine the choices for sustainable aquaculture practices and technology thus according to Training Manual for African Catfish farming in Western Region,

2016. Therefore, users of the manual are encouraged to understand the principles on which this catfish static water-pond-production technology is based upon. This means that the specific environment where the farm is located defines what additional opportunities and constraints in production one is likely to encounter.

### 2.2.3 Theory of Change

This theory of change was put in place as a scale up strategy in Nzema, Jomoro and Ellembelle districts. According to WRCF, (2016), the pilot intervention was designed to address the main strategic constraints in aquaculture, which are, Poor production knowledge by farmers leading to large wastage of feed and poor water quality management which results in high production cost of catfish farming, Lack of knowledge on business management to support which leads in non-profitable operations being undertaken, Limited access to better quality fingerlings and catfish feed because of low market penetration, by hatcheries and feed companies, and Weaker relationships between the value chain actors at different functional levels and with end markets, and supporting research services. Its propositions were that the change will contribute to moving them from subsistence to a commercial orientation to meet high demand coming from within and outside the Region; When farmers and community members apply their training and knowledge to their activities and have increased productivity and profit, feed and hatchery companies will benefit immensely as farmers will buy more feed and fingerlings. These companies will therefore be motivated to participate in the project to increase their market share. (WCRF 2016).

Since the situation seemed to be similar with this under study, this theory is of much relevance to this study and be much applicable however, it should be implanted by the Research servive providers and the government in different approaches like this way: Support aquaculture extension through a region wide Training of Trainers approach; Support the establishment of local micro fish feed production units to improve feed access, and Coordinating the establishment of demonstration ponds on existing sites farmers demonstrating a potential to invest time and resources to learn and

adopt improved technical and market oriented management system

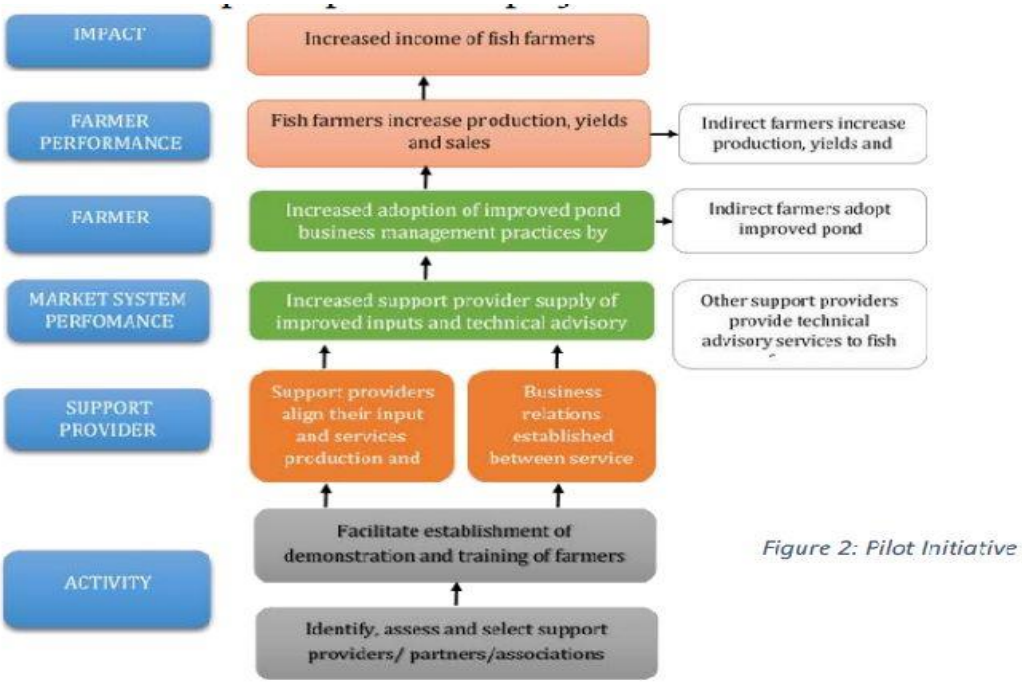


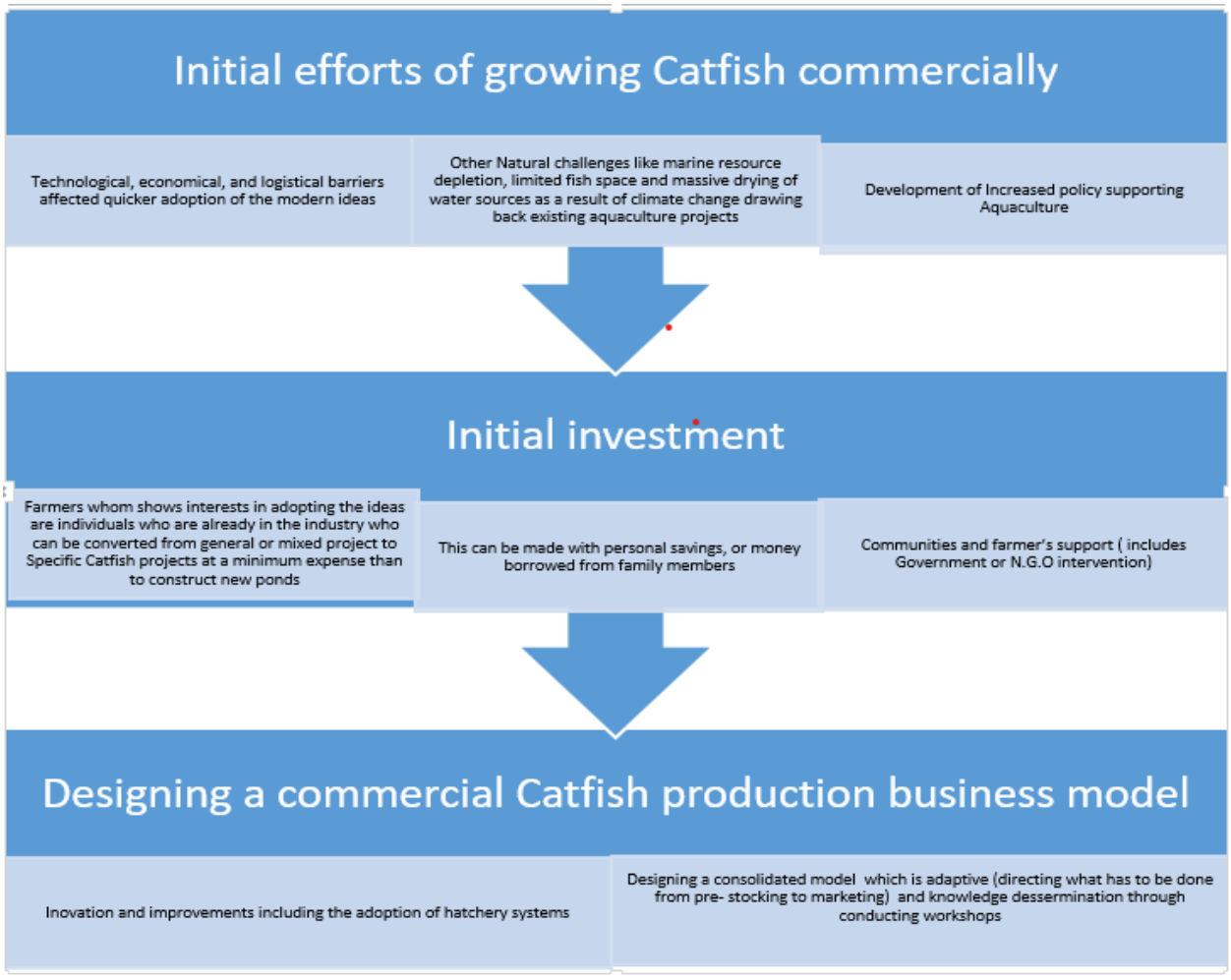

*Figure 2: Pilot Initiative*

**Figure 2.2: The pilot initiative results (strengths and weaknesses) on the Theory to change. Adapted from WRCF, 2016**

According to WRCF (2016), farmers need to strengthen their capacities in aquaculture management through technical and business training in order to boost production, profitability, and competitiveness as well as enhance their standard of living. This will help them transition from a subsistence to a commercial orientation in order to meet the high demand from both inside and outside the Region. Feed and hatchery companies will greatly benefit when farmers and community members apply their training and knowledge to their activities and have increased productivity and profit because more farmers will be purchasing feed and fingerlings. As a result, these businesses will be encouraged to take part in the project in order to grow their market share. (2020, Olaganju). Pilot Initiative Results are clearly displayed in Figure 2.2 with Link 13 An explanation of the intervention based on theory: the pilot began with. These farmers were involved in opportunistic sales practices characterized by poor productivity, weak market and input linkages. The intervention support provided support for two earthen ponds per association, which shows positive results, but there is an opportunity for these theories and ventures, leading farmers

to become local consultants with the capacity to sustainably respond to demands for technical assistance in the field of agriculture. (WRCF, 2016). Its strengths also to the community includes, Identification of groups or individuals willing and able to invest time and resources to learn and adopt new technologies through training and capacity-building sessions, to enable them overcome productivity and management challenges, establishment of demonstration ponds and value chain strengthening through commercially oriented market linkages. However, downsides includes a significant lack of adoption and knowledge for the farmer.

### 2.3 Conceptual framework




**Above diagram illustrates a framework which describes the whole proposed concept of unlocking a catfish production business model. (Basing on Olaganju, 2020 and Nyikahadzoi, 1998)**

As illustrated by the insert above, according to Giachelli, et al 1989, the first efforts at raising catfish commercially were made in the early 1900's at several federal and state fish hatcheries. In the 1950's commercial catfish farming first started in Kansas and Arkansas. Much of the information used by the early catfish farmers in the 1950's and 60's was provided by workers of Auburn University. However Technological, economical, and logistical barriers make commercial catfish farming beyond the reach of many small-scale producers in most Zimbabwean communities, (Olaganju, 2020). This is because most of the fish farmers haven't yet adopted Catfish production as their commercial business entity but rather dwell much on Tilapia and bream fish when Aquaculture business is concerned, that is according to Upton Hatch and Henry Kinnucan, 2021. However, this has been a waste of millionaire making opportunities since catfish is much ahead than those two in terms of quick income generation. In Africa as a whole it has been noted that there is increased policy support towards aquaculture development, and in the entire region, aquaculture expansion has proved to have great potential in creation of new jobs and improvement of food security among poor households. However according to Nyikahadzoi, (1998), Zimbabwe's catfish industry has been characterized with numerous challenges ranging from marine resource depletion; persistent absolute poverty among fish farmers; poor management practices; limited fishing space due to massive drying of water sources as a result of climate change, to aquatic resource conflicts. This was because Zimbabwean farmers didn't adopted modern management practices in catfish production of which they could enhance productivity, coping the situation.

Harvesting equipment such as a seine and live cars are useful because harvested fish can be temporarily held in live cars, via a water exchange mechanism with pond water, while awaiting sales. (Olaganju 2020).Credit facilities usually are adopted as a startup capital to cater for investment in land, ponds, equipment, and operating supplies like fingerlings and feed during the first year of operations and use the income from fish sales to meet future cash flow demands, thus according to Agbeko et al, 2016. The initial investment is usually made with personal savings, or money borrowed from family members. In this regard, farmers who tend to be interested in extensive catfish farming are individuals with existing ponds which can be converted from general aquaculture at a minimum expense, than to construct new ponds.

### 2.3.1 Communities and farmer's support

The Ghanaian government, according to WRCF, 2016, wants to expand the aquaculture pilot program that was first put into place in the Jomoro, Ellembelle, and Nzema East Districts, involving roughly 120 farmers who are members of four distinct fish farmer associations. The primary strategic limitations in aquaculture, which are: inadequate production expertise on the part of farmers resulting in significant feed waste and inadequate water quality management raising the cost of catfish farming, were the focus of the pilot intervention's design. Insufficient expertise in business management leading to unprofitable enterprises, restricted availability of high-quality fingerlings and feed due to hatcheries' and feed firms' limited market penetration, and Weak connections with end markets and across value chain participants at various functional levels, as well as with supporting aqua services for research and cultural extension. However, with better in-depth training, this approach reduced the knowledge gap between technical and business. It's a market-oriented alternative because the trained recipients might then provide their services at a profit to other farmers, providing them with a means of subsistence.

### 2.3.2 The Concept of Commercial Catfish production

According to Potongkan, K. and Miller, J. (2006), Consumers in Nigeria have made the catfish (*Clarias* and *Heterobranchus* Species) these most consumed fish in restaurants, placing these fish in high demand in market. These species can survive in conditions with very less oxygen for a while yet they do breathe. The purpose of commercial fish production is to grow fish for profit, (Isyagi et al, 2009). In this case, a fish pond is one of the several production units used in fish farming to grow fish. Therefore, as argued by Isyagi et al, 2009, a farmer using ponds to commercially produce fish must ensure optimal conditions within the pond that will enable fish to grow efficiently, provide the fish with the correct nutrition to grow within a stipulated production period, and have a production plan that matches the marketing strategy. As according to Isyagi et al, 2009, Fish farming is not a traditional agricultural practice in Uganda and its case is like similar to the Zimbabwean situation in that, majority of fish farmers in the country have not yet fully understood the fundamental principles of fish farming or how these should be applied to their production management.

This caused majority of catfish farmers not being able to match their management with yields, hence failed to attain expected yields and profits from the adopted technologies. Agbeko et al,

2016 stated that, there are several management procedures and operations which are most crucial in as much as commercial catfish production is concerned and however, most of these haven't yet been adopted by Zimbabwean farmers. And some are explained as below,

### 2.4 Designing a commercial Catfish production business model

According to The Catfish farmer's handbook, 1989, Catfish farming is much more than just stocking a pond with fish, feeding them, and then reaping the profits a few months later. The investment required per acre to get into catfish farming varies depending on factors such as these Do you own or will you buy the land, who will do the construction work, you or a con tractor, The amount of dirt that must be moved, the depth and size of the well(s) needed

#### 2.4.1 Initial phase (prestocking)

According to Agbeko et al, 2016, for a fish farming business to be successful, major activities should be planned for and executed well with good record keeping. These include construction and/or re-construction, liming, fertilization, filling pond with water, and quality management before and after stocking ponds with fingerlings.

#### 2.4.2 Fish Pond Construction (Agbeko et al, 2016)

Fish pond is a fish holding system that is essential for environmentally sustainable and profitable production of fish. A fish pond can be constructed as an earthen pond, concrete pond, or plastic or canopy layer pond.



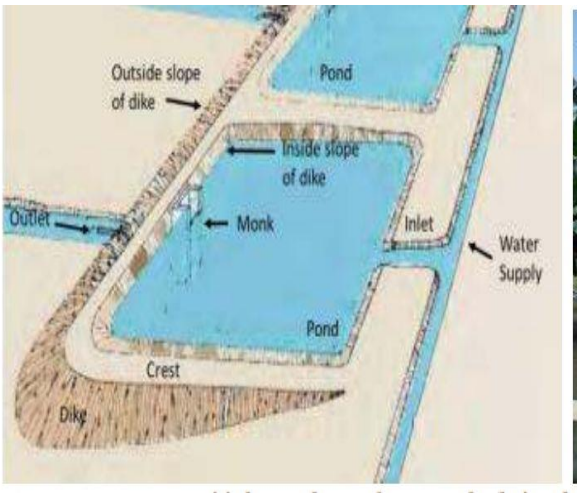


**Fig 2.3: View of Earthen ponds are the most economical to build as it involves excavation of earthen materials (soil) to create dugout. (Adapted from Training Manual for African Catfish farming in Western Region, 2016, Ghana )**

Ideally, fish farms should have three types of ponds based on environmental and economic reasons. These are:

**Nursery Pond**: A nursery pond should have a surface area of 100–500 m^2 and a water depth of 1–1.5 m. This pond makes up 5% of the fish farm's overall productive area. The pond's shallow depth and compact size mimic the natural habitat for fingerling growth and make management procedures simpler. This is particularly true when sorting and grading using partial harvesting (Figure.2.3).

**Rearing Pond**: The rearing pond's area spans from 500 to 1000 m2, and its water depth is between 1.5 and 2 m. 15% of the fish farm's overall productive area is made up of this kind of pond.

**Grow-out Pond:** The stocking pond's area ranges from 10,000 to 20,000.

This kind of pond occupies 60–70% of the total productive area of the fish farm, with a surface area of m2 and a water depth of 2–2.5 m (Figure 2.4).

**Nursery Pond**: Area of nursery pond ranges from 100- 500 $m^2$ and the depth of water should be between 1- 1.5 m. This pond covers 5% area of total productive area of the fish farm. The small size and depth of the pond simulates the natural environment for growth of fingerlings and ease for management practices. This is especially so in partial harvesting for sorting and grading (Figure .2.3).

**Rearing Pond**: Area of rearing pond varies between 500- 1000 $m^2$ and the depth of water ranges from 1.5- 2m. This type of pond covers 15% area of the total productive area of the fish farm. Sometimes farmers may use this as a stocking pond also.

**Grow-out Pond**: Area of stocking pond varies between 1000- 20000 m2 and the depth of water ranges from 2- 2.5 m. This type of pond covers 60- 70% area of the total productive area of the fish farm (Figure 2.4).

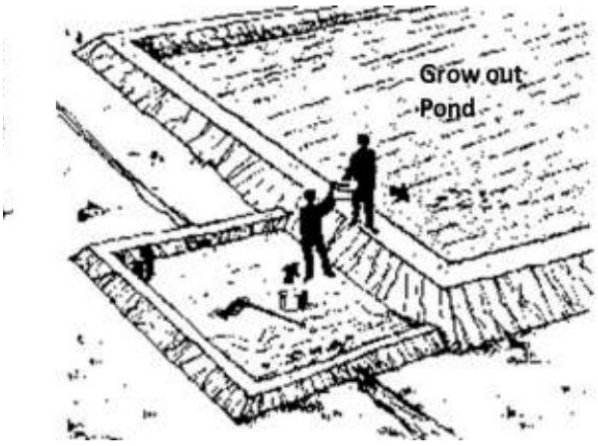



**Fig 2.4: Nursery Pond and grow out pond on a farm. Adopted from Training Manual for African Catfish farming in Western Region, Ghana, (2016)**

Biopond/Sediment Pond: Have a reserve pond where the water used for agricultural fish ponds is cleaned and/or kept for refilling other ponds, ensuring sustainable water use and protecting the environment. It serves as a sizable settling tank for silt and the biological decomposition of living things.

**Dig-out ponds**, are the easiest to construct because they are built entirely from excavated dirt. There are two primary varieties of dug-out pond structures, depending on the kind of water delivery system. Rain and surface runoff feed dug-out ponds, typically located in comparatively low point of a natural depression, for example, or flat, well-drained terrain (WRCF demonstration pond in New Ankasa, Western Region).

**Nursery (Tan-Fermin, 2013)**

According to Tan-Fermin (2013), more raising facilities are required for the nursery's production of catfish fingerlings. If the fry are raised in ponds, it is best to rear the larvae inside a net cage with a mesh size of 0.5–1.0 mm. Agbeko et al. (2016) found that raising fry in net cages hanging in ponds or tanks increased their chances of survival. Fry receive the same specially prepared diet during the nursery stage. Feeding occurs three times a day, with 20% BW in the first week, 15% BW in the second, and 10% in the third

**Catfish stocking**

Isyagi et al. (2016) state that a farmer must stock only healthy fish while farming for profit. That is, no overt indications of damage, extreme strain, or illness that have been packed and transported in well-ventilated tanks or bags with sufficient oxygen. The intended harvest size and the pond's carrying capacity are also factors that determine stock. In this instance, fish with an average weight of at least 5 grams or a length of at least 10 cm should be the minimum stocking size for grow-out ponds. According to Potongkan, K. and Miller, J. (2006), when fish are brought in directly from the hatchery, an initial nursery phase of one (1) month is advised before the fish are put into the grow-out pool. As a result, having a nursery phase at first increases survival rates and allows for better inventory control.

**Management of pond water**

As stated in the Training for African catfish production, 2016, Water should be static. This means that, Water should only be added to ponds: A - to top up water levels, or B - to correct water quality problems, such as low oxygen, high ammonia, not just random. It should be noted that, continuous water flow can be expensive and, the water is often cold, which will reduce growth rates.

**Feeding**

According to Isyagi et al. (2016), it is crucial to train fish to eat in the same part of the pond since this allows a farmer to view his or her fish every day during the production cycle. This is very helpful for tracking fish health and determining the quantity and size of fish in the pond between sampling periods. Furthermore, the catfish feed chart should be used as a guide to estimate daily feeding needs; fish should be fed based upon their eating response. According to Tan-Fermin (2013), a farmer must consider how many meals fish of a certain size should be given each day. This indicates that suggested feeding records that detail both the quantity provided and reaction at every feed ought to be maintained. Utilize the records consistently to assess feeding efficacy and work with the pond records to modify the feeding schedule.

**Harvesting**

According to Tan-Fermin (2013), harvesting the pond at critical standing crop should occur before it reaches its carrying capacity, in order to maximize returns on commercial catfish farming. The following actions must be taken in order to fully harvest the pond:

• To start, review your records to determine your approximate standing crop.
• Secondly, when the pond is still full, sieve the water once or twice to eliminate the majority of fish.
• Third, lower the water level by roughly halfway before removing the remaining fish with a net
• Fourth, remove all of the fish from the pond and empty it completely. The remaining fish in the pond will gather if the harvest basin is built properly.

### 2.5 Adopting the Hatchery system Model

According to the Training manual on catfish hatchery and fingerlings production, 2024, Due to the difficulties of getting consistent, fast growing, disease resistant and uniform sized catfish fingerlings and juveniles, the African Catfish Hatchery came into existence. In the African Catfish Hatchery, catfish fry 'come out' from eggs under an artificial condition in commercial numbers and these fries grow into fingerlings and they later become juvenile (young catfish). Ogunsina, 2023 alludes that, the past practice of capturing African catfish fingerlings or juveniles from the wild (natural habitat) often encouraged disease infested stocks and therefore supplies of the fingerlings in large numbers from the wild are not always consistent. This practice has never been commercially reasonable since the man hours expended in capturing the fishes are not commensurate with the fishes caught. (Hogendoorn, 2023). Similarly, the semi-natural or hormone-induced propagation of catfish in ponds/ tanks has not proved to be a reliable method for mass production of fry. Therefore, artificial propagation under controlled environmental conditions in a hatchery has become a necessity to ensure a mass production fry and fingerling. However, this model enables much the farmers especially in areas who have adopted it in such a way that, it maximized stocking rate and productivity

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.0 Introduction

This chapter entails the how part of the research study that is how the researcher has conducted the research, up to how the findings were presented so as achieve the objectives. This chapter then covers the research philosophy, the research design, the research approach, data sources, the population of the study, sample size, and sampling techniques employed in this study. It further on highlights how data analysis and presentation has been conducted for this research and finally the ethical considerations in the basis of this research.

## 3.1 Research philosophy

Jansen and Rautenbach (2023) define a research philosophy as, in general, the set of beliefs, assumptions, and principles that guide the researcher's approach to the study. It is also referred to as a paradigm. A research philosophy can also be described as a set of predetermined ideas about the nature of the reality under investigation. The knowledge under investigation influences the research study's application of a particular research philosophy in each of its domains. (Otieno and Chege, 2020). Therefore, the research philosophy helps in reflecting what sort of knowledge the researcher seeks to obtain by undertaking the study. Importantly, the research philosophy forms the foundation of the study and specifically have a direct influence on the whole research methodology. (Jansen and Rautenbach, 2023). Pragmatism, Positivism, Interpretivism, and Realistic research philosophies are the four basic categories of research philosophies that are distinguished in the works and applicability based on the nature of the study, according to Pranas et al. (2018). The researcher employed the Pragmatism research philosophy for this investigation

### 3.1.1 Pragmatism Research Philosophy

According to Pranas et al. (2018), pragmatism research philosophy is an approach that contends that there are numerous approaches to understanding the world and conducting research, and that the combination of these approaches may offer a more comprehensive understanding of the phenomenon of catfish farming under investigation. It further asserts that the selection of research

philosophy is primarily dictated by the identified research gap, taking into account practical outcomes. To bolster the aforementioned, it can also be defined as a philosophy that acknowledges that concepts are only relevant if they spur action and acknowledges that there are numerous ways to interpret the world and conduct research, and that no single point of view is necessarily the most relevant can never provide the full picture and that various farmers may experience different realities (Saunders et al, 2018).

According to the essence of this research, this research philosophy is primarily applied to qualitative and quantitative research strategies, or to any one of them, as this study entails. It is not dependent on the mind, which is not subject to reality state of mind, but rather on what is currently in action (Alghamdi et al, 2023 and Saunders et al, 2018). Therefore, the researcher has chosen Pragmatism research philosophy since it allows the employment of qualitative and quantitative research methodologies of which they are crucial to be employed in this survey in a bid to successfully acquire data needed in the process of deciphering the Catfish commercial business model. Additionally, the pragmatism research philosophy is appropriate for this study because it focuses on examining and surveying current practices related to catfish production, suggesting ways to improve the phenomenon and putting other environmentally compatible models into practice

### 3.2 Research design

'Procedures for collecting, evaluating, interpreting and reporting data in research projects' is how Boru (2018) characterized a study design. Verma, 2021 provides evidence to support these definitions, stating that a research design is the blueprint or skeleton of the research study, highlighting the entire process through which the study was conducted. Features of a research design include objectivity, neutrality, validity, reliability, and generalizability. Verma, 2021 asserts that the goals of the study design are to guarantee that the data gathered on the topic—in this case, adoption and restrictions in catfish farming—allows the researcher to successfully solve the reduction in catfish production because it is the research issue, reducing costs and avoiding blind searching, providing guidance and aiding in decision-making on the enhancement and creation of new models. According to Taherdoost, 2022 and Gimblert, 2016, there are various kinds of research designs, including cohort, case study, causal, explanatory, descriptive, and exploratory, as well as philosophical, historical, and sequential research designs. Given that this

research is focused on a single entity, the case study research strategy has been selected by the researcher

### 3.2.1 Case study research design

According to Taherdoost (2022), a case study research strategy is not a broad statistical survey but rather a detailed examination of a specific research subject. When little is known about a phenomenon, it is useful to test whether a particular theory or model actually applies to it in the real world. This requires the use of a mixed approach and multiple data collection methods, as it helps to focus a very broad field research into one or a few easily researchable examples (Taherdoost, 2022). Jeane (2023) asserts that it is crucial to use onsite collection techniques because they give researchers the chance to connect directly with participants. In order to conduct study, the investigator used this design deep on the catfish business concepts, about which farmers know very little and haven't completely embraced in the real world, with a particular emphasis on Shamva farmers. Furthermore, in light of the goals and suitability of the case study research design mentioned previously, the researcher was correct to select this approach because it allows the researcher to investigate and offer a foundation for the application of concepts, theories, models, and extension techniques in analyzing modern real-life scenarios.

## 3.3 Research approach

A research approach, according to Tiffany and Kimberly (2023), is the method the researcher chooses to gather, examine, and interpret data. In certain ways, Taherdoost, 2022 contends that the methodology—also known as “the way to do the research”—is a methodical strategy for carrying out the research. According to Verma (2021), the significance and goals of this research approach are to: assist in assessing the research's evidence; gather information and significance; characterize the scenario in line with the study; and explore the fundamentals of what, when, and where decision-making occurs. According to Mohajan, 2020 and Taherdoost, 2022, there are three main categories and forms of research approaches. These include mixed-method, quantitative, and qualitative. As a result, the researcher decided to use a mixed-method technique for this survey.

### 3.3.1 Mixed-method research approach

The goal of the study was to design a commercial catfish production business model and evaluate farmers' adoption of it. The research questions were primarily focused on adoption levels, commonly used models in the area, and obstacles that are preventing adoption and resulting in a decline in production. Taherdoost, (2020P), states that a mixed-method approach simply combines qualitative and quantitative approaches in order to provide a better understanding of the subject. Almighty et al. (2021) state that a mixed method research study is just a combination of the two popular research methodologies, qualitative and quantitative, with the option to focus on any or both approaches equally or based on one approach while taking the chosen integration procedure into account (Taherdoost, H., 2020). The commercial aspect of Catfish Enterprises and general production, which are the subjects of this study, are examples of complex research conditions that can be addressed by the researcher by integrating the two methodologies. The researcher adopted and used a mixed approach because it encompasses the benefits of both qualitative and quantitative methods. This was necessary because using only one approach was insufficient to produce effective results for this study, necessitating the collection of both qualitative and quantitative data.

## 3.4 Data sources

Taherdoost, H. (2020) defines data as unique information for research purposes, either quantitative or qualitative, that is gathered from various sources using techniques that are appropriate for the type of data. Data sources are the oases from where information for research is gathered, according to Taherdoost, H. (2016). Kabir (2016) asserts that the data is then divided into two categories, primary data and secondary data, based on these definitions. Given the nature of this study, primary and secondary data sources were used in order to collect all relevant information—both qualitative and quantitative—for the phenomenon of catfish production.

### 3.4.1 Primary data

According to Mohajan, (2020) primary data is information that has not yet been published and is first-hand and unaltered by anybody; in other words, researchers used various techniques to gather and collect primary data for a specific goal. Supporting this, Kabir and Taherdoost, 2022 state that primary data are those that are newly obtained and for the first time, making them unique in nature. The benefits of primary data are best expressed by Rimando et al. (2016), who point out that

compared to secondary data kinds, primary data has higher levels of validity, impartiality, and authenticity. Nonetheless, depending on primary data has certain benefits given that dependability depends on respondents providing accurate information, which means it involves field effort and can be time-consuming and costly (Taherdoost, 2021). In order to get primary data for this study, a variety of sources have been used, including focused group discussions, questionnaires, and interviews (Kabir, 2016; Taherdoost, 2021).

### 3.4.2 Secondary data

Taherdoost (2021) defines secondary data as information obtained from published sources, which implies that the information has already been obtained by another party for a different purpose and may be utilized for additional purposes in a research study. Put another way, secondary data is the foundation for the literature review section of all papers. According to Rimando et al. (2016), secondary data are those that have previously been examined or put through the statistical process by another party after being obtained by another party. There are several benefits to using secondary data: it can be managed rapidly, and time and expense balance are preserved because the information is already thoroughly examined by professionals. Still, the drawbacks are that, there is no standard method for determining the veracity of these secondary data, thus expertise is required (Taherdoost, 2021). There are other sources of secondary data, including books, journals, research articles, records, and articles that have just been published online. The researcher in this study also used these sources to gather secondary data.

## 3.5 Target Population of the study

As Neyman (2020) defines population as the grouping of all individuals of interest in a study context. According to Rahman et al. (2022) also, the "target population" is a collection of individuals or objects about which researchers hope to draw wide conclusions. A sample may occasionally be taken from a population, also referred to as the "target population." That refers to the research study's real population. Pertaining to this study, the small-holder fish farmers in the Shamva district make up the population under study in this instance. By then, the people who are most specifically targeted are those who are currently involved in the catfish farming industry and those who are wanting to start a business in this field

### 3.6 Sample size determination

A sample is a portion of the overall data collected through surveys or in-depth observations in quantitative data analysis. Consider it as a more compact unit of measurement that captures the real data (Rahman et al., 2022). According to Bolarinwa (2022), in nearly every quantitative study, a certain sample size is necessary in order to get reliable results. Subsequently, sample size estimation is a crucial factor to take into account while developing research concepts and proposals. As a result, the Online Sample Calculator was used to determine the sample size for this investigation.

#### 3.6.1 Sample Online Calculator

This online tool was utilized to compute and establish the sample size needed for this study's data collection. This calculator (www.calculator.net) makes use of the population proportion, size, margin of error, and percentage of confidence. In conducting this study, the researcher employed an 85% confidence level, a % margin of error, and a 50% population proportion. The sample size for this study was determined to be 50, and these were the respondents from whom the researcher distributed questionnaires and gathered data. This tool is typically helpful in studies such as this one where the population size lacks a defined and specified number

### 3.7 Sampling techniques /methods

According to Shona (2019), in order to derive meaningful conclusions from research findings, the researcher must carefully consider the sampling method—which is chosen based on the type and nature of the research as well as the research approach chosen—in order to choose a sample that is representative of the group as a whole. Probability sampling and non-probability sampling are the two primary categories of sampling techniques. (Shorten and Moorley, 2014; Elfil and Negida, 2017). Probability sampling techniques were used in this study because they are suitable for both quantitative and qualitative research approaches, as well as pragmatic case study-based investigations in which every component has an equal chance of being selected.

#### 3.7.1 Probability sampling method

Rahman et al. (2022) state that the probability sampling technique is commonly used when every member of the population has an equal chance of being selected. This technique is widely regarded as the most effective means of guaranteeing that every sample unit is equally representative of the

populations it represents. Given that the main goal of probability sampling is to obtain a sample that is representative of the population from which it was drawn, most researchers typically employ this sampling technique. Furthermore, adopting random sampling does not guarantee that any given sample is a perfect representation of the population. Conversely, it shows that most random samples will typically be close to the population and that it is feasible to ascertain how likely a sample is accurate. In 2022, Rahman et al. According to Shona (2019), there are four primary categories of probability samples: stratified, cluster, plain random, and systematic sampling. Regarding this research project, the investigator chose basic random sample methodology. Shona, 2019 goes on to argue that since every member of the population has an equal chance of being selected in a simple random sample, researchers should include the entire population in their sampling frame. This makes the process simple and ensures that reliable and well-balanced facts can be obtained, as each member is treated equally and regardless of population differences. This is why the researcher chose this technique.

### 3.8 Research instruments

Questionnaires and interviews were employed in this study in order to gather both quantitative and qualitative data. Qualitative data were also gathered through observations. According to Moore (2018), an interview is characterized as a dialogue involving two or more individuals during which the interviewer asks questions in order to extract information or assertions from the subject. The written instruments used to conduct the survey were questionnaires. A few benefits of employing questionnaires are that they are simple to compare and analyze, anonymous, encouraging honest responses, gather responses in a clearer manner when referring to what was sought for each objective and are easy to distribute to a large number of individuals, and yield a large amount of data (Tochim, 2022). According to Choga and Njaya (2021), using this strategy entails taking an active role in addition to observing. As stated according to Shona (2019), while conducting explanatory research and examining the correlations between variables, organized interviews are useful. It is possible to conduct interviews with people who are illiterate. However, according to Tochim (2022), questionnaires are inexpensive, quick to provide study replies, maintain anonymity, and contain standardized questions and answers that make data collection easy. The benefit of observations is that the subjects may act naturally because they are not aware that they are being watched as according to Shona (2019). The nature of the models that farmers are using was seen in this study through direct observations. Additionally, both closed- and open-ended

items were included in the semi-structured questionnaire. Respondents are allowed to choose the format, content, length, and form of their answers to open-ended questions, which do not offer predetermined answers. They were simple to ask, and the researcher was able to get a wide range of answers. Respondents were able to elaborate and clarify their answers in response to open-ended questions. Semi-structured interview questions were also utilized in direct interviews.

### 3.9 Reliability and validity

Based on Middleton's (2019) definition, validity refers to a measure's accuracy, and reliability is the consistency of a measure. These were determined by testing and retesting the methods; questionnaires were pilot tested to reduce instances of respondents answering questions in order to appease the researcher; respondents were informed that the study was academic and that there were no incentives for participation; respondents were reassured that the exercise's purpose has no bearing on them; participants were asked for consent, which included a description of the research's purpose and the participant's right to choose whether or not to participate in the survey. The fact that the data collection tools made every effort to incorporate all models currently being utilized by farmers in the cat fish farming industry ensured the study's authenticity. This approach had the benefit of allowing participants to be candid and open, without worrying about their opinions being misinterpreted, when sharing their opinions with the researcher. By posing the identical questions to each responder and comparing their responses, an effort was made to regulate the item reliability. The researcher enhanced the relevance of the data response to the research by ensuring that the respondents' answers to the semi-structured questionnaires and interviews were directed and streamlined to the research objectives. A comprehensive consultation process during the design of the questionnaire, interview, and discussion guides resulted in a data collection instrument whose results may be used in the real world to other related research projects, scenarios, and locations. The questionnaire was also brief and simple to complete.

### 3.10 Data collection procedure

Both questionnaires and interviews were pre-tested. This was done a month before going into the field in Shamva district. For interviews, the researcher started by engaging farmers and giving appointment for the farmer to be interviewed a day prior to the research personally. Questionnaires were given and answered whilst the researcher is present that is to explain the events where the respondent is not understanding. In the event that the farmer is absent, the researcher left the

questionnaire for the farmer to familiarize with it and collected it the following day but it was answered at the presence of the researcher. Observations were done at the presence of the respondent or even if not present. Focused group discussion was done after the farmers were fully booked and organized a day for the group discussion. All the data collection was done in a month time.

### 3.11 Data analysis and presentation

In order to obtain valuable insights, data analysis techniques entail processing and analyzing the data. The goals and research question determine which data analysis technique is best (Kumar, 2023). Additionally, inferential statistical, descriptive statistical, content analysis, and data mining techniques are the four methods that are typically employed in data analysis, according to Kumar, 2023. Since both qualitative and quantitative data were obtained for this study, the researcher utilized both descriptive and inferential statistics, but handled them differently: descriptive statistics were used for qualitative data, and inferential statistics were used for quantitative data. By the way, data presentation refers to techniques used to represent and explain study findings in a way that they can be simple to comprehend. In this survey, the quantitative results were presented using tables, graphs, and pie charts; the qualitative data were presented using methods such as pictures and description statements.

### 3.12 Ethical considerations

The researcher ensured that potential volunteers were told about the study's goal and design, as well as guaranteed confidentiality, in order to uphold ethical standards in research. It is important to take ethical considerations into account in order to prevent violating the rights of study participants. One could refer to them as moral precepts that need to be kept in mind when interacting with participants or responses. Before beginning any research, the researcher gets consent from the respondent and local leaders to perform the study in the area. The study honored the individual's freedom to engage in the study while maintaining their right to privacy, by the research and whether it is appropriate to make public his or her views, values, beliefs, and opinions. It also considered the participants' right to be shielded from physical or psychological harm; in other words, the researcher promised not to divulge any information that would put the participants' lives, the lives of their families, or any kind of property damage or harm in jeopardy. Before

involving the subjects in the investigation, the researcher obtained their consent. As a result, nobody was forced to participate in the study by the research.

### 3.13 Summary

In summation, chapter 3 outlays the research methodology being adopted and used by the researcher in the research starting from the research philosophy, research design, sample determination target population, data collection methods, data collection procedure as well reliability and validity. Ethical considerations were also outplayed in this chapter.

# CHAPTER 4

# RESULTS AND DISCUSSION

## 4.0 Introduction

This chapter deals with presentations, analysis and interpretation of the findings which were collected from respondents using questionnaires, interviews and observations and focused group discussions. The findings, results and implications were presented using tables, graphs and pie charts as they were analysed through the Statistical Package for Social Sciences (SPSS). Descriptive statements were also used to display and present the observations and judgements as per respondents' own perspectives and explanation on the subject matter which aims to air out qualitative results. Presentation, analysis and discussion of the results here in has been done per objective and research question just as what has guided the research to cover the research gap. The objectives of the research entails assessing the levels of adoption of Catfish production business, identifying also commonly applied Catfish management models by the farmers particularly under Shamva district, designing a commercial catfish production business model compatible particularly with Shamva District, imparting the model knowledge to farmers and assess its uptake for recommendations on subject matter but with least technology, and finally assessing the challenges being faced by the Catfish farmers in Shamva District basing on the adopted and commonly applied management models which are limiting also the adoption of new models. However, in creating basis for the achievement of results pertaining to the objectives, the researcher commenced by having data collection and assessment on demography and farming experience of the respondents relating to the Catfish farming Business as the subject matter.

## 4.1 Demography and farming experience

This section largely focuses on the socioeconomic and demographic features of the respondents in Shamva district. The demographic information has been captured important since it determines the level of awareness regarding the adoption of new farming technologies brought into the area aiming at improving the living standards of the people and age also determines the smallholder farmers' activeness, hands on and ability to work hard in agricultural terms. The data gathered also included the experience of smallholder farmers in the field of fish farming, as well as demographic

details such as respondents' age, sex, degree of education, and the kind of fish being farmed. The respondents' age distribution is shown in Table 4.1 below.

**Table 4.1: Demography on Age of farmers (respondents)**

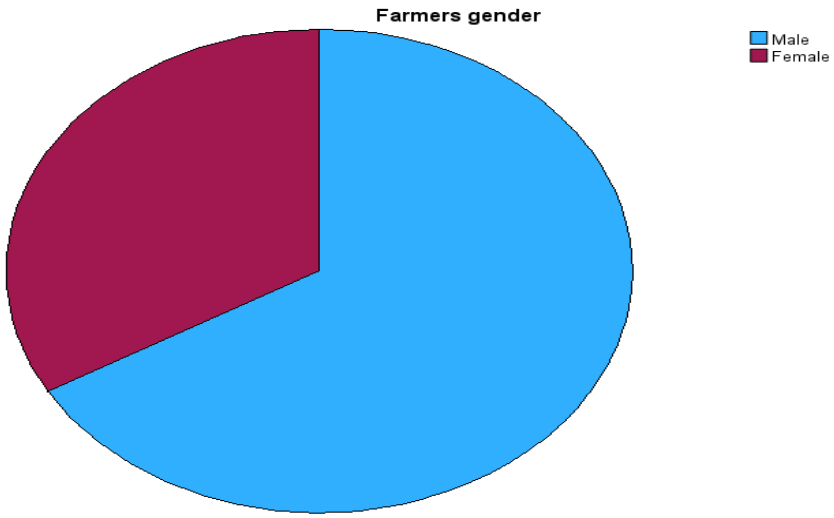
| | | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Valid | 21-30 years | 3.3 | 3.3 | 3.3 |
| | 31-40 years | 43.3 | 43.3 | 46.7 |
| | 50+ | 26.7 | 26.7 | 73.3 |
| | 41-50 | 26.7 | 26.7 | 100.0 |
| | Total | 100.0% | 100.0% | |

According to the study's findings, the majority of fish farmers (43%) were in the 31–40 age range (Table 4.1), making them youthful, vibrant, economically engaged, and quick to adapt new technology. Olanrewaju (2020) cites studies by Mohammed and Adewumi (2018) that show comparable findings. This suggests that younger people are becoming more involved in fish farming. Following this age group with 26, 7% each were 41-50 and 50+, indicating that home farming is becoming increasingly popular.

### 4.1.1 Distribution of the farmer's in terms of gender

It has been discovered that men (67%), rather than women, dominate the fish farming industry in the Shamva study area. This is consistent with findings from earlier research (Ibeun, Ojo, Mohammed, & Adewumi, 2018), which examined how women of the highlighted age group may not have had as much access to financing as they would have had if catfish or other intensive fish farming didn't require a large initial investment. They frequently work more on fish processing, which uses less money than fish production in the first place (Ucha, Ume, Ivoke, Silo, & Ogbulie, 2018). The gender distribution is then shown in figure 4.1 below.

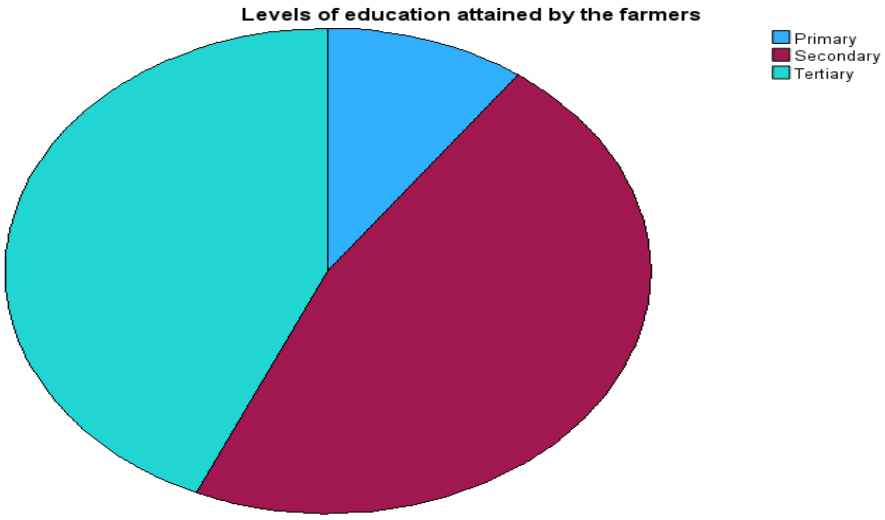
**Figure 4.1: Demographic results in terms of Gender of the respondents**




### 4.1.2 Farmers educational level

The goals of this study included evaluating the rate and capacity of adopting new, improved business models in the context of farming. To this end, the educational backgrounds and farming experience of the farmers were taken into account in order to ascertain whether the farmers had a general understanding of the use of fish farming for both income and food security, as well as whether they were capable of adopting new, improved models in aquaculture. According to the study, every respondent in the region has completed formal education, with 43.3% holding a postsecondary degree and 46.7% reporting a high level of education exceeding 80% among fish farmers in the study area. Still, given the exceptionally high level. However, a companion study conducted in Nigeria suggests that the reason for the unusually high level in the study area may be the study location's urbanized nature (Ebukiba, 2019). Furthermore, being a highly scientific industry, fish farming demands a high degree of literacy from its farmers in order to succeed. The data about the respondents' educational attainment is shown in Figure 4.2 below.

**Figure 4.2: Demographic results pertaining to levels of education attained by the Respondent farmers**



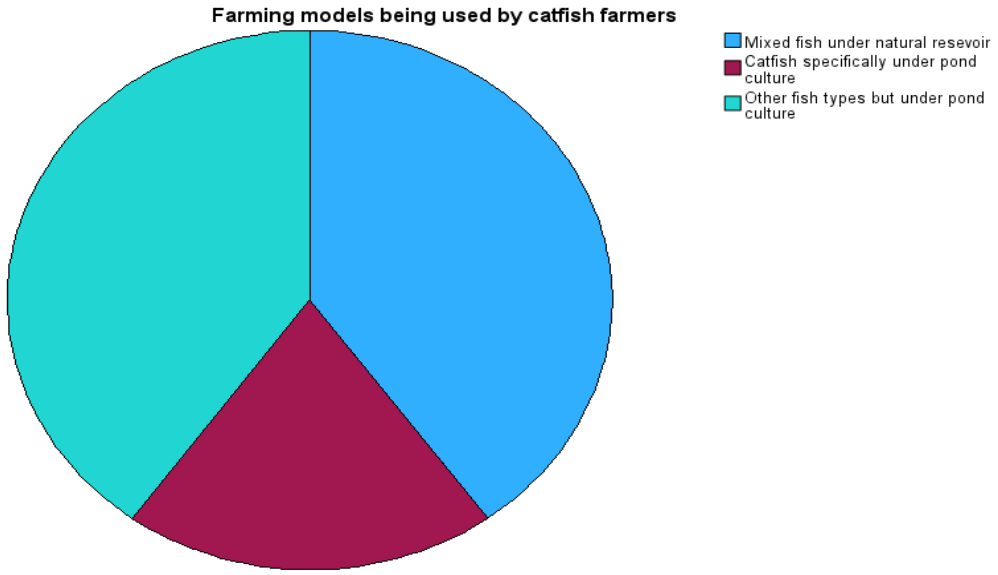

## 4.2 Model designing, imparting the model knowledge to farmers and assess its uptake for recommendations. (Objective 1)

Since this was the first objective, the researcher used a survey to gather data and information for it. The questionnaires were distributed with questions that addressed various factors that form the basis for developing a commercial catfish business model that increases catfish production and evaluates farmers' adoption of it. These factors include the general population of farmers already involved in fish farming, particularly with regard to catfish, the methods or models of production that farmers use in their operations, farmers' interests in upgrading and adopting improved catfish production systems, and farmers' access to the production necessities.

### 4.2.1 General populations of farmers into Catfish farming Business models.

The majority of fish farmers in Shamva District have not yet implemented the production basin, specifically catfish nut, as a mixed method, according to the Agriculture Extension (AGRITEX) and Veterinary Services personnel. Below is a table that is followed by a figure that shows the populations that were included in the survey based on the sample.

**Figure 4.3: Data on General population of farmers into Catfish and the general models used**




As the following statistic illustrates, forty percent of farmers who answered the poll are interested in mixed fish farming, which includes catfish but is done under natural reservoirs. These results, however, support the claims made by Knowler et al. (2020) that a large number of farmers in developing nations have not yet embraced the upgraded models, despite being polled about regularly used fish farming models. Only 20% of the remaining 40% are specifically up to producing catfish under pond culture, while the remaining 40% are specifically up to producing Tilapia fish. It has gained validity because it challenges Mbokane et al.'s (2022) research on a comparable scenario in South Africa, which contends that catfish production in the studied area was primarily conducted in large and semi-intensive systems (95%) such as aqua dams and earthen ponds, with only a small percentage of catfish farmers (5%) using intensive culture techniques. This suggests that farmers occasionally lack understanding of the financial benefits of enhanced business models in the fish farming industry and the returns on fish, which has been contributing to the disadvantages in catfish commercial farming.

### 4.2.2 Imparting the model knowledge to farmers

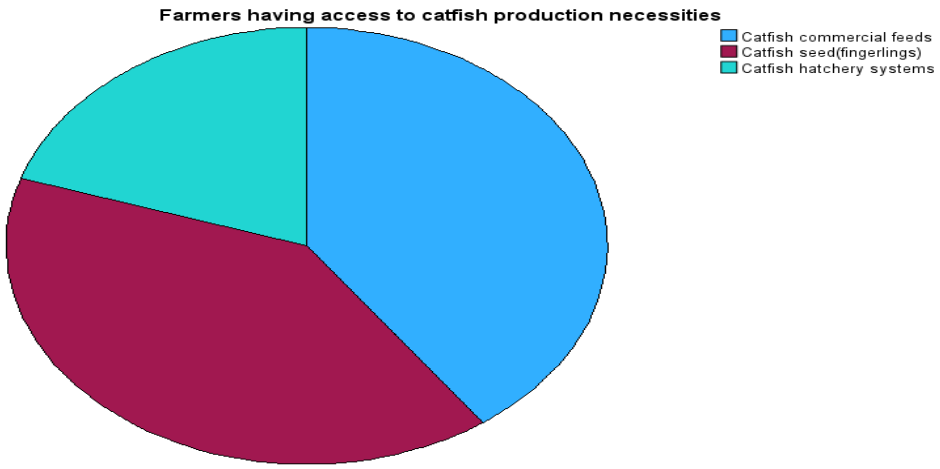
Olanrewaju (2020) argues that since the majority of the farmers in the sample were farm-owned (100%) and had a higher percentage of catfish farming (60%) despite the fact that many of them

operated on a mixed basis, catfish have become a popular choice for homestead fish farming. Of these, 33% specialized in raising catfish alone, with the remaining 33% raising other types of fish. Earthen or aqua dams (67%) and concrete ponds (33%) were the two main cultivation systems surveyed. These results, however, verify Ebukiba's (2019) assertion that farmers are willing to produce catfish under freshwater pond culture, despite their lack of knowledge and access to resources. According to a study, the majority of catfish farmers just assume that the business must be run naturally without any extra care.

As most of the farmers sampled were farm-owned (100%) and also a larger percentage of catfish farming (60%), although much of them are under mixed basis, the hardiness of catfish which makes it thrive under seemingly difficult conditions has made it a favorite choice for homestead fish farming which led a certain percentage (33%) to specialize on it alone with however other mixing with other types, as also argued by Olanrewaju, (2020). The two major culture systems surveyed were concrete ponds (33%) and earthen or aqua dams (67%). These findings however shows that the farmers are willing but have little knowledge and access to the resources on the production of Catfish under Fresh water pond culture and it then corroborates with Ebukiba, (2019) who asserts after a study that, most of the Catfish farmers just assume the venture as it has to be done just naturally without any special care provided.

That being said, the data supports this: of the farmers, 80% had only limited access to catfish seed (fingerlings), which they identified as coming from other natural dam harvests; only 20% had limited access to those hatchery systems specifically for the purpose of obtaining catfish seed (Figure 4.4). This is consistent with studies conducted in other regions of the nation, including the Niger Delta (which includes nine Southern States), Abia State (Igwe, 2014), and Nassarawa State (Ebukiba, 2019). (Iruo, Onyeneke, Eze, Uwadoka, & Igberi, 2019). This, however, runs counter to the findings of Olaoye et al. (2013), who discovered that 63% of Oyo State's farmers are raising their own catfish fingerlings. However, this method is steadily growing since the fish farming sector appears to be moving toward enhanced specialization (Igberi, Onyeneke, Eze, Uwadoka, & Iruo, 2019).

**Figure 4.4: Results on the access to Commercial production necessities**




**4.3 Assessment on the interest level of adoption, identifying also commonly applied Catfish management models, by the farmers under Shamva district. (Objective 2).**

The researcher also gathered information on the farmers' interest in and adoption of catfish production methods and models in their business, taking into account the constraints that have been impeding the continuous flow of commercial catfish production. This information was considered crucial in unlocking the potential of the model and developing an efficient one that will increase revenue and commercialize catfish farming. The data collected at the time was particularly lax when it came to the sources of technical assistance, which includes the farmers' degree of reliance on the catfish industry and any obstacles to the smooth operation of their enterprise. A table that illustrates the distribution of fish farmers in the catfish industry can be found below.

**Table 4.2: Frequency and distribution of Catfish farmers.**

| **Group** | **Percentage** |
|---|---|
| Mixed Fish Farmers | 67% |
| Specific Catfish Farming | 33% |
| Grand Total | 100% |

As indicated by Table 4.2 above, the majority of respondents (67%) work in fish farming, but on an extensive basis using mixed breeds and less labor and inputs. This is followed by 33% who work in intensive catfish farming, which uses high inputs and management. These figures validate the enterprise's potential and people's willingness and interest in investing in fish, as also argued by Adelekea et al. (2021), but they shouldn't rely solely on it because there are other issues that are impeding its effective adoption.

The substantial proportion of farmers with fewer than ten years of experience—6% with 0–5 years, and 56% with 5–10 years—corroborates this further. This suggests that the industry has grown at a rapid pace over the last ten years. A significantly high rate of new arrivals during such periods has been documented in several research. According to Olanrewaju (2020), for example, 99% in the North West of Nigeria (Olukotun et al., 2013) and above 80% in the South West of Nigeria (Busari, 2018).

**Figure 4.5: Results on the Sources of technical support**

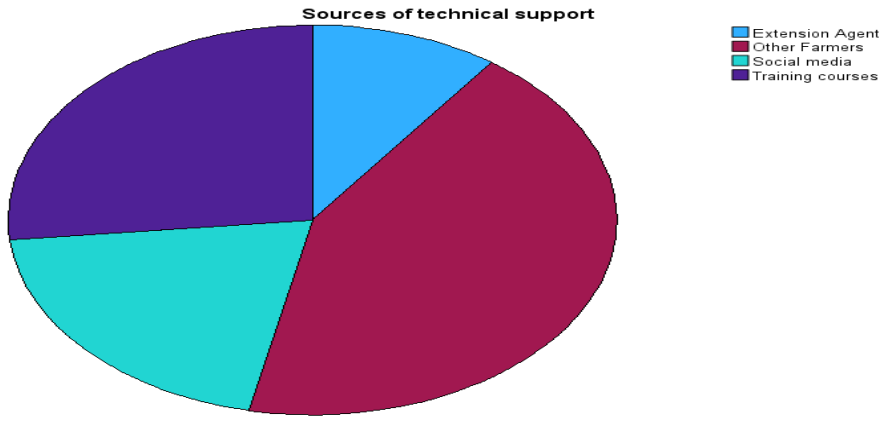



Figure 4.5 shows that the majority of farmers (10%) relied on extension agents, while other farmers (43%) and training course attendance (26.7%) were the main sources of technical support for their catfish farming operations. However, as noted also following a similar study in Nigeria by Ebukiba, (2019), this could not be due to the farmers' lack of interest in extension services but rather to a lack of sufficient extension staff and services. It was discovered that a specific percentage (20%) also depended on social media as their primary source of technical assistance when carrying out their industrial operations. These farmers contend that because they have a high level of education, they were interested in catfish farming after reading a variety of books. They

cited the source of technical assistance for the internet and social media, as similarly argued by Mbokane et al. (2022)

## 4.4 Assessment on the challenges being faced by the Catfish farmers in Shamva District basing on adopted applied management models.

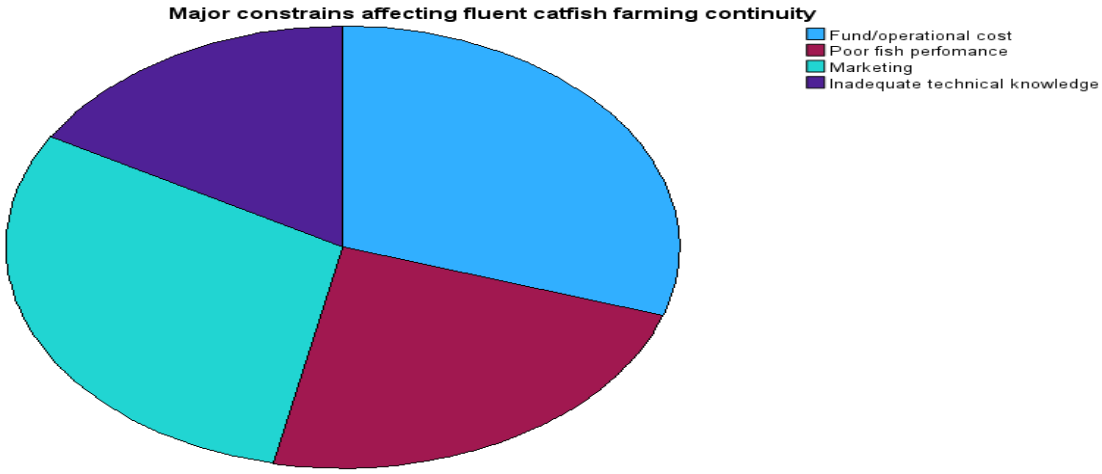
### 4.4.1 Analysis on the profitability levels basing on the models being used and experience

Following a study of the factors that contributed to technical inefficiency, it was discovered that experience with more than ten years of dominance had a large negative coefficient, suggesting that it positively leads to increased technical efficiency. However, more research on the correlation between experience and profitability as evaluated shows that there are significant differences in profit across low experience levels and that most of the accepted improved methods (intensive pond culture) resulted in losses. These results, however, support the assertion made by Olanrewaju (2020) that profitability increased in step with newly developed and improved technologies because those innovations are meant to increase production efficiency. This suggests that, seasoned farmers were able to benefit from years of experience in order to maximize profit through the adoption of better technologies and either cost reduction or revenue gain through better market prices. This illustrates even further how expertise and production models support productivity and profitability.

### 4.4.2 Challenges and constrains being faced by Catfish farming

Since there has been a lack of adoption in the research area, particularly with regard to extensive catfish farming, information on the challenges experienced by adoptees has also been acquired. The results are shown in the figure below.

**Figure 4.6: Results on the Major Constrains affecting fluent catfish farming by the respondents.**




As shown by Fig. 4.6, the farmers' top two obstacles are low cash and high operating costs, both of which rank at 39%. The farmers were also hampered by the high cost of feed and fingerlings because their sources are limited. This was followed by subpar fish performance (22%) and issues with marketing (22%), both of which were mostly ascribed to ignorance. These results, however, are consistent with those of Amachree & Jamabo (2019), who discovered in a related study that problems with the high cost of production and the availability and caliber of fingerlings have been noted by farmers over time as key obstacles.

## 4.5 Challenges affecting fluent Catfish farming and limiting also the adoption of the new Commercial models

Overall, the production data from the area for both general fish farming and specifically catfish farming demonstrates that, despite large investments and the creation and adoption of supportive policies in the catfish industry, there are still constraints and a number of issues that are impeding the sector's sustainable growth and adoption, thereby realizing its potential.

### 4.5.1 Reasons for the decline of the Catfish farming business.

Since the majority of the difficulties encountered by catfish farmers have already been evaluated and discussed (see figure 7), these were held accountable for the industry's downfall as a commercial enterprise. According to Olanrewaju (2020), these and other problems, such as little

knowledge, poor fish performance, and marketing, are what are causing the decrease of catfish farming in Nigeria. Nonetheless, respondents to this study have also identified additional obstacles.

#### 4.5.1.1 Feed inputs

One of the main challenges facing catfish growers in the Shamva district is the availability of high-quality feed at a lower cost. According to study and identification, manufactured feeds that contain expensive materials like fishmeal are the main source of energy for Zimbabwe's productive commercial aquaculture sector. Due to the paucity of essential materials and the fact that the majority of farmers lack knowledge about where to obtain them, this exposes the business to higher prices. This supports the findings of Moyo and Rapatsa (2021), who found that feed costs and quality are two major factors limiting the development of aquaculture in Southern Africa. These factors primarily affect the small-scale aquaculture sector because most farmers lack the resources necessary to purchase commercial diets. Because of this, a lot of small-scale catfish producers use subpar feeds, which has an impact on output and profitability. Therefore, it is imperative that researchers concentrate on finding inexpensive, readily available substances in the area that can be used into aqua diets. Governments should think about short-term measures like subsidized feeds, price controls, and broader access to credit facilities for catfish farmers in the interim.

#### 4.5.1.2 Fingerling supply

Obtaining high-quality fingerlings is one of the issues influencing Shamva District's catfish output. The district's majority of catfish growers lack access to high-quality fingerlings. Additionally, according to DAFF (2019), there aren't many nations in Southern Africa that have operational hatcheries capable of providing the catfish business with high-quality seeds. Based on the findings of Mbokane et al. (2022), certain research stations and institutions that offer courses in aquaculture have historically provided fingerlings to fish farmers; however, a large number of them have stopped actively producing catfish fingerlings. As a result, this served as a barrier to the development and continuation of the commercial catfish farming industry.

#### 4.5.1.3 Systems of Production

##### 4.5.1.3.1 Earthen pools

As The majority of catfish production in Shamva District (67%) is done in substantial and semi-intensive systems, like aqua dams and earthen ponds. In the district, only 33% of catfish farmers use intensive culture technologies, which include built pond culture and recirculating aquaculture systems. But the bulk of fish farmers in the district use badly built ponds, which results in low yield. It appears that many farmers build their ponds without consulting aquaculture specialists throughout the design and construction process. This results in ponds that are improperly sized and built, which in turn causes inadequate upkeep, low-quality water, and improper stocking densities. This supports the findings of Mbokane et al. (2022), who reported on a study conducted under South African conditions that the quality of earthen ponds used for catfish production in the region's small-scale sector directly affects the industry's growth. This is because inadequate maintenance of water quality typically results in high levels of total suspended solids and total dissolved solids, which lower primary production in earthen ponds and raise fish growth rates, necessitating high feed input. Long-term farm profitability is impacted by this. Additionally, in order to produce better strains and superior fingerlings, attention must be directed toward the development of cutting-edge breeding technology. Governments ought to consider methods for boosting funding in the industry to allow farmers to implement the newest agricultural technologies required to boost output.

### 4.6 Summary

In summation, chapter 4 outlays the data which were collected from the respondents basing on the objectives and the research questions of the study through the employment of the data collection instruments highlighted earlier in chapter 3. The first part highlights the demographic distribution the respondents in terms of age, educational level and farming experience, thus to create basis of understanding and analyzing the information to be collected. The information has been also discussed in this chapter, thus checking coherence and or divergence of the information gathered to what other scholars who did similar researches argues.

# CHAPTER FIVE

# SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 5.0 Introduction

This chapter contains summary of the findings, conclusions and the recommendations from a depth analysis of the study

## 5.1 Summary of the findings

In summary, the focus of chapter 4 was on presenting, evaluating, and interpreting the results in light of the study's goals. Since the objectives guided the collection of the data, the results for each objective have been examined and presented. However, the analysis and presentation of the data began with the results regarding the demographic distribution and farming experience of the farmers, as these findings served as a foundation for assessing the certainty and confidence of the data that would be gathered to fulfil the objectives. According to Table 4.1's demographic findings, which include respondents' ages and educational attainment, the majority of fish farmers (43%) were between the ages of 31 and 40, characterizing them as youthful, vibrant, economically engaged, and In addition to being early adopters of new technology in the fish farming industry, it was discovered that all respondents in the area had completed formal education, with 43.3% having completed postsecondary education and 46.7% having completed secondary education, which is equivalent to a high level of education exceeding 80%. Designing a commercial catfish production business model, educating farmers about the model, and gauging their acceptance of the model's recommendations was the first goal. It was discovered that 40% of the farmers who answered the questionnaire were interested in mixed fish farming, which includes catfish but takes place in natural reservoirs. This indicates that the farmers are willing to try catfish farming and are capable of adopting new models, but they lack knowledge of the improved models. This has been supported, meanwhile, by the fact that only 20% of farmers had limited access to such hatchery systems specifically for the purpose of obtaining catfish seed, while the remaining 80% have limited access to fingerlings, which they identified as coming from other natural dam harvests. Additionally, it was discovered that the majority of respondents (67%) work in fish farming, but

on an extensive basis using mixed breeds and less labor and inputs. This is followed by 33% who work in intensive catfish farming, which uses high inputs and management. These findings validate the opportunities available in the enterprise as well as people's willingness and interest in investing in catfish. The most frequent difficulties that catfish farmers encounter in difficulties the Shamva areas have been found as costs, markets, and lack of understanding on the commercial catfish production models and also on where to source feeds and fingerlings hence production necessities.

## 5.2 Conclusions

Because the catfish breed is able to adapt to harsh conditions, most farmers have commented on it as a major enterprise, despite the fact that general fish farming has risen rapidly over the previous ten years in various parts of Zimbabwe, including Shamva District. It makes a major contribution to the establishment of jobs and the food security of fish. However, the area needs to encourage the adoption of catfish farming due to the recent decrease, reduction, and poor adoption of specifically catfish in production lenient with profitable business models. As a result, inferences have been made based on the study's findings because all of the data was found in accordance with the objectives and however confirms at most with the findings of other literature discussed in chapter 3 of the studies similar to this which have been conducted in other different regions.

### 5.2.1 Objective 1

The study's first objective led to the conclusion that, given the higher percentage of respondents who were interested in catfish production, Shamva catfish farmers and those of other fish breeds are highly motivated to pursue commercial catfish production business models. But the farmers don't know enough about the newer models, such intensive farming and pond culture. It is therefore necessary for veterinary officers to educate farmers and help them adopt

### 5.2.2 Objective 2

The evaluation of the adoption of catfish-specific production models also makes it evident that farmers are keen to get into the industry, but they are discouraged by a number of obstacles and limiting factors. These should be addressed at the farmer level by implementing models that

increase efficiency and are profit-oriented. The practical experience demonstrated that although a large number of farmers handle the technical components of their operations, the financial portions are not as well-managed. These farmers require goal-oriented agricultural management and an economic plan. Above the years, the majority of fish farming training has prioritized the technical part of production above the commercial side.

### **5.2.3 Objective** 3

This chapter has made it abundantly evident that catfish farming in Shamva has enormous potential to expand quickly. However, there are a number of complex obstacles that must be overcome, necessitating drastic measures at the government, farm, and research levels. To enhance the sector's growth, for example, attention must be directed toward the implementation of sophisticated production systems. While the overall profitability assessment demonstrates the venture's profitability, it also reveals that a small number of farmers who have been successful in upgrading their production ventures and using superior models have a significant financial impact

Overall, strengthening the weaker areas in the various production categories is necessary to increase the overall profitability of catfish farming, restore and unlock the commercial catfish production business model, and further promote food and nutrition security. This study implies that in order for fish farming to be a viable, profitable, and sustainable endeavor, farmers must not only enhance their technical proficiency but also acquire sufficient understanding regarding the economic management of fish farming as argued also by Moyo and Rapatsa (2021), To assist farmers in successfully operating their farms, efforts must be made to set up regular training seminars on fundamental animal husbandry (i.e., feeding, disease management, and water quality monitoring).

## **5.3 Recommendation**

Given the aforementioned findings, the researcher strongly advises that;

### **5.2.1Farmers**

The study area's fish farmers require additional training in the business management facet of fish production. Farmers must maintain sufficient records so that trainers or extension agents can accurately evaluate the farm's operations and provide recommendations. The farmer could also receive training from this record on how to evaluate their operation's finances. Farmers must expand their operations in the catfish farming industry by building nursery ponds where they can raise fingerlings to the standards they set for quality. Extension officers can also help to improve this. Farmers also have to improve in the Pond and water management, results in reduced mortality Farmers are advised to acquire an increase in profits because of cost savings they achieved through efficiency gains in feed conversion and reduced mortality through good water management

### 5.2.2 Government

More emphasis should be placed on the economics of general catfish farming than only its technical aspects in the training of government fisheries and extension officers. Farmers should have access to mobile and online platforms where they can learn about ventures that other farmers around the world are pursuing on social media and obtain basic profitability ratios tailored to aquaculture that they can apply to their own operations. As one of the most resilient and promising breeds, catfish requires government support to increase economic ventures. This can be achieved by thinking of short-term solutions like subsidized feeds, price controls, and easier access to credit facilities for catfish farmers. Also, efforts should be forced to set up frequent training sessions on fundamental animal husbandry (i.e., feeding, managing diseases, and monitoring water quality) in order to assist farmers in effectively managing their farms.

### 5.2.3 Further study

The profitability study's findings highlighted the impact of ineffective cost control. Thus, it is necessary to evaluate the farmers' allocative efficiency and comprehend how far they deviate from the ideal in order to be able to evaluate the farmers' economic efficiency in its whole. Research projects like the cryopreservation of sperm cells and the creation of polyploidy brood stock should be accelerated since more breeding centers are needed in the area to address the fingerling shortage.

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www.sample culculator.com

## APPENDICES

### Appendix 1: Questionnaire for Catfish farmers




**BINDURA UNIVERSITY OF SCIENCE EDUCATION**

**FACULTY OF COMMERCE**

**GRADUATE SCHOOL OF BUSINESS**

*Where Great Minds Meet*

**QUESTIONNAIRE FOR CATFISH FARMERS**

**Re: Academic Research Questionnaire**

Chiverengo Juliet is my name B1541403, and I am a student at Bindura University of Science Education studying towards Master's in Business Leadership. My kind requests are your participation in this survey by responding and providing answers to my programmed set questions

below with your confidentiality and truelity. The study has got this title '**Unlocking the adoption of Ccommercial Catfish Production business model'.A case study for Shamva District, Mashonaland Central Province,** for it seeks to study is to rresearch on modern cat fish production regimes applicable and compatible with the Zimbabwean scenario, particularly in Shamva District and it further on aimed at delivering and imparting knowledge to the already existing and interested farmers on effective Morden innovated Catfish production business models which are compatible and applicable to the area. I would very much appreciate it if you answer all questions carefully. Data being collected under this survey will be strictly used for academic purposes and business purposes so strict confidentiality is to be practiced.

Please note: Your participation is voluntary and you can withdraw at any time. Please do not write your name on this questionnaire.

- The answers will only be used for academic research purposes.
- If you have any queries about the survey, please contact me on 0775 726 750.
- Tick the number for your answer to the questions.
  Thank you for your time and participation.

**APPENDIX 1**

**<u>Questionnaire for the Farmer</u>**

Farm Name.....location…….

Section 1: Demographic Data *(Tick appropriate)*

a. Sex Male ☐ Female ☐

b. Age of respondent

21-30yrs ☐ 31-40yrs ☐ 41-50yrs ☐ 50+yrs ☐

c. Period of working experience on the Farm

0-5yrs ☐ 6-10yrs ☐ 11-15yrs ☐ 16-20yrs ☐ 21+yrs ☐

d. Education attained by household head Primary secondary tertiary none

Primary ☐ Secondary ☐ Tertiary ☐ None ☐

e. Marital status

Married ☐ divorced ☐ widowed ☐ single ☐

f. Type of Fish under production.

African Catfish ☐ Tilapia ☐ other ☐

**Section 2: To design a commercial catfish production business model, imparting the model knowledge to farmers and assess its uptake for recommendations on subject matter but with least technology**

**Part 1: To design a commercial Catfish production business model**

a. Do the farmer already in Catfish production

Yes ☐ No ☐

b. Which method does the farmer used in Catfish production

Fresh water fish farming (pond culture) ☐ under earth dams and natural reservoirs ☐

c. Which model does the farmer adopted and used in the production of fish

Intensive model (fish grown in ponds under a lot of labor and inputs like feed are high ☐

Semi intensive model (fish grown with moderate need for labor and inputs) ☐

Extensive model (fish grown naturally with minimum to no labor and inputs provided) ☐

d. Does the farmer have interest to invest in Catfish production as a profit-making entity

Yes for local market ☐ yes for export markets ☐

e. Does the farmer have enough to be spared for Commercial catfish ponds construction

Yes ☐ No ☐

f. Does the farmer have enough inputs capacity to adopt the extensive system of catfish farming

Yes ☐ No ☐

**Part 2: Imparting the model knowledge to farmers**

a. Does the farmer have any knowledge on how to partake fresh water Catfish farming (pond culture?)

Yes ☐ No ☐

b. Do you have access to where fish commercial feeds are purchased
If yes state the distance from the farm to where they are found

Yes ☐ No ☐

---

c. Does the farmer have access to where catfish seed (fingerlings) are purchased

Yes ☐ No ☐

d. Does the farmer have access to Catfish hatchery systems

Yes ☐ No ☐

e. Are the farmers willing to adopt the hatchery systems

Yes ☐ No ☐

**Section 2: Assessing the challenges being faced by the Catfish farmers in the are**

a. How profitable was actually their catfish farming business using the commonly used models

……

……
……

b. When often do they harvest for a bigger viable market

……
……
……
…

b.Where do the farmers market their Catfish produce

.....
.....
.....

c.Does catfish have a competent market and demand with those other fish breeds…….....……
……
……

d. What actually are the costs of production they are incurring in the production process of catfish?

.....
.....……
……

e. What are the marketing problems being faced by these farmers in marketing their produce

……
……
……

f. What are the general problems which are affecting the fluent catfish farming in the community……
……

……
…

**Section 3: Investigating the limitations of fluent catfish farming and the adoption of the new models**

a. What are the reasons for the decline in the catfish farming business

……
……
……

b. Does the farmers have enough requirement which are necessary to facilitate fluent catfish farming like water source capital etc?

……
……
……

c. What are the factors in the area which affects the business like social, economic, political etc?

……
……
……..

****Thank you for your participation in this study****

**Appendix 2: Guidelines for non-participatory observations**

- Method being used the farmer
- Presence of Growing ponds
- Nature of management on the growing ponds

**Appendix 3: Analyzed data collected through questionnaires**

**Farmers adoption to catfish farming**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Yes | 30 | 60.0 | 60.0 | 60.0 |
| | No | 20 | 40.0 | 40.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

**Farmers gender**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Male | 33 | 66.7% | 66.7% | 66.7% |
| | Female | 17 | 33.3% | 33.3% | 100% |
| | Total | 50 | 100.0 | 100.0% | |

**Farming models being used by catfish farmers**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Mixed fish under natural resevoir | 12 | 40.0 | 40.0 | 40.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Catfish specifically under pond culture | 6 | 20.0 | 20.0 | 60.0 |
| | Other fish types but under pond culture | 12 | 40.0 | 40.0 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

**Sources of technical support**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Extension Agent | 3 | 10.0 | 10.0 | 10.0 |
| | Other Farmers | 13 | 43.3 | 43.3 | 53.3 |
| | Social media | 6 | 20.0 | 20.0 | 73.3 |
| | Training courses | 8 | 26.7 | 26.7 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

**Age of farmers**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 21-30 years | 1 | 3.3 | 3.3 | 3.3 |
| | 31-40 years | 13 | 43.3 | 43.3 | 46.7 |
| | 50+ | 8 | 26.7 | 26.7 | 73.3 |
| | 4 | 8 | 26.7 | 26.7 | 100.0 |
| | Total | 30 | 100.0 | 100.0 | |

**Levels of education attained by the farmers**

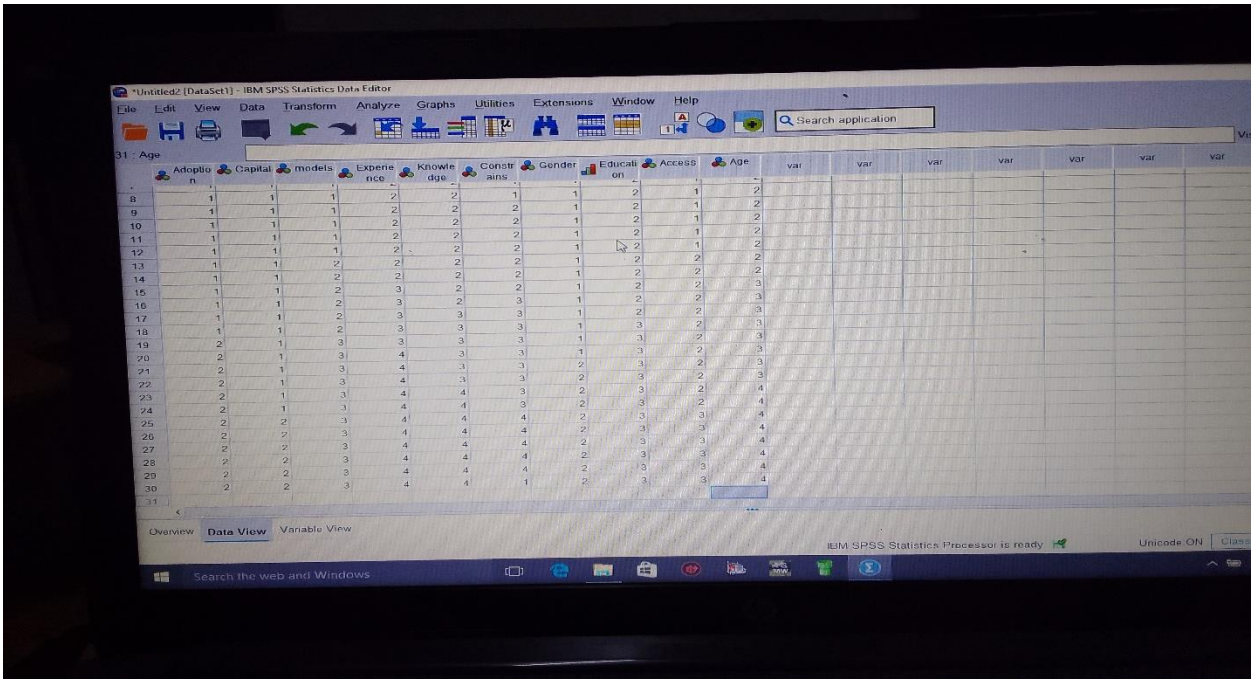
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Primary | 5 | 10.0 | 10.0 | 10.0 |
| | Secondary | 23 | 46.7 | 46.7 | 56.7 |
| | Tertiary | 22 | 43.3 | 43.3 | 100.0 |

| | | | | | |
|---|---|---|---|---|---|
| | Total | 50 | 100.0 | 100.0 | |

**Farmers having access to catfish production necessities**

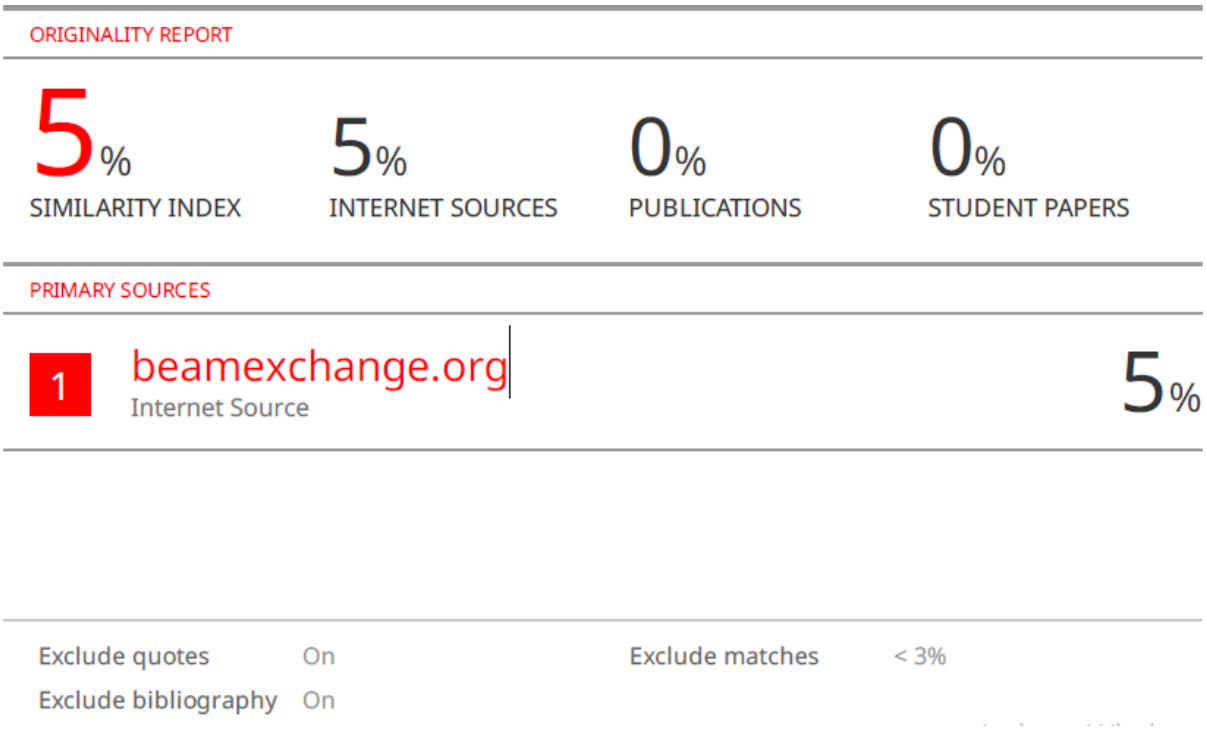
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Catfish commercial feeds | 12 | 40.0 | 40.0 | 40.0 |
| | Catfish seed(fingerlings) | 12 | 40.0 | 40.0 | 80.0 |
| | Catfish hatchery systems | 6 | 20.0 | | 100.0 |
| | Total | 30 | 100.0 | | 20.0 |
| | | | | | 100.0 |

## Appendix 6: Running data by SPSS



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