
**ASSESSMENT OF SEASONAL FARM- BASED CHALLENGES FACING FISH
FARMERS AND ADAPTIVE STRATEGIES BEING USED IN NAGONGERA
SUB- COUNTY TORORO DISTRICT**

BY

NGOLOBE SILAS K

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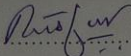
**A RESEACH PEPORT SUBMITTED TO THE DEPARTMENT OF BIOLOGY IN
PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF
DEGREE OF BACHELOR OF SCIENCE EDUCATION OF BUSITEMA
UNIVERSITY**

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CONSET FOR SUBMISSION

CONSET FOR SUBMISSION

This research report has been compiled under my supervision and is now ready for submission to Busitema University for examination purpose.

Signature  Date..... 9/9/2024

Mr. RICHARD KIFUKO

Department of Biology,

Busitema University.

P.o Box 236, Tororo, Uganda.

DECLARATION

I NGOLOBE SILAS K declares that this research report is my original work and is submitted for the award of the degree of Bachelor of Science Education of Busitema University. This report has never been submitted to any university for any award whatsoever.

Signature Date.....

ACKNOWLEDGEMENT

I would like to extend my sincere gratitude to my dear parents; Mr. NGOLOBE ISREAL and Ms. APIO CAROLINE, all my academic friends and relatives for your contribution towards my success.

Dedications

I dedicate this report to my dear family, friends and to whoever assisted in my academic pursuit.

TERMS USED

1. Aquaculture; Farming practice that occurs in or on water
2. Emigration of fish; Fish movement out of the fish pond or from one fish pond to the other.
3. Farm based seasonal challenges; challenges that vary depending on seasons.
4. Fingerlings; Young fish
5. Fish seeds; another name for fingerlings.
6. Fisheries resources; Natural aquatic organisms available for consumption and ecosystem balance.
7. Flooding; Overflow of water onto normally dry land, causing damage and disruption.
8. Predatory birds; Birds that hunt and feed on fish for survival.
9. Management cost; Expenses associated with overseeing and maintaining pond operations.
10. Water quantity; Volume of water available in a fish pond.

11. Water quality; Water's chemical, physical, and biological characteristics.

List of Acrimony

PHLs -Postharvest losses

CABI – Center for Agriculture and Bioscience International

SSA - Sub-Saharan Africa

FAO -the food and agriculture organization.

FAOSTAT- the food and agriculture organization corporate statistical database.

IPM – Integrated pest management. Economic injury level (EIL) and economic threshold (ET)

NGO - Nongovernmental Organization

NPC- National population and housing census.

ABSTRACT

Introduction

Fisheries sector plays an important role in Uganda's economy. Contribution of the sector to the nation's economy can be increased if challenges in the industry are minimized and the benefits explored. Uganda is blessed with numerous opportunities for large-scale aquaculture; however, the challenges seem to override these opportunities. Constraints to production in the industry have been identified as recurrent high-cost fish feed, poor water quality management, poor quality fish seed, technical know-how etc. Beyond the constraints to production are more pertinent factors responsible for un-sustainability of fish farm operation as business ventures. This research focused on seasonal farm-based challenges and how different farmers were managing such challenges in the study area of Tororo.

Methods

The total number of fish farmers sampled were 11, all coming from different parishes in Nagongera sub-County. The instructions used in data collection were informant's interview guides and structured observation methods. The study adopted a cross-sectional research design because it helped to measure the prevalence of different challenges with a fish farm wheos study samples were obtained by purposive and simple random sampling.

Results

The study showed that majority of the fish farmers, 30.77% are male adults of above sixty years who only archived elementary studies. Majority being elderly and of primary level, the key challenges faced include the following; Predatory birds, drought, shortage of fish feeds in dry season and siltation, emigration of fish, rapid growth of weeds in wet season.

Conclusion

Most farmers in the study are dependent largely on local technologies and natural sources of feeds for their fish, in addition to natural sources of water. Most challenging season recorded was dry season

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CHAPTER ONE; INTRODUCTION

1.0 Background

Fish production is an essential component of agriculture and global food security (Olaifa, 2015). Billions of people around the world depend on fisheries and aquaculture for food, essential nutrients, and livelihoods (FAO, 2016). However, the global trend reflects that fish production from capture fisheries no longer meets demand (Gabriel et al. 2007). Fish stocks in African waters have been declining (Adebo and Ayelari, 2011). The capture fishery sub-sector is being threatened by increasing climate change impact vulnerability (Boko et al. 2007; Allison et al. 2005). This climate scenario is expected to worsen the future (Rhodes et al. 2014). On the other hand, the aquaculture subsector of fish production continues to grow. Aquaculture is being noted as indispensable to meet the fish supply deficit, driving economic and social growth (FAO, 2010). Aquaculture can serve as adaptation strategies to climate change impacts on fisheries (Coulibaly et al. 2007). It has great potential in ensuring food and nutrition security, especially in Africa (Olaifa, 2015).

Pond fish farming in Uganda has significantly expanded, contributing to food security and income generation. The sector is characterized by diverse species, primarily tilapia and catfish, with over 100,000 registered fish farmers (Nangendo et al., 2020; FAO, 2021). This growth is supported by government initiatives (MAAIF, 2022) and increasing market demand (Kakooza et al., 2021).

Fish farming is one of the economic activities carried out by fish farmers of Nagongera Sub County. The fishing activities are carried out on Small scale where the majority of the fish farmers have less than five fish ponds but of different and non-uniform measurements. Trading centers of Namwaya west and east, pokongo, and Nagongera town council offers the market for the fish harvested. Fish farmers

are facing challenges resulting from predatory birds (kupii), theft from local people, poor quality fingerlings, flooding of fish ponds, and rapid growth of water weeds among others. To record success on their farms, farmers have come up with numerous strategies some of which are as follows: introduction of whistling equipment to deter away birds, increasing on the depth of fish ponds to accommodate large volumes of water, tranches to redirect water flow, planting water weeds in the fish ponds among others. The data reveals that there are more fish farmers in pokongo valley of Nagongera because of its largeness and relatively flat nature which favour construction of the fish ponds.

1.1 Problem statement

Capture fisheries have not been able to keep pace with growing demands, many marine fisheries have already been over-fished (FAO,1999) and therefore, there is need of urgent management of fisheries resources and places (MacLennan,1995). Based on current assessment of overexploitation of the many fish stocks, overcapacity, and or over capitalization of many fishing fleets, Mace (1997) concluded that many capture fisheries would probably not be commercially viable without significant government subsidies. Aquaculture is going under intense scrutiny and criticism as environmentalists fear that it could cause significant environmental problems and further impact wild species that are already threatened. The modern fishing methods for example, trawling techniques capture a very large amount of by-catch most of which are simply discarded (Alverson et al, 1994). Lack of quality seed (fingerlings) and commercially produced feeds are also problems facing the fish farming sector (Shitote et al, 2013)

Gabriel et al. (2007) stated that ecological importance of fish farming is always under looked by researchers. Yet its aspects are of paramount importance in integrated fish farming (Nesar et al, 2011). Gabriel et al. (2007) stressed that clear and explicit linkages between aquaculture and the environment must be defined and the complementary role of aquaculture in contributing to environmental sustainability must be developed and made known to all stakeholders in aquaculture industry. Furthermore, there are no comprehensive policies on fish farming and legislation are inadequate (Mwangi, 2008; Osure, 2011). Farm-based assessment will help to educate fish farmers about how seasonal challenges and climate change interact in fish farming, through assessing vulnerabilities and identifying adaptive strategies for farmers to cope with the changing environmental conditions and develop climate-resilient aquaculture practices (IPCC., 2019). Therefore, there is need to come up with how fish farming can ecologically be sustained and its benefits documented.

1.2 Objectives of the study

1.2.1 General objectives

Identifying and assessing the different farm- based seasonal challenges faced by different fish farmers of Nagongera Sub-County.

1.2.2 Specific objectives

- i. To identify the different farm- based seasonal challenges facing different fish farmers in Nagongera Sub County.
- ii. To assess the impacts of different challenges on fish farming in Nagongera Sub- County.

- iii. To analyze the adaptive strategies used by different fish farmers in Nagongera Sub- County.

1.3 Research questions

- i. What are the different seasonal farm-based challenges facing fish farmers of Nagongera?
- ii. What are the impacts of the challenges facing fish farmers of Nagongera?
- iii. What are the adoptive strategies being employed by different fish farmers of Nagongera?

1.4 Significance of the study

The study contributes to the broader body of agricultural research, particularly in the area of aquaculture, by providing empirical evidence on the challenges and adaptive strategies of fish farmers in a specific geographical context.

The study takes into account seasonal variations in fish farming, which is crucial in understanding the specific challenges and adaptive strategies required during different seasons. The study promotes sustainable agriculture practices that can help ensure food security, reduce poverty and protect the environment.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

Uganda is a land-locked country but richly endowed with natural water bodies. Fisheries are important both for subsistence and commercial livelihoods. Of the national fisheries, Lake Victoria is by far the largest and economically most significant. Other important water resources include large lakes such as George, Edward, Albert and Kyoga, the River Nile, and a great variety of swamps and streams. The 68 000 km² of Lake Victoria are shared between Uganda (45 percent), Tanzania (49 percent) and Kenya (6 percent) (FAO, 2022)

Total capture production peaked at 461 500 tonnes in 2014, but decreased the following years to reach 389 600 tonnes in 2017. Production recovered in 2019 to reach some 603 000 tonnes. During the last decade, catches of Nile perch, the most valued species, continued to decrease and, from the peak reached in 2005 (175 000 tonnes), was reported to be less than 74 000 tonnes in 2017. Also, for this important species, 2018 saw a recovery to 80 000 tonnes. In 2019, there were an estimated 43 293 undecked small boats of which 97 percent were less than 12 m total length (FAO, 2022)

Aquaculture in Uganda has gained prominence as a sustainable food production method, addressing food security and economic growth (Mugisha et al., 2018; Nanyeenya et al., 2020). The sector faces challenges such as limited access to quality feed and disease management (Kagiri et al., 2019; Ogutu-Ohwayo, 2016). Government initiatives aim to enhance aquaculture practices (Nsubuga et al., 2021; Ssentongo & Muwanga, 2022), promoting fish farming technologies (Basaalirwa, 2017; Kagawa et al., 2023).

2.1 Challenges facing fish farmers

The push to enhance the aquaculture sector, combined with the diversification of aquaculture production systems, resulted in a surge in demand for fish seed, which could not be met by the existing low-productivity fish fry hatcheries (Mwanja et al. 2015). Local private producers drive the feed business, but their uneven geographic distribution and production activities are insufficient to supply the local aqua- feed demand. As a result, a number of aquaculture farmers had to start producing their own feed in order to keep their businesses afloat (Kasozi et al. 2017, Adeleke et al. 2021). However, the lack of electricity and machinery on most fish farms in rural areas limits the preparation of farm-made feeds, and the use of hand-operated mincers to create feeds limits the size of the fish farming operation. Moreover, poor processing, handling, and storage affect the quality of raw materials, which in turn affect the quality of farm-made feeds (Adeleke et al. 2021). In addition, the limited land availability and competitive demand for land amidst the growing population, the high transaction costs, limited technical support for farmers, poor fish disease management, and the difficulty for farmers to access financial support from lending institutions affect development of Uganda's aquaculture sector (Kasozi et al. 2017, Adeleke et al. 2021).

2.2 Challenges during dry season

Water Availability and Quality; According to Bhatnager, A., and Devi, P. (2013), one of the primary challenges faced by fish farmers during the dry season is the availability and quality of water. In many regions, water sources tend to dry up or become limited during this period, leading to difficulties in maintaining adequate water levels in fish ponds. Additionally, the quality of water can deteriorate due to increased salinity, temperature fluctuations, and pollution, which can negatively

impact fish health and growth. Majority of fish farmers obtain their water from seasonal sources like swamps, rivers, streams while others use borehole water.

Oxygen Depletion: During the dry season, high temperatures and reduced water flow can lead to oxygen depletion in fish ponds. According to Ranjan, R., and Kumar, V. (2022), Oxygen is crucial for the survival and growth of fish, and low oxygen levels can result in stress, reduced feed conversion efficiency, and even mortality among fish populations. Fish farmers need to implement strategies such as aeration systems or regular water exchange to maintain optimal oxygen levels in their ponds.

Disease Outbreaks: Dry seasons are often associated with higher disease prevalence among fish populations. Stressors such as high temperatures, poor water quality, and overcrowding can weaken the immune systems of fish, making them more susceptible to diseases. Fish farmers need to closely monitor their stocks, practice good biosecurity measures, and seek timely veterinary advice to prevent and manage disease outbreaks effectively (Akinwumi, O. J., and Adeyemo, A. A., 2020).

Feed Availability and Cost: The availability and cost of fish feed can be a significant challenge for fish farmers during the dry season. Fluctuations in feed prices, scarcity of feed ingredients, and disruptions in supply chains can impact the profitability of fish farming operations. Farmers may need to explore alternative feed sources or adjust feeding practices to mitigate these challenges (Akinwumi., O. J., and Adeyemo, A. A., 2020).

Pest Infestations: Pests such as predatory birds, snakes, and insects pose a threat to fish farms, particularly when water levels are low during the dry season. These pests can prey on fish stocks, damage infrastructure, and disrupt farming activities. Fish farmers need to implement pest control measures such as netting, scare devices, or physical barriers to protect their ponds.

Infrastructure Maintenance: Maintaining infrastructure such as ponds, pumps, aerators, and water supply systems is crucial for successful fish farming operations. However, the dry season can expose vulnerabilities in infrastructure due to increased usage and environmental stressors. Regular maintenance and repairs are essential to ensure the efficient functioning of farm facilities (Kaur, R., and Singh, S., 2021)

2.3. Challenges during wet seasons.

The challenges facing fish farmers in wet season are predominantly siltation of Ponds, flooding, emigration of fish and among others as discussed below.

Siltation of Ponds; Siltation of ponds is a common issue during the wet season due to increased runoff carrying sediments into the ponds (Akinwumi, O. J., and Adeyemo, A. A., 2020). This can lead to reduced water quality, oxygen depletion, and accumulation of organic matter at the bottom of the pond. Siltation can also affect the feeding habits and health of the fish, ultimately impacting their growth and survival rates. To address siltation, fish farmers can implement proper pond design and construction techniques to minimize sediment inflow. Regular maintenance practices such as dredging and sediment removal can also help mitigate the effects of siltation on pond ecosystems.

Flooding; According to Bhatnager, A., and Devi, P. (2013) flooding poses a significant threat to fish farms during the wet season, as excessive rainfall can cause water levels to rise rapidly and overflow pond banks. This can result in fish escaping from the ponds, loss of stock, damage to infrastructure, and contamination of water with pollutants. To mitigate the impact of flooding, fish farmers can elevate pond banks, install proper drainage systems, and implement emergency response plans to safeguard their fish stocks during extreme weather events.

Emigration of Fish; According to Bhatnager, A., and Devi, P. (2013), during periods of heavy rainfall and flooding, fish may attempt to escape from ponds in search of better habitat or due to changes in water quality. This emigration of fish can lead to reduced stocking densities, loss of valuable species, and disruption of farming operations. To prevent fish emigration, farmers can install effective barriers such as screens or nets around the pond perimeters. Maintaining optimal water quality conditions within the ponds can also help reduce stress levels in fish and discourage them from leaving their designated habitats.

Rapid Growth of Weeds; According to Ranjan, R., and Kumar, V. (2022), the wet season provides favorable conditions for weed growth in and around fish ponds. Weeds can compete with fish for oxygen and nutrients, obstruct water flow, and create breeding grounds for pests and diseases. Controlling weed growth is essential to maintaining a healthy aquatic environment for fish farming. Fish farmers can manage weed growth through manual removal, use of herbicides (with caution to avoid harming fish), introduction of weed-eating species like grass carp, and regular monitoring to detect early signs of weed infestation.

2.3 Adaptive strategies being used by farmers.

Closed Containment systems provide a barrier between the farmed fish and Native species. This minimizes the impact on the environment by providing safer water, avoiding escaped fish, processing waste without simply polluting the shores, and keeping predators away from the area (Sharrer, M. J., & Summerfelt, S. T., 2019). Because the water is cleaned there is less need for antibiotics, or other substances that can find their way into the food. These still have an environmental impact from the large biomass (Tacon, A. G. J., & Metian, M., 2017)

Other projects, such as the Velella Project in Hawaii, provide an unanchored drifter pen that rides eddies in Open Ocean 3-75 miles off the Big Island of Hawaii (NOAA, 2016). The pen is submersible over the surface of the ocean, away from reefs and corals. The fish were stocked with fingerlings of a Native species. The fish were fed with a sustainable diet of fishmeal and oil and soy, no antibiotics, hormones or pesticides. There was minimal impact on the marine environment, while they raised the sashimi-grade kampachi (tropical yellowtail). The fish farm is raised in the ocean, freely floating, with minimal impact on the local environment.

Other aquaculture systems become sustainable when multiple species are raised in close proximity, which mimics the food pyramid. This is called “integrated multi-tropic aquaculture.” In these systems the sustainability and environmental damage is decreased because they mimic nature’s cycle (Chang et al., 2019). Fish are fed but below them are feeders like lobsters, sea cucumbers, and urchins that obtain the excess fish food. Mussels and other shellfish are downstream from the fish to provide filtering and recycle the organic nutrients (Ahmed et al., 2019). Seaweed downstream from that absorbs and captures the inorganic waste and produce oxygen.

CHAPTER THREE: MATERIALS AND METHODS

3.0 Description of study area

The study was conducted in Nagongera Sub- County, Tororo district. The district is bordered by Mbale district in the north, Manafwa district in the Northeast, Kenya in the east, Busia district in the South, Bugiri in the Southwest, and Butaleja in the Northwest. The largest town in the District and the location of the District Headquarters is approximately 230 kilometers East of Kampala, the largest city of Uganda. The District covers a land area of 1196.4 km² and a population of 487900 (NPHC, 2014).

MAP OF UGANDA SHOWING THE LOCATION OF TORORO DISTRICT

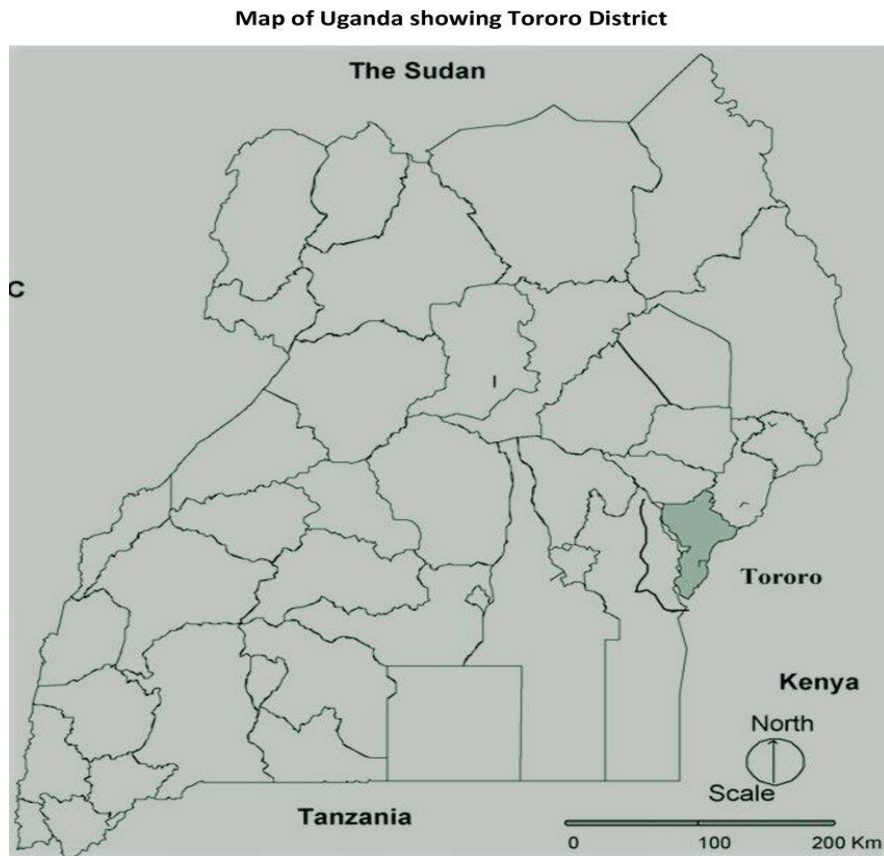


Figure 1 Map of Uganda showing Tororo District.

MAP OF TORORO DISTRICT SHOWING THE LOCATION OF NAGONGERA SUB-COUNTY



Figure 2 Map of Tororo District Showing location of Nagongera Sub county.

3.1 Social economic activities

The majority of the people of Nagongera sub- county access their livelihood from sand mining, rearing livestock, aquaculture, apiculture, agriculture produce like maize, cassava, beans sorghum etc. some people also engage in either large scale or small-scale retail businesses.

3.2. Overview

The instruments used in data collection were informants interview guides and observation methods. Structured interview guide was prepared and submitted to the department of biology, Busitema university to check its validity and content, and was issued to farmers through face to face.

3. 3. Research Design

Paulin, (2007) defines a research design as a plan of data collection and what data to gather, from whom, how and when to collect data, and how to analyze the data obtained. This study adopted a cross-sectional research design because it aimed to measure the prevalence of different challenges within the fish farmers. The study dependently relied on qualitative approaches to get views and perceptions of respondents about the study research questions.

3.4. Sampling techniques

Gay (1996) defines sampling as the process of selecting a number of individuals (a sample) from a population, preferably in such a way that the individuals selected represent the larger group from which they were selected. The researcher employed simple random sampling technique to obtain the study sample.

3.4. 2 Simple random sampling technique.

According to Gay (1996) simple random sampling is the process of selecting a sample in such a way that all individuals in the defined population have an equal and independent chance of being selected for the sample. This was used to select respondents from the four different parishes of the study area including Namwaya, Katajula, Maunda and Nagongera. Furthermore, samples were gotten from the seventy-one villages of the Sub-County.

3. 5. Data collection

3 .5. 1. Data collection instruments

The data collection instruments consisted of structured interview guides and observation techniques.

3. 5.1. 1 Interview guides

An interview guide was administered to all selected fish farmers. The interview guide was used because it allowed to get deeper views and perceptions of respondents about the study elements better because of a social preference as respondents who are illiterate were willing to talk therefore their total participation in the research.

3.5.1.2 Observation

Observations on visual aspects was taken by the interviewer for example the location of the fish ponds, sex of the respondent, vegetation around the ponds, open inlets and outlets and many others. This method was used in order to reinforce and crosscheck the accuracy of data collected using the interview guide. This is because information from observations emerged from what was actually happening rather than from pre-conceived notions. First-hand information was got concerning the area of study.

3.5 Ethical considerations

The researcher obtained the informed consent from the participants before data was collected.

Confidentiality and anonymity of respondent's information was assured Paramount during and after interaction with different fish farmers.

3.6 Data analysis

The data collected was analyzed through a Comparative analysis technique, which involved comparing and contrasting different cases or contexts within the qualitative data. It also helped in understanding how challenges vary across different seasons and contexts (Merriam, S. B., 2009).

CHARPTEER FOUR:

PRESENTATION OF DATA RESULTS AND ANALYSIS

4.0 introduction

This chapter presents, discusses, and analyzes the findings about the Respondent's personal data, and findings were presented in statistical tables and figures in chronology with study objectives

4.1 Demographic Characteristics of Respondents

Table 1 below shows the Gender of different respondents

Gender	Frequency	Percentage frequency
Male	8	72.7
Female	3	27.3
Total	11	100

Table 1 Gender of different respondents.

The findings represented on table 4.1.1 revealed that the majority of the respondents who took part in the study from the different parishes in Nagongera sub-county, Tororo district were male with a percentage 72.7 then, the percentage of female respondents was 27.3. This is because females are engaged in other domestic work like poultry, farming of plants and other activities which are not labour intensive.

4.2 Age structure of the respondents

Table 2 below shows the age structure of the respondents

Age group	Frequency	Percentage frequency
<19	0	0
20- 39	2	18.1
40-59	4	36.2
60+	5	45.7
Total	11	100

Table 2 Age of different respondents interviewed.

The results shown in table 4.1.2 indicated that 0% of the respondents were below 20years, 18.1% were between 20-39 years, 36.2% were between 40-59years and 45.7% were above 60 year.

4.3 Level of education of the respondents

Table 3 below shows the education level of the respondents

Education level	Frequency	Percentage frequency
Primary	7	63.6
Secondary	3	27.3
High school	1	9.1
Tertiary	0	0
Total	11	100.0

Table 3 Education Level of the respondents interviewed.

The educational level was categorized into primary, secondary, high school and tertiary respectively which had the percentages of 63.6, 27.3, 9.1 and 0% respectively indicating that primary took the biggest percentage followed by secondary, high school and tertiary had a percentage of 9.1 and 0 respectively showing that majority of the respondents did not even proceed to secondary level.

4.5 Extent of seasonal challenges.

According to the information got from different farmers, drier seasons are characterized by various challenges to fish farming including but not limited to the following;

4.5.1 Kupii birds.

Kupii is a Japadhola word referring to the fish eating birds. During hotter days, water level reduces which make flaying birds, Kupii easily recognize moving fish in water, they pick using their long beaks and feed on such fish. These birds can pick all sizes of tilapia ranging from fingerlings to big fish of 1 kilograms. The challenge due to these predatory birds was reported by all the fish farmers sampled.

4.5.2 Fish feeds;

All the sampled population of eleven fish farmers do not use artificial sources of feeds for their fish, but rather depend on suspended feeds which flow in as water enters their fish ponds. During such seasons, as water ceases to flow in and out of fish ponds, water turns to reddish, according to a one Okecho zekiel, a fish farmer in Pokongo bendo, with a 10 year experience in fish farming. There is death of fish in such situations and he attached resulting deaths to little feeds in water.



Figure 3 Seasonal source of water and natural fish feeds to Mr. Matuka William's fish ponds, Maundo West village on 20th, may 2024

4.5.3 People theft:

During drier seasons, vegetation dry out including green leafy vegetables, this forces the local people to look for alternative sources thereby encroaching on their neighbor's fish ponds. For example in 2021, Mr. Okecho, fed his ponds with 500 fingerlings and on harvest only 410 fish were collected. Not only Mr. Okecho, 7 other fish farmers reported theft of fish on their farms.

Table 4 below shows some of the challenges facing fish farmers during drier seasons

Challenge	Frequency	Percentage frequency
Kupii birds	11	100
Fish feeds	11	100
Theft by people	8	72.3

Table 4 challenges facing fish farmers during drier periods.

It was realized in the field that some challenges are felt throughout the year that is they span across both rainy and drier seasons.

4.5.4 Poor quality fingerlings;

All the eleven fish farmers of Nagongera depend on inherited fish species, which have stayed long in production. The fish take long to mature and the matured big fish can only go up to 1.2kg that is according to Mr. Matuka William of Maundo west village, a farmer with 50 year experience in fish farming.

During rainy season

4.5.5 Flooding of fish ponds;

During the months of March, April and May, there is always a lot of rain in the areas of Nagongera, and because fish farming in Nagongera is valley-based, these areas collect a lot of running water which ends up taking fish away along it, introduce unwanted species and potentially damage the fish pond structures. Flooding was a serious challenge facing 9 fish farmers of Nagongera sub-county.

4.5.6 Fish migrations:

Nine fish farmers reported the challenge of fish migrations. This is the movement of fish between different habitats often driven by factors like heavy rainfall. When fish

attempt to escape the ponds, it leads to loss of fish stock and also lead to complexity to the pond management and feeding regimes.

4.5.7 Rapid growth of weeds:

Refers to the uncontrolled proliferation of aquatic plants for example the submerged vegetation/ floating plants within the fish ponds. Weeds compete with the cultured fish for nutrition and oxygen during their respiration leading to reduced growth and productivity. Dense weed growth provide a habitat for unwanted organisms such as fish predator which threaten the framed fish.

Rapid Growth of weeds was a challenge to 8 fish farmers.



Figure 4 Source: Field image of one of Mr. Matuka William fish ponds, Maundo West village on 20th, may 2024

Table 5 bellow shows some of the challenges facing fish farmers during rainy seasons.

Challenge	Frequency	Percentage frequency
Flooding of ponds	9	81.8
Migration of fish	9	81.8
Rapid growth of weeds	8	72.3

Table 5 Challenges facing farmers during rainy seasons

4.6 Impacts of different seasonal farm based challenges of Nagongera fish farmers.

4.6.1 Fish Theft:

The eigh Fish farmers who recorded theft of their fish said; fish theft has a significant negative impact on the productivity of fish farming operations. When fish are stolen from a farm, it directly reduces the farmer’s potential revenue and profit. This loss of income can hinder the ability of the farmer to reinvest in their operation, purchase necessary supplies, or expand their business. Additionally, the stress and financial burden caused by fish theft may lead to decreased motivation and morale among fish farmers, which can further impact productivity.

4.6.2 Poor quality Fish Feed:

The quality of fish feeds plays a crucial role in determining the productivity of a fish farming operation. Poor-quality feeds may lack essential nutrients required for optimal growth and development of the fish. Inadequate nutrition can result in stunted growth, increased susceptibility to diseases, and higher mortality rates among the fish population.

Moreover, poor-quality feeds may not be efficiently utilized by the fish, leading to wastage and inefficiencies in feed conversion ratios. This inefficiency not only

increases production costs for the farmer but also hinders the growth potential of the fish stock.

4.6.3 Predatory Birds:

Predator birds pose a threat to fish farming productivity by preying on farmed fish stocks. Birds such as cormorants, herons, and kingfishers are known to target ponds or aquaculture facilities for easy access to prey. The presence of predator birds can result in significant losses for fish farmers through reduced stock numbers and potential damage to infrastructure.

4.6.4 Flooding of Fish Ponds:

Flooding of fish ponds can have detrimental effects on fish farming productivity. Excessive flooding can disrupt the ecological balance within the pond, leading to oxygen depletion, increased stress on the fish, and potential disease outbreaks. It can also result in loss of fish stock due to escape or suffocation. Additionally, flooding can damage infrastructure such as pond walls and equipment, further impacting productivity.

4.6.5 Poor quality fingerling:

If the fingerlings are of poor quality, they may have stunted growth, higher susceptibility to diseases, and lower survival rates. This has led to decreased overall productivity in the fish farming operation as the growth and health of the fish are compromised.

4.6.6 Fish Migration:

Fish migration can impact fish farming productivity in various ways. If native fish species migrate out of the farm ponds, it can lead to a decrease in stocking density and potential imbalances in the ecosystem. On the other hand, invasive species migrating into the ponds can outcompete native species for resources and disrupt the

natural equilibrium. Managing fish migration through proper barriers or monitoring is essential to maintain productivity in fish farming operations.



Figure 5 Source: Field image of one of Mr. Okecho Zekiel fish ponds, Pokongo Bendo village on 20th, may 2024

4.6.7 Rapid Growth of Weeds:

The rapid growth of weeds in fish ponds can negatively affect productivity in several ways. Weeds compete with fish for oxygen, nutrients, and space, which can hinder the growth and development of the fish. Dense weed growth can also impede water circulation and reduce dissolved oxygen levels, leading to poor water quality conditions that are unfavorable for fish health. Controlling weed growth through manual removal or use of herbicides is crucial to maintaining optimal conditions for productive fish farming.

4.7 Adaptive strategies

4.7.1. Predatory Birds:

To deter predatory birds from targeting fish, farmers have implemented various bird control measures such as installing bird netting (one farmer) or using scare tactics like visual deterrents (6 farmers). Most of the farmers in Nagongera are using

poisoned rice grains, which fish feeders, where predator birds attempt to feed on rice, and die off in the process.

Image showing a visual deterrents of predatory birds (radio tape wires wound around a fish pond)



Figure 6 Source: Field image of one of Mr. Okecho Ezekiel's fish ponds, Pokongo Bendo village on 20th, may 2024

4.7.2. Poor Quality Fish Feeds:

To address this issue of poor fish feeds, four farmers are trying to source high-quality feeds that meet the nutritional requirements of their specific species of fish. Investing in proper feed management practices and working with reputable suppliers can help optimize feed utilization efficiency and ultimately enhance productivity in fish farming operations. Farmers of Nagongera are adding chicken droppings, half cooked maize bread while others put half cooked animal blood.

4.7.3. Theft:

In terms of security measures to mitigate fish theft, farmers have invested in infrastructure such as fencing (1 Farmer) or employing security personnel (1 farmer). These additional costs can strain the financial resources of fish farmers and divert

funds away from other aspects of their operation that could enhance productivity. Farmers have gone an extra mile of warning the locals about fish theft (all farmers), where by farmers have involved police personnel.

4.7.4. Poor Quality Fingerlings:

Farmers of Nagongera are engaging in selective breeding programs to produce high-quality fingerlings that are more resilient to diseases and environmental stressors (3 farmers). Some farmers are trying to implement strict quarantine procedures for incoming fingerlings to prevent the introduction of diseased fish into the farm (2 farmers). The district fisheries department is also providing training to farmers on proper handling and care of fingerlings to ensure their optimal growth and development.

4.7.4 Flooding of Fish Ponds:

Farmers have tried elevating Pond Banks, this is an effective strategy to address flooding (3 farmers). By raising the pond banks above the expected flood levels, farmers can prevent water from overflowing into the ponds during periods of heavy rainfall or flooding. Proper drainage systems are helping in managing excess water during floods by channeling that divert excess water away from the fish ponds preventing inundation and minimize damage to the aquatic ecosystem.

Image showing a fish pond with elevated banks to accommodate flooded waters



Figure 7 Source: Field image of one of Mr. Owor Francis fish ponds, Pokongo kwoyo village on 20th, may 2024

4.7. 5 Migration of Fish:

To prevent fish migration, farmers are using barrier nets within their ponds. These nets act as physical barriers that restrict the movement of fish between different sections of the pond, or out of ponds through outlets hence minimizing unintended migration. This method has been employed by Mr.Omollo Francis on all his fish ponds, of Kadewere -village, Namwaya parish.

4.7.6 Rapid Growth of Weeds:

Manual removal or cutting of weeds within the ponds is being carried out to help control their growth. Using tools such as rakes or weed cutters, farmers are physically eliminating weeds and preventing them from overcrowding the aquatic environment. All the farmers remove weeds from their farms manually.

Image showing a cleared fish pond (weeds manually picked)



Figure 8 Source: Field image of one of Mr.Omollo Francis fish ponds, Kadewere -village,

CHAPTER 5

DISCUSSION OF RESULTS.

5.1 Effectiveness of different strategies to overcome seasonal farm based challenges.

The results shows that Visual deterrents being cost-effective and easy to implement, their effectiveness vary depending on the species of birds present and their adaptability to new stimuli. Over time, birds may habituate to certain visual deterrents, reducing their efficacy. Therefore, it is essential to rotate or combine different types of visual deterrents to maintain their effectiveness in deterring predatory birds. Reflective tape wires has been highly employed among farmers of Nagongera. This is inline with the study conducted by Cummings et al., (2019) which demonstrated that reflective tape reduced the presence of predatory birds of a certain species by over 50 percent in agriculture fields.

The most effective strategy to combat the effects of poor quality fish feeds is to source high-quality feeds from reputable suppliers. High-quality fish feeds are formulated using the right balance of essential nutrients such as proteins, fats, carbohydrates, vitamins, and minerals that are necessary for the optimal growth and health of the fish. This is inline with Gatlin et Al., (2007) which demonstrated that high quality feeds help prevent diseases by boosting the immune systems of the fish.

Hiring security personnel is another effective strategy that help enhance security on a fish farm. These personnel are responsible for monitoring activities on the farm and ensuring that unauthorized individuals are kept at bay. However this is not in correlation with Aquaculture Research Institute, (2022) which stated that over reliance on human security can lead to complacency if personnel are not adequately trained or motivated, their presence may not significantly reduce risks

Poor quality fingerlings lead to various negative effects such as stunted growth, increased mortality rates, susceptibility to diseases, and overall poor performance of the fish stock. To combat these effects, the main strategy employed is providing training to farmers on how to handle and care for fingerlings. The findings of this research are in-line with FAO, (2020), which asserted that well bred fingerlings with superior genetic traits tend to grow faster and exhibit higher survival rates compared to those of inferior quality.

5.2 Impacts of different farm-based challenges

Farmers face multitudes of challenges which impact their productivity. One of them is predatory birds that pose a direct threat to fish population by preying on juveniles and adults leading to substantial losses. The findings are in-line with that of Hoffman et al., (2020).

Furthermore, low quality fish feeds and fingerlings hinder growth rate and overall health of fish stock, resulting in lower yields, due to stunted growths, and susceptibility to diseases. The findings also conform to the study of Meyer et al., (2021) and Tacon & Metian., (2013).

Theft is also a pressing concern for fish farmers of Nagongera as it not only results in financial losses but also creates an atmosphere of insecurity that deters further investment in aquaculture. This is also cemented by the study of Bennet et al., (2019)

CHAPTER 6:

CONCLUSION AND RECOMMENDATIONS.

6.1 Conclusion

The finding of the study revealed chief challenges faced are; predatory birds (reported by all fish farmers), scarcity of fish feeds (all fish farmers), Poor quality fingerlings (all fish farmers), migration of fish (9 fish farmers) , Flooding of ponds (9 fish farmers), Fish theft (8 fish farmers) and Rapid growth of weeds (8 fish farmers).

Most farmers in the study are dependent largely on local technologies and natural sources of feeds for their fish, natural sources of water. Most challenging season recorded was dry season.

The fish farmers are trying to deal with the challenges they face on their own with no guidance from special groups of trained personnel and on rare occasions do government officials have involved in imparting knowledge to fish farmers, then other fish farmers are too busy to the extent that they do not turn-up when called upon.

6.2 RECOMMENDATIONS.

Basing on the findings of the study, I recommended the following;

1. Government should
 - Intensify training services to farmers.
 - Credit fish farmers to maximize their operation services
2. Famers should form joint associations to raise finance to purchase modern equipment, dig their dams to store water channeled to fish ponds during hot days.

3. Further research should be carried out on farmer's perceptions on adoption of new technologies in pond fish farming.

REFERENCES

Adeleke B; Robertson-Andersson D; Moodley G; Taylor S 2021. Aquaculture in Africa: A comparative review of Egypt, Nigeria, and Uganda vis-a-vis South Africa. *Rev. Fish. Sci. Aquac.* 29(2): 167-197. Budget Monitoring and Accountability Unit (BMAU). 2018. Briefing paper (14/18): The Rate of Rural Electrification: Will the National Development Plan targets be realised?

Boko, M., Niang, I., Nyong, A., et al. (2007). Africa Climate Change 2007: Impacts, Adaptation, and Vulnerability. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, & C. E. Hanson (Eds.), *Contribution of Working Group II to the fourth assessment report of the intergovernmental panel on climate change* (pp. 433–467). Cambridge: Cambridge University Press.

Coulibaly, A., Ouattara, A., Koné, T., et al. (2007). First results of floating cage culture of the African cat-fish *Heterobranchus longifilis* Valenciennes, 1840: Effect of stocking density on survival and growth rates. *Aquaculture*, 263, 61–67.

FAO (2002). *The State of World Fisheries 2002*. FAO, (Ed.) 148pp FAO.

FAO (2003). *The role of aquaculture in improving food and nutrition: Committee on World Food Security*. 12-16 May 2003, Rome, Italy.

FAO (2004). *Aquaculture extension in sub-Saharan Africa*. FAO Fisheries Circular. No. 1002. Rome, FAO. 55p.

(govdocs.aquaculture.org/cgi/reprint/2005/115/1150200.pdf – accessed 25/07/07).

FAO (2011). Handbook of Fishery Statistical Standards. Section J: AQUACULTURE. CWP Data Collection. In: FAO Fisheries and Aquaculture Department [online]. <http://www.fao.org/fishery/cwp/handbook/J/en>

FAO. 2020. The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome. <https://doi.org/10.4060/ca9229en>.

Kasozi N; Rutaisire J; Nandi S; Sundaray JK 2017. A review of Uganda and India's freshwater aquaculture: Key practices and experience from each country. J. Ecol. Nat. Environ. 9(2): 15-29.

Mbowe S; Odokonyero T; Munyaho AT 2017. Harnessing floating cage technology to increase fish production in Uganda, Research Series No. 138.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). 2011. Department of Fisheries Resources Annual Report 2010/2011. Republic of Uganda. 13–14.

Munialo M (2011). Fish Pond Management, Fisheries workshop presentation, Kisumu, Kenya.

Musinguzi L; Lugya J; Rwezawula P; Kanya A; Nuwahereza C; Halafu J; Kamondo S; Njaya F; Aura C; Shoko AP;

Mwangi HM (2008). Aquaculture in Kenya, Status Challenges and Opportunities, Directorate of Aquaculture, Nairobi, Kenya. Ngugi CC, Bowman JR and Omolo BO (2007). A New Guide to Fish Farming in Kenya, Aquaculture CRSP, Nairobi,

Kenya.

Mwanja M; Rutaisire J; Ondhoro C; Ddungu R; Aruho C 2015. Current fish hatchery practices in Uganda: the potential for future investment. *Int J Fish Aquatic Studies*. . 2(4):224–232.

OCED (2010). Barriers to fish farming Development as a Pathway to Poverty Alleviation and Food Security: OECD Workshop, Paris, 12-16 April 2010, France. Malcolm Beveridge, Michael Phillips, Patrick Dugan and Randy Brummett.

Osinde R 2019. The extent of cage aquaculture, adherence to best practices and reflections for sustainable aquaculture on African inland waters. *J. Great Lakes Res.* 45(6):1340-1347.

Osure G (2011). Introduction to Aquaculture. The Sphere Project (2004). Humanitarian Charter and Minimum response in Disaster Response. The Sphere Project, Geneva, Switzerland.

Rutaisire J. 2007. Analysis of feeds and fertilizers for sustainable aquaculture development in Uganda. FAO

Shitote Z., Wakhungu J., China S. (2013). Challenges Facing Fish Farming Development in Western Kenya. *Greener Journal of Agricultural Sciences*, 3(5): 305-311, <http://doi.org/10.15580/GJAS.2013.5.012213403>.

Appendix 1

Interview guide

Interview guide (for key informants)

Dear participant,

I am NGOLOBE SILAS K, a student of Busitema University from the department of Biology.

This interview guide is part of the wider study to document seasonal farm-based challenges facing fish farmers and adaptive strategies in Nagongera sub-county, Tororo District.

Guidelines

Circle where applicable

Provide more detailed information where appropriate.

Information provided herein will be treated as confidential for academic purposes only.

General information of respondents.

Participant's name:.....

Date:.....

Address:.....

Sign:.....

1. Sex of the respondent

A. Male.

B. Female

2. Age of respondent.

- A. Less than 20 yrs. C. 40-59
B. 20-39. D.60+

3. Number of fish ponds.

- A. Less than 3. C.6-9
B. 3-5. D. 10+.

Key questions

1. Do you practice monoculture (farming a single species) or polyculture (farming multiple species) in your ponds?
2. Which seasons or months of the year do you consider to be the most challenging for fish farming in your area? Please specify.
3. How do these challenges affect the overall productivity and profitability of your fish farming operation?
4. Have you implemented any strategies or management practices to mitigate the impact of seasonal challenges? If yes, please describe them.
5. Are there any specific challenges that you face during the transition between seasons? If yes, please describe them.
6. How do you manage water quality and quantity in your fish ponds during different seasons?

7. How do you deal with excessive rainfall or flooding in and around your fish ponds during the rainy season?
8. Do you face any challenges related to fish feed availability and quality during certain seasons? If yes, please explain.
9. How do seasonal variations impact fish feeding patterns and growth rates?
10. Have you made any adjustments to the feeding practices based on seasonal changes? If yes, please describe them.

Thank you for participating