

Assessing the Impact of Aquaculture production on the Livelihood Asset for promoting food security and sustainable livelihoods: Case Study of Tongogara Smallholder Farmers, Shurugwi, Zimbabwe.



A research project submitted to Van Hall Larenstein University of Applied Sciences in partial fulfilment of the requirements for the degree of Master in Management of Development, specialisation: Rural Development and Food Security

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Dedication

This work is dedicated to my husband Sylvester Mhangwa, my sons Jayden and Ethan Mhangwa without whose caring support it would have not been possible and my loving mother Fungai Manyida who passed on a love of reading and respect for education.

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List of Abbreviations

A1	Smallholder farming system composed of farmers with 6 hectares of land or less
CBD	Central Business District
DCLPD	Department of Crop and Livestock Production and Development
DFID	Department for International Development
FAO	Food and Agriculture Organisation
FTLRP	Fast Track Land Reform Programme
GDP	Gross Domestic Product
NGOs	Non- Governmental Organisations
SLF	Sustainable Livelihood Framework
WFP	World Food Programme

Definition of Terms

1. Aquaculture Production – is the farming of aquatic organisms in both coastal and inland areas involving interventions in the rearing process to enhance production (Greene et al. 2003).
2. Livelihood Asset- comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (Cook, 2017).
3. Vulnerability context - refers to the seasonality, trends and shocks that affect people’s livelihoods. A main characteristic of these dimensions is that they cannot be controlled by local people themselves in the short and medium term (DFID, 2000).

Abstract

Aquaculture production has been considered as an approach for economic transformation and poverty alleviation. It focuses on alleviating the significant challenges faced by smallholder farmers, traders, processors and other related actors in the agricultural value chains. In Zimbabwe, aquaculture production was mainly spearheaded by non-governmental organisations (NGOs), as an economic mechanism for generating employment and increasing food security in vulnerable communities. Aquaculture production has fast gained momentum among other rural livelihoods such as agriculture because of its untapped potential to generate employment and improve food security as it provides highly nutritious animal protein and important micronutrients among vulnerable households (FAO 2012). Shurugwi District lies in natural region III, which is characterized by an annual low rainfall of 450mm – 600mm, high temperatures and poor soils (Chenje, 2011). Due to climate change the district has been experiencing recurrent droughts, erratic rainfall and persistence of pests and diseases (WFP, 2016). Tongogara smallholder farmers are located 80 km out of Shurugwi CBD, and the area is mainly characterised by high prevalence of crop failure and rely more on livestock production due to their geographical location that is mainly entailed by grasslands. The Ministry of Agriculture in collaboration with different stakeholders (European Union, Aquaculture Zimbabwe and Department of Crop and Livestock Production (DCLPD)), spearheaded and funded 'Command Livestock and Fisheries' programme, whereby all state dams were stocked with fish fingerlings to benefit all the farmers in the district (European Union Factsheets, 2015).

Access and control of all the livelihood assets enabled Tongogara smallholder farmers to increase more from what they had. Through a strong base of the livelihood asset, there was increased fish production for home consumption and increased income for the household. It is clear from the research findings that outcomes from aquaculture production improve most livelihoods of those engaged in it. Outcomes of aquaculture production are either through an improved livelihood through employment and increased income. From this research, it is evident that Tongogara smallholder farmers benefitted from tangible and intangible outcomes of not only aquaculture production but also from upscaled agricultural activities. Theft and predation of fish in ponds has been a challenge and farmers could put up security structures such as fences to control and secure their ponds.

Integration of aquaculture production with other agricultural activities such as horticulture production, poultry production, rabbit production and beekeeping benefitted farmers as this reduced production costs of farmer in setting up a new enterprise. This has enabled farmers to maximise the optimal utilization of available resources to their benefit on a cost effective basis. It is evident that gender equality in livelihood asset control, access and ownership are prerequisites to agricultural modernization. The research pointed out on the active participation of both men and women in aquaculture production. It can be concluded that men in Tongogara still had control on decisions concerning land, livestock (large stock) and income.

As such some of the recommendations are: 1. The Ministry of Agriculture should institute policies that educate farmers in fingerling production to solve the problem of limited fingerlings, educating the farmers on fingerling breeding programs and to encourage the associations to invest in infrastructure for hatcheries instead of relying on donor funds and government projects.

2. Farmers should be taught how to produce their high-quality fish feed from locally available raw materials such as soya bean and cotton seeds.

Chapter One: Introduction

1. Background Information

Zimbabwe like any other Southern African countries, has experienced episodes of El-Nino induced drought which is characterised by high temperatures, poor and erratic rainfall (Muchara, 2010). This phenomenon has in recent times been wreaking havoc on the country's agriculture sector. The forecasted conditions are usually associated with agricultural risks which include limited water availability, poor grazing and heat stress that could affect both crops and livestock (Muchara, 2010). In Zimbabwe, the agriculture sector forms an integral part of the economy, however, in particular given that most is rainfed. In 2017, agriculture contributed 10.46% to the economy (GDP), employing up to 70% of the population and contributing roughly to 60% of raw materials to industry (Mafu, 2017). Poverty has increased and has been the major cause of food nutrition insecurity and vulnerability (Cook, 2017). Zimbabwe's economy has struggled over the last decade as a result of poor agricultural policies and economic management to cope with the combined effects of the Fast Track Land Reform Programme (FTLRP), hyperinflation, capital constraints and government controls on markets (Ward et al, 2012). Nevertheless, the potential of agriculture sector contributes to the economic development and improves the lives of the vulnerable is undeniable. Sanginga (2009), highlights that poor soils and unreliable rainfall are the major constraints to food production and sustainability of smallholder agriculture in Zimbabwe. One of the key areas is that Zimbabwe holds an estimated 60% of all dammed water in Southern Africa and is home to the largest freshwater fish farm in Africa (Chazovachii, 2013), however, last 8years government have been making concrete efforts to developing and setting projects to stimulate production. Aquaculture production has become one of the key priorities in the agriculture sector.

Mwaijande & Lugendo (2015) describe aquaculture production as an approach for economic transformation and poverty alleviation. It focuses on alleviating the significant challenges faced by smallholder farmers, traders, processors and other related actors in the agricultural value chains. In Zimbabwe, aquaculture production is mainly spearheaded by non-governmental organisations (NGOs), as an economic mechanism for generating employment and increasing food security in vulnerable communities. Aquaculture production is fast gaining momentum among other rural livelihoods such as agriculture because of its untapped potential to generate employment and improve food security as it provides highly nutritious animal protein and important micronutrients among vulnerable households (FAO 2012). Resilience is the ability of communities to withstand shocks and uncertain impacts of changes (Adger, 2000). Aquaculture production helps to build community resilience to impacts of climate related shocks that often result in food insecurity (Devendra, 2012).

Shurugwi District lies in agro-ecological region III, which is characterized by an annual low rainfall of 450mm – 600mm, high temperatures and poor soils (Chenje, 2011). Due to climate change the district has been experiencing recurrent droughts, erratic rainfall and persistence of pests and diseases (WFP, 2016). Tongogara smallholder farmers are located 80 km out of Shurugwi CBD, and the area is mainly characterised by high prevalence of crop failure and rely more on livestock production due to their geographical location that is mainly entailed by grasslands. These smallholder farmers are vulnerable to climate change and they are food insecure as they have been affected with a lot of challenges such as low crop yields, low income and lack of governmental input support. In terms of grain production their food supply does not last them for more than 3 months instead they rely on selling their beef cattle, goats and poultry in order to purchase grain and other food items during the dry season (WFP,

2016). Nevertheless, challenges make farmers more vulnerable, depleting their livelihood asset base as they sell their livestock in the dry season when market prices are low, hence there was a need to have an integration project that could run parallel with other agricultural activities so as to reduce their vulnerability. The Ministry of Agriculture in collaboration with different stakeholders (European Union, Aquaculture Zimbabwe and Department of Crop and Livestock Production (DCLPD), spearheaded and funded 'Command Livestock and Fisheries' programme, whereby all state dams were stocked with fish fingerlings to benefit all the farmers in the district (European Union Factsheets, 2015). For effective benefit and impact of Command Fisheries on farmers' livelihoods, farmers fish cooperatives were formed to manage and protect the fingerlings stocked in the state dams. Due to predation, theft and illegal harvest of the stocked fish the project became unsustainable for an effective impact on farmers' livelihoods (WFP, 2016). An improved intervention of construction of 20m X10m fish ponds on their homesteads was employed with the help of relevant stakeholders for effective management and feeding of fingerlings to run parallel with other agricultural activities.

1.2 Problem Statement

Climate change and poor economic changes had adverse effects on Tongogara smallholder farmers' livelihood. There is widespread crop failure due to drought, effects of erratic rainfall and food insecurity. Farmers were forced to sell their livestock during the dry season at very low prices as a coping strategy thereby depleting their livelihood asset base. Government and local NGOs recognised the vulnerability of smallholder farmers in the area and had to intervene with aquaculture production to run parallel with other agricultural activities for the past four years. It was not known whether integration of aquaculture production has had any impact on the livelihood asset base so that smallholder farmers become more resilient, maintaining the long term productivity of the natural resources.

1.3 Research Objective

The main aim of the research was to:

Assess the impact of aquaculture production on the livelihood asset base in achieving food security, resilience and not to depend on external support of Tongogara smallholder farmers in order to provide recommendations to the Ministry of Agriculture, Aquaculture Zimbabwe for upscaling of aquaculture production in similar drought risk areas.

1.4 Research Questions

How has integration of aquaculture production impacted on the livelihood asset base in achieving food security of Tongogara smallholder farmers?

Sub questions

- a. Which livelihood assets were influenced by aquaculture production on farmers' livelihood in achieving food security?
- b. How does the vulnerability context affect the sustainability of the aquaculture production for farmers to become more resilient?
- c. How has the livelihood asset base upscaled other agricultural activities in maintaining long term productivity of aquaculture production?
- d. How does control over assets effect the sustainability of aquaculture production system

Chapter Two: Literature Review

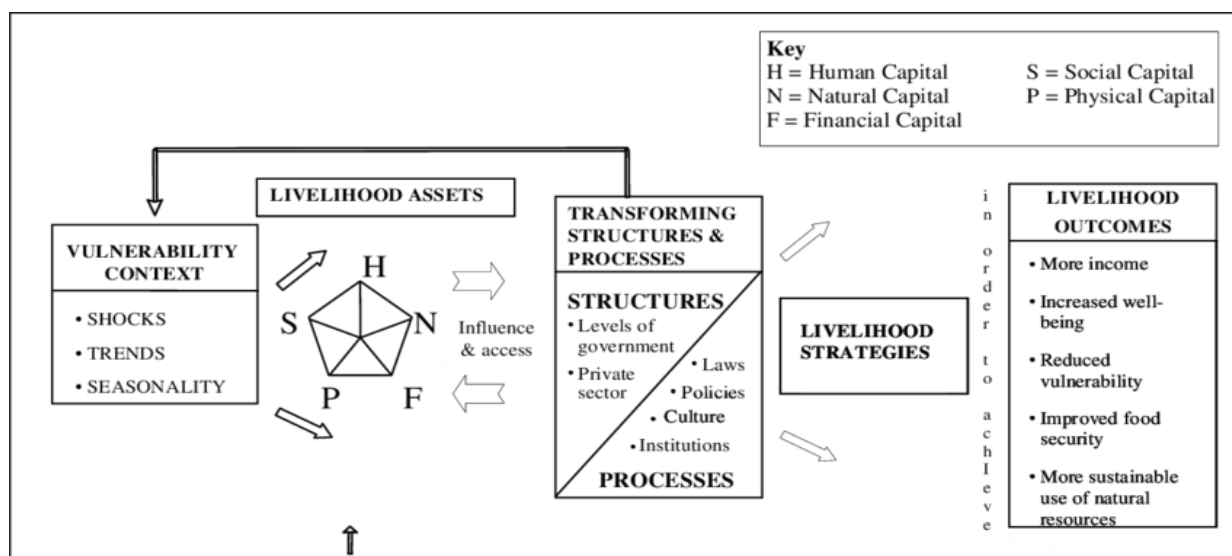
2. Introduction

This chapter gives an account of the main theoretical foundations on which this thesis is built. The Sustainable Livelihoods Framework (SLF) offers a comprehensive framework for understanding the complex multi-dimensionality of poverty. It is used in this thesis to help identify the impacts of aquaculture production on livelihood asset for smallholder farmers. My analysis focuses on the Vulnerability context and five distinguished assets found in the SLF pentagon and each deserves a concise description because the presence or lack of assets determines the level of vulnerability in the livelihoods perspective.

2.1 Sustainable Livelihood Framework

The analysis and presentation of this work is based upon the core principles of Sustainable Livelihood Framework (SLF). SLF is neither a bottom-up nor a top-down but stresses that all levels should be holistic. A livelihood is sustainable when it can cope from stresses and shocks maintain or enhance its capabilities and assets, while not undermining the natural source base (Chambers & Conway et al, 2001). Sustainable poverty reduction can only be achieved only if external support works with people in a way that is congruent with their current livelihood strategies, social environments and ability to adopt (Helmor & Singh, 2001).

Figure 1: The Sustainable Livelihood Framework



Source: (DFID and FAO, 2000).

2.1.1 Vulnerability Context

The vulnerability context refers to the seasonality, trends and shocks that affect people's livelihoods. A main characteristic of these dimensions is that they cannot be controlled by local people themselves in the short and medium term (DFID, 2000). Trends comprise of factors that may be susceptible to change and those that most likely will follow their current trajectory. Vulnerability is a function of how a household's livelihood would be affected by a certain hazard and how it is able to cope with its impact (DFID, 1999). When households are exposed to shocks and stress and has difficulties with coping, there is a condition of vulnerability present. Vulnerability is a concept aimed at evaluating community and

households' exposure and sensitivity to future shocks (Chambers, 2006). The degree of vulnerability is determined by their ability to cope with their exposure to various risks, such as economic fluctuations, droughts and crop failure. Ultimately the asset base and livelihood strategies pursued by households or communities decide if and to what degree they can cope with shocks and trends (Huatala, 2010).

2.1.2 Human Capital

Human capital is probably the most important asset, because in addition to its own intrinsic value, it is necessary in order to make use of the other four assets. Human assets refers to the skills, knowledge, creativity, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve the livelihood objectives (DFID, 1999). Essential assets include the amount of available labour within a household and the quality of labour might be determined by health and education level (Cook, 2017). Attempts to address those core dimensions of poverty is required to obtain overall improvements in livelihood strategies and outcomes, but is not sufficient on its own. Initiatives might focus on building schools and hospitals, but for education to be attractive, issues regarding employment opportunities in the community are also vital (Helmor & Singh, 2001).

2.1.3 Social Capital

There has been some ambiguity regarding social assets and their place in the livelihood portfolio. All social relationships are counted as social assets (DFID, 1999). It further describes social assets as social resources upon which people draw in pursuit of their livelihood objectives. These are developed through networks and connectedness, membership of more formalised groups which often entails adherence to mutually- agreed or commonly accepted rules, norms and sanctions, and relationships of trust, reciprocity and exchanges that facilitate co-operation, reduce transaction costs and may provide the basis for informal safety nets amongst the poor. Social relations ultimately determine the distribution of property, patterns of work and division of labour the distribution of income and dynamics of consumption and accumulation (Scoones 2009).

2.1.4 Natural Capital

Natural assets play a crucial part of the asset pentagon in rural areas, where most people engage in some kind of agricultural activity. The available natural assets condition the possibility of farming, as well as the level of productivity (Cook, 2017). It is not only essential for livelihood creation but to sustain life itself. The range of natural resources might consist of intangible public goods such as biodiversity and climate, to assets such as land, trees and water used directly for production. The relationship between natural capital and the Vulnerability context is particularly close within the SLF. Many of the shocks that devastate the livelihoods of the poor are themselves natural processes that destroy natural capital (e.g. Fires that destroy forests, floods and earthquakes that destroy agriculture land) and seasonality is largely due to changes in the value or productivity of natural capital over the year (DFID, 1999). Those who derive all or part of their livelihoods from resource based activities, like farming aquaculture and gathering in forests, are obviously particularly vulnerable to shocks and trends that damages, destroys or depletes their natural resource base (Scoones, 2001).

2.1.5 Financial Capital

Financial assets refer to the different financial resources that people use to achieve their livelihood objectives, such as cash flows, savings and credit-providing institutions (Scoones, 2009). Excluding earned income, the most common types of inflows are pensions, or other transfers from the state and remittances. Financial capital is according to DFID, (2000) probably the most versatile of the five categories of assets. This is because it can be converted, depending upon Transforming structures and

Processes, into other types of capital. What is certain, however, is that for most poor people, access to financial assets might be the most difficult to obtain (Devendra, 2012).

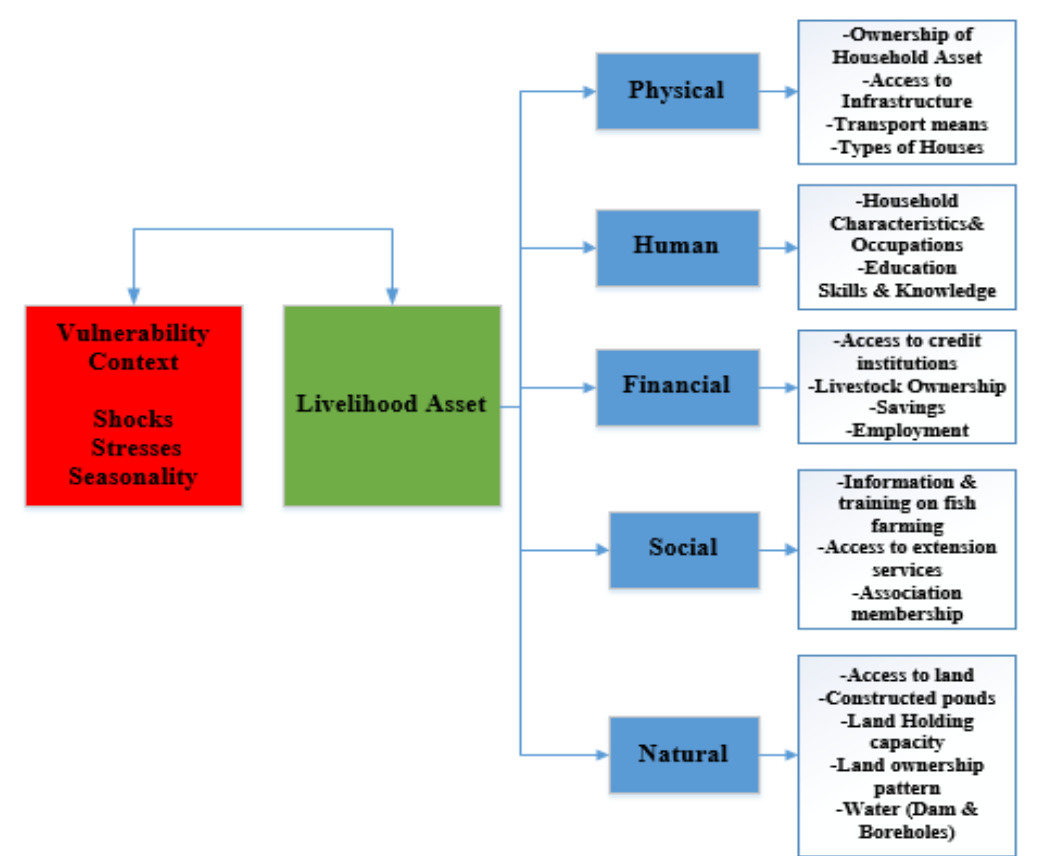
2.1.6 Physical Capital

Physical assets include public and private infrastructure, services, good and equipment needed to sustain livelihood (Ellis, 2012). Public infrastructure such as roads, water supply and sanitation, energy, schools, hospitals and access to information help people meet their basic needs and to more productive (FAO, 2012). Secure shelter and equipment needed to sustain livelihoods are also vital and for farmers this might include livestock and farming tools (DFID, 1999). Much research shows that lack of infrastructure can be a key dimension of poverty, lack of access to water supplies and energy can inhibit income generation activities due to the time needed to secure these assets (Payne, 2004). For farmers, transport infrastructure is a necessary to be able to transport produce and fertilizer, and to access markets. This in turn leaves producers at a comparative disadvantage in the market, when excess effort is used on non-productive activities, such as meeting basic needs, production and gaining access to market (DFID, 1999).

2.2 Conceptual Design and Operationalization

The figure below indicates the main concepts, dimensions and indicators of aquaculture production in Tongogara smallholder area. Vulnerability Context and Livelihood asset are elements derived from the SLF which will be used in the study elaborating on the dimensions and indicators in blue that will determine the impact of aquaculture on the livelihood asset of Tongogara smallholder farmers.

Figure 2: Conceptual design and operationalization



Source: Mhangwa, (2019)

2.3 Aquaculture Production

According to Edwards & Demaine (2007), rural aquaculture is generally explained as 'aqua production practices in extensive to semi-intensive scale with relatively low production cost and technologies'. Although most of the time aquaculture farms operated by the rural communities are in the mission of improving the life standards in terms of alleviating poverty and securing food availability, a successful aquaculture does not guarantee the earlier terms nor comes along with the benefits (Greene et al. 2003).

2.3.1 Aquaculture Production in Africa

In sub-Saharan Africa, aquaculture production has quickly gained momentum as a drought mitigation strategy and economic mechanism for generating employment and increasing household income. According to FAO (2013), Tanzania presents the most favourable aquaculture production opportunity, supported by the abundance of land and water sources. About 14 100 freshwater fish ponds are available in Tanzania which are still to be tapped. Chenyambuga et al, (2012) reiterate that aquaculture in Tanzania is still being operationalised at a subsistence level by small-scale farmers of low status although they are being constrained by lack of technology to make fish industry expand. FAO (2013) argues the lack of capacity in the government to exploit the viable aquaculture production which can be diversifying production and developing the export market for the largely rural Tanzanian economy. In Uganda, a study was conducted by Maurice et al, (2010) to investigate the value chain of farmed African catfish and it was discovered that 68 % of small scale farmers reduce their vulnerability through aquaculture production.

2.3.2 Impacts of Aquaculture on the Livelihood

Aquaculture contributes to the livelihood of the poor through improved employment and income (Devendra, 2012). Due to its smallholder operating size and free from high advanced-technology machinery, rural aquaculture is labour intensive (Mufudza, 2015). Account to this, villagers who do not have access to land can at least earn a living by providing manpower to other aquaculture farms (Ahmed & Lorica, 2012). Rural aquaculture creates an 'own enterprise' employment, where the entire family devote to the business (Edwards, 2000). Occasionally, during harvesting season or net changing period, extra hands are needed from casual or occasional labourers (Ahmed & Garnett, 2010). Aquaculture then creates job opportunities for illiterate women to earn side income for their household. According to the recent study of number of fish farmers in Ghana. Nigeria and Kenya, it is reported that every single individual who get involved in this sector, has three family members to support financially (Edward, 2000). Ahmed & Garnett (2011), have reported that after the farmers' income has increased, they reflected stronger purchasing power than before and have better access to the resources, which includes sanitary, transportation, housing, health services and communication technologies, all are credited to integrated farming. The successful aquaculture in Bangladesh has significantly improved the living standards of the locals. Although aquaculture provides fewer advantages to the poor communities in absolute terms, it definitely benefits much more in terms of relative terms via poverty reduction and relative inequality (Irz et al, 2007).

2.3.3 Impacts of Aquaculture on Food Security

Food security is the situation where all the people existing, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2000; Schmidhuber & Tubiello, 2007). Aquaculture in small farmer system in rural areas provides a high quality of animal protein and essential nutrients,

especially for nutrition vulnerable groups, such as pregnant and lactating women, infants and pre-school children. In fact, almost half of the child deaths around the globe are linked to malnutrition (UNICEF STATISTICS 14, 2015). It was proven that after supplied with sufficient needed nutrition which can be found in fish, such as vitamin B12, calcium and potassium, unfortunate cases like child blindness and infant mortality has substantively decreased (Ahmed& Garnett, 2011). According to Gale (2015), the practice of collecting free fish from fish ponds has contributed as the main nutrient source to the poor families in rural areas and helped in reducing malnutrition among young children. In the midst of raising nutrition and health implication fish production managed to provide stable food supply and fulfil food security of the poor in all three utmost dimensions, stabilised food availability, provided the villagers sufficient access to it and ability to utilise it (Bell et al, 2009). Additionally, aquaculture by rural communities helps in increasing the availability of fish in both local rural and urban markets.

It has been noted from reviewed literature that aquaculture has a significant role to play in rural development and poverty alleviation. The review of literature related to aquaculture production and sustainable livelihoods is limited in Sub-Saharan Africa and it has highlighted a number of gaps in literature. It showed that even though there are some examples of aquaculture influence on livelihood assets and reduced vulnerability, mainly from Asia and Sub-Saharan Africa, there is little documented evidence of direct poverty reducing impacts. Furthermore, evidence from Asia and Africa suggests that it is better resourced farmers who are able to adopt aquaculture production and from the few studies from Africa it does not seem clear whether poor farmers are also able to adopt and sustain aquaculture without outside assistance. With regard to this study the impact of aquaculture production system is assessed to determine whether Tongogara smallholder fish farmers will maintain the long term productivity becoming more resilient thereby reducing their vulnerability.

Chapter Three: Research Design and Methodology

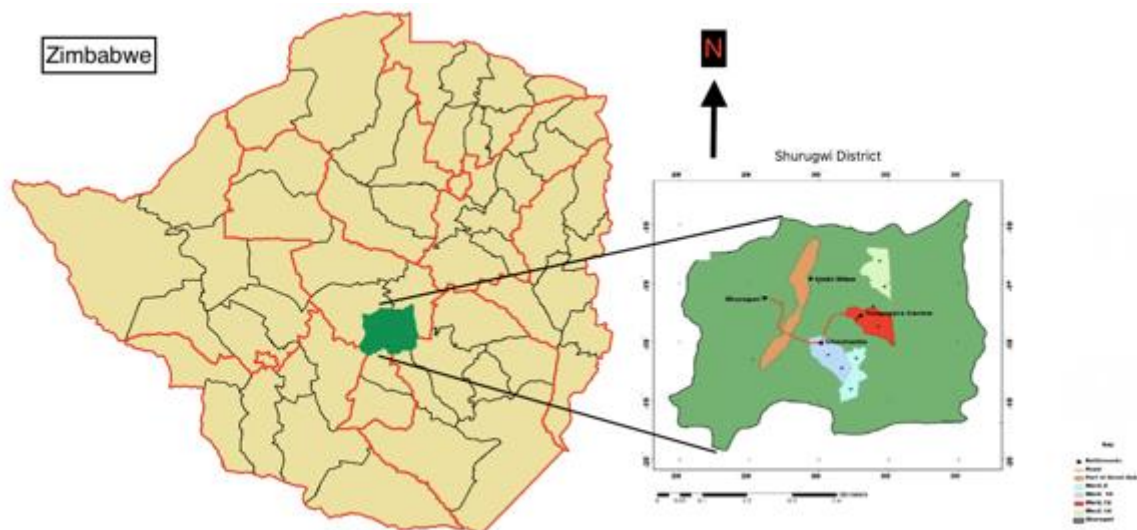
3. Introduction

This chapter therefore presents the basis for choice of methodological approach, choice and description of study area. Primary and secondary data collection methods, sampling procedure and data analysis will be discussed under this chapter.

3.1 Study Area

The study area lies in agro-ecological region III that receives an average rainfall of between 450mm-600mm. It is characterised by a number of land uses including residential (settlement), agricultural, mining, industrial and forest areas with the major human activities in the rural areas being subsistence to intensive cropping and animal farming, cattle and goat forming the backbone of the community's wealth (Madebwe and Madebwe, 2005).

Figure 3: Map of Tongogara Shurugwi, Zimbabwe



Source (Google Maps, 2019)

3.2 Selection of Study area

The study area was chosen because it was one of the pioneers and beneficiaries of the Aquaculture Zimbabwe project in the Midlands Province due to the availability of dams, rivers and non-contested land. Adequate knowledge was gathered during scoping phase and later verified during fieldwork. It is of interest of the Ministry of Agriculture and Aquaculture Zimbabwe to comprehend the impacts of aquaculture production on the Livelihood asset base of Tongogara smallholder farmers. Tongogara area has 1275 smallholder farmers, with a combined total land size of 9 576 ha (ZIMSTAT, 2012), and only 300 farmers are involved in aquaculture production. The smallholder farmers fall under the Agricultural Zone One (A1) land tenure model, to which each farmer owns a maximum of 6- 10ha land.

3.3 Research Design

The research strategy forming the base of approach to this study was a case study. A case study is being used to describe a unit of analysis. A case study also means an intensive study of specific

individual or specific contexts (Trochim, 2000). To gain a better understanding on impacts of aquaculture production on the livelihood asset of Tongogara smallholder farmers a case study research design was used. Typically, a case study researcher uses interviews, focus group discussions and documentary materials as major data sources.

3.4 Research tools

Desk study was employed during formulation of the research thesis in gaining in-depth knowledge of key concepts and baseline information from the past 5 years to present state of aquaculture production. Both primary and secondary data was used in carrying out this research. Primary data was obtained during fieldwork, and data collection tools such as semi-structured interviews, key informant interviews, observations and focus group discussions was used.

During piloting a desk study was employed in understanding the baseline information of aquaculture production. Relevant literature from Aquaculture Zimbabwe library and Department of Livestock Production archives was used for deeper understanding of key concepts. During piloting semi-structured interviews were done with key informants (Aquaculture Zimbabwe project officer and local agricultural extension worker), checking whether the researcher would gather proper information to answer all the research questions. The key informants as expected by the researcher, they managed to give a baseline information in line with the area of study, characteristics and operations of aquaculture production from a technical point of view. The local extension officer gave out expected information since he dealt with farmers on the ground and was aware of the day to day operations and challenges the farmers were encountering.

After the baseline information and interviews with key informants, a first focus group discussion was employed using a checklist. During the focus group discussion, asset ranking was done to gather information on the livelihood assets they have from the past 5 years. The first focus group discussion consisted of 20 females was conducted at the community centre and there was 100% in attendance. Females actively participated answering questions according to the checklist. An asset ranking exercise was done using note books and the note books were collected after the discussion by researcher for further analysis. Polls were done in answering some of the research questions. The second group discussion was conducted after three days as men had indicated that they will be available at the weekend when they are not at work. The focus group discussion was conducted at the community centre and all the sampled male farmers were present making it 100% attendance. An activity was done closely following the focus group questions and checklist. During the exercise and question time, half of the men were participating. The researcher quickly observed that some male respondents were not actively participating. For adequate data collection the researcher realised the power of pen and gave out pens and note books so that farmers could freely write down what they perceived in their privacy.

Semi-structured interviews with the rest of farmers (respondents) was conducted as the researcher had gained the trust from farmers. During interviews with respondents all the questions were adequately done and more insights were brought before the researcher by the respondents. During farm visits, observations were made all the time using a checklist and researcher asked for permission to capture photos on mostly relevant items that would answer the research questions. As the researcher interacted with members, walking to and from pond sites respondents freely expressed their feelings on aquaculture production. Observed phenomena was recorded in a note book and

photographs were captured as primary data that will be further used during analysis on the impact of aquaculture production on the livelihood assets.

3.5 Sampling Technique

Two sampling techniques were employed which are purposive sampling and stratified random sampling. The study was purposively selected on basis of knowledge of area and Tongogara area was the pioneer and benefitted from aquaculture production. De Vos et al. (2011) states that purposive sampling techniques falls in the category of non-probability sampling method. The key informants were purposively selected due to their roles they played and knowledge of Tongogara aquaculture production. The key informants were Aquaculture Zimbabwe project officer and the local agricultural extension officer. Stratified random sampling was used for the selection of respondents for the semi-structured interviews, to afford equal representation of households and also to see that female headed households are incorporated in the sample. The respondents were split into male and female categories to effectively answer research questions. The female category constituted of 20 households who are either widows, single or divorced and the male category of 20 households to reduce researchers' bias. A total of 40 respondents out of 300 smallholder farmers was used in data collection for a large sample size.

Table 3. 1: Operationalization of Research Methods

Sub Question	Source of Information	Data Collection Methods	Data Analysis	Sampling	When	Where	Expected Outcome
1. Which livelihood assets were influenced by aquaculture production on farmers' livelihood in achieving food security?	1. Key informants	-Semi-structured Interview	Thematic Content Analysis	Purposive 3 Key Informants	Piloting	Office	Specific Level of Impact on the livelihood asset (Physical, Financial, Human, Social and Natural capital).
	2. 12 Farmers (Respondents) 40 Farmers	-Focus Group Discussion -Asset ranking	Generate trends	Stratified random Sampling	Piloting	Community centre	
		-Semi-structured Interviews	Thematic Content Analysis	Stratified random sampling	During Research	Fieldwork	
		Observations	Photo elucidation	Purposive	During Research	Fieldwork	
2. How does the vulnerability context effect the sustainability of the aquaculture production in farmers becoming resilient?	Key Informants	-Semi-structured Interviews	Thematic Content Analysis	Purposive (Project Officer)	During Research	Fieldwork	Shocks and stresses faced by farmers
	40 Farmers	-Semi-structured Interviews	Thematic Content Analysis	Stratified random sampling	During research	Fieldwork	
		Observations	Photo elucidation	Stratified random sampling	During research	Fieldwork	
3. How has the livelihood asset base upscaled	Key informants	Semi-structured interviews	Thematic content analysis	Purposive	During research	Fieldwork	-More crop production

other agricultural activities in maintaining long term productivity of aquaculture production?	40 Farmers	Semi-structured interviews	Thematic content analysis	Stratified random sampling	During research	Fieldwork	-More livestock production
		Observations	Generate themes and trends	Purposive	During research	Fieldwork	
4. How does control and access over assets affect the sustainability of aquaculture production system?	20 Female Farmers	Focus group discussion	Harvard Analytical analysis	Purposive	During research	Community centre	Who has access and control over assets that effect sustainability of aquaculture production
	20 Male Farmers	Focus group discussion	Harvard Analytical analysis	purposive	During research	Community centre	
		Observations	Generate themes and trends of roles	purposive	During research	Fieldwork	
		Semi structured interviews	Thematic content analysis	Stratified Random sampling	During research	Fieldwork	

Source: Mhangwa, (2019)

3.7 Data analysis

Qualitative data is a collection of fragments from interviews, reports of participant observations and focus group discussions that need to be arranged in ways that help the researcher formulate themes, refine concepts and link them together to create a clear description of a topic in the final stages of analysis (Baarda & Law et al, 2014). Baarda (2014) states that a method used by many qualitative researchers is the grounded theory. Data analysis was unravelled and organised following all the five steps of grounded theory which are organising the data in fragments, relevance, open coding, axial coding and selective coding. Open coding addressed the what, why and how questions from the information gathered. The use of open coding was used to identify assets acquired after aquaculture production as well as the impact on livelihood asset base of farmers. Axial coding was used to break down information into themes and generating trends, looking for the phenomena and causal effects of aquaculture production. Harvard analytical tool was used to analyse the control and access of men and women to available resources in maintaining long term productivity of aquaculture production. Graphs, tables and pie charts were prepared using Microsoft excel from the data gathered using observations, semi-structured interviews and focus group discussions.

3.8 Ethical Considerations

In this research, the researcher asked for consent from the participants and the identity of the smallholder aquaculture farmers was made clear to be confidential. The researcher used proper channels to gain entry and approval of carrying out the research in Tongogara area from the local authorities (Department of Crop and Livestock, Aquaculture Zimbabwe and Shurugwi Rural District Council). The researcher ensured confidentiality and highlighted the purpose of the research being solely academic to guard against respondents' mind set of deeming it as a predecessor to government or donor assistance programmes.

Chapter Four – Results

4.0 Introduction

This chapter presents the findings of the research on the impact of livelihood asset on integration of aquaculture production in Tongogara smallholder area. It starts with giving the baseline information on aquaculture production, information on the demographic statistics of the area and answering the research questions. The results from interviews and focus group discussions are presented in form of tables, graphs, quotes from interviews with farmers and field pictures.

4.1 Baseline information of Aquaculture production in Tongogara smallholder area

Zimbabwe is one the most dammed country in Africa which contains many inland water bodies including Lake Kariba and a host of other dams suitable for fresh water aquaculture. There are 400,000ha suitable for inland aquaculture and currently less than 5% of this is exploited. Most fish farmers lack information on how to assess the profitability of their farms. This has partly hampered aquaculture development in the country. This is leading to potential farmers not opting into fish farming and others becoming inactive because the profitability and sustainability of aquaculture has not been demonstrated to them. Furthermore, financial institutions and credit facilities are not keen to give loans to farmers whose enterprise profitability has not been feasibly appraised.

Tilapia which belongs to the Cichlid family originated from Africa where the temperature ranges from 14 to 33 degrees Celsius. Tilapia is well suited to fish farming because it grows quickly, is able to survive in poor water conditions and eats a wide range of feed. Tilapia was regarded as the best species for cultivation in ponds and is common in Zimbabwe. In ponds after four to six months of culture, tilapia can weigh 500g although males grow faster than females. The major problems reported by most smallholder fish farmers include unavailability of fingerlings, lack of commercial feeds, inadequate knowledge in fish farming and theft. Other studies have shown that more general issues including high input price, price fluctuation, shortage of land, drought, lack of credits, poor roads, high transportation costs, predation and poor extension services are main constraints to development of aquaculture in Zimbabwe. These challenges need to be addressed in order to improve fish productivity and make aquaculture production more profitable under smallholder production system.

Aquaculture production in Zimbabwe has been underdeveloped at the small scale farmer level. This was particularly the case for commercial small scale aquaculture. Traditionally this has been due to barriers at almost all the links in the value chain – finance, availability of equipment, availability of fingerlings, availability of fish feed, knowledge on farming, harvesting and marketing. Apart from the knowledge at Lake Harvest company and the work of some NGOs, there was no widespread aquaculture production expertise available in-country. Where aquaculture has been practised, it has been extended with slow production.

Aquaculture Zimbabwe identified Tongogara smallholder farmers as they had readily available livelihood assets such as land, water, infrastructure and partial knowledge on aquaculture production. Aquaculture Zimbabwe mainly targeted vulnerable areas with several developments in Zimbabwe which were set to address the constraints farmers had and enable small scale farmers to farm fish profitably. Aquaculture Zimbabwe in conjunction with Lake Harvest Company started making and providing sex-reversed genetically improved fry available to the farmers. It also partnered with Aquafeeds company that would produce a high-quality specialized tilapia feed for the Zimbabwe

market. Aquaculture Zimbabwe has continued to train farmer groups in aquaculture and together with the availability of feed and are starting to see a sustainable fish farming community emerge.

Picture 1: Interview with Key Informant (Aquaculture Zimbabwe Project officer)



Source: Field Data, (2019)

A total of 300 farmers have benefitted to aquaculture production in Tongogara communal area. The project primarily identified poor smallholder farmers with access to land, water, labour and typically involved in low input or low productivity crop and livestock production. Tongogara smallholder farmers also depended on wage labouring for their livelihood and could be supported to increase their productivity to become more food secure. During interviews with the project officer as one of the key informants, it was highlighted that Tongogara smallholder farmers were cash-constrained and subject to shocks but with a potential of increasing productivity, links to markets, help drive food security and economic growth. Only 15% of farmers had the knowledge and pieces of training on basic aquaculture production.

'Aquaculture is recognized as a pro-poor intervention that benefits farming communities both in terms of income and nutrition as well as creating employment. Fish are not only an important source of animal protein in human diets but also of micronutrients (vitamins and minerals) and essential oils.'

During the interview, the project officer highlighted that Aquafeeds company and Aquaculture Zimbabwe continued to ensure women are prioritized in gaining access to inputs and information as well as finance where possible. Training and input fairs were held at times and locations which were conducive to women attending.

'It is noted that where women sell their fish on market days, they can have meaningful control over the proceeds they accrue and that these are generally spent constructively on food, education, and healthcare.'

Picture 2: Women selling fish to a customer



Source: Field Data, (2019)

4.2 Socio-Demographic characteristics of respondents

A total of 40 semi-structured interviews were conducted with Tongogara aquaculture production farmers. This was done to solicit data on the impact of aquaculture production on their livelihood asset base. The rate of response for the semi-structured interviews by smallholder farmers was 100%. The socio-demographic data also comprises of sex composition of respondents, their age, marital status, and household size.

4.2.1. Sex Composition and age of respondents

Of the 40 semi-structured interviews conducted both males and females were equally represented. Tongogara smallholder farmers who are involved in aquaculture production constitutes of 20 males and 20 females. The youth (18-30 years) had the highest involvement (45%) which can be attributed to the sustainability of aquaculture production and continuity of other agricultural activities that will alleviate poverty as well as improving their food security. The middle-aged 31-50 constituted 35% of the sampled farmers and these farmers have families to take care of their families thereby they would fully involve themselves in aquaculture production as an additional source of income to improve on the food availability and stability in their households. The 51 years and above age group was 20%. These are the most vulnerable since they can no longer be involved in formal employment because of their age and therefore opt for the aquaculture production and other agricultural activities as a means of survival.

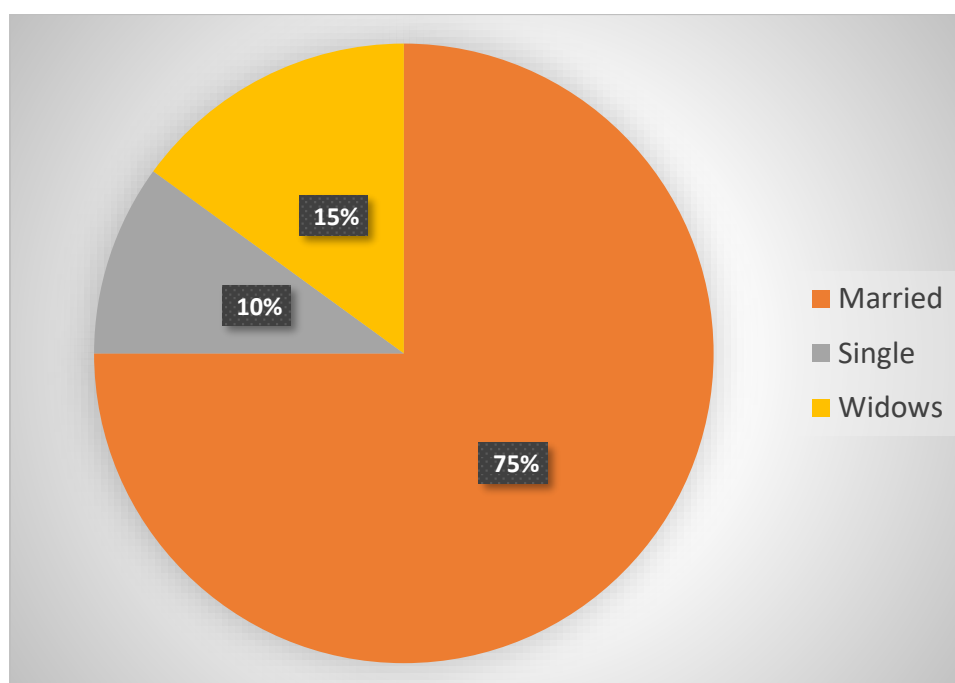
Table 4. 1: Statistics on Age and Sex of Respondents

Age	Total	Male		Female	
		Frequency	Percentage	Frequency	Percentage
18-30	90%	9	45%	9	45%
31-50	70%	7	35%	7	35%
50 and above	40%	4	20%	4	20%

Source: Mhangwa, (2019)

4.2.2. Marital Status

Of all the respondents from the semi-structured interviews, the highest percentage of 75% (n=30) were married making it an advantage in providing adequate food for consumption in their households as both could use it as an advantage as either one of them was formally employed. Focus group discussions highlighted that married households that constitute 75% of the total households have more labour and there can pursue different livelihood strategies thereby reducing their vulnerability as well as promoting food security. Through the integration of aquaculture production, Tongogara smallholder farmers perceive the continuity of the project due to the average age of the household age which is 37.8. 10% (n=4) of the sample were single who are found within 45% (n=18) of the respondents between the ages of 18 and 30. Widows and widowers constituted 15% (n=6) of the respondents. There is a very low divorce rate and this could be attributed to the African culture and Christianity which do not encourage divorce. Figure 4.1 shows the marital status of the respondents in percentage form of Tongogara smallholder farmers who are involved in aquaculture production:

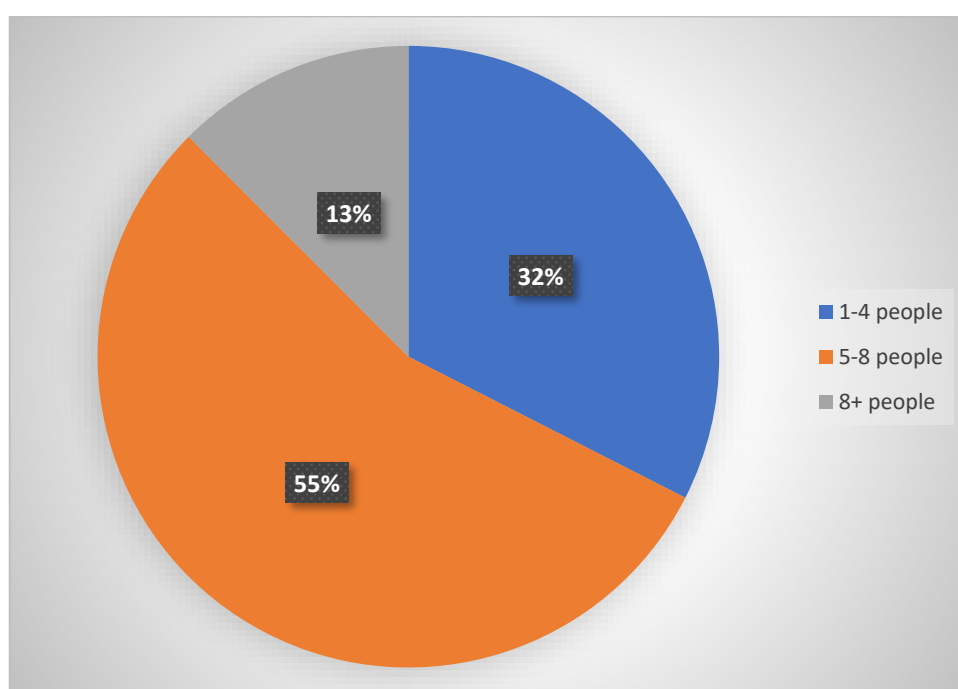
Figure 4. 1: Marital status of Tongogara smallholder farmers

Source: Mhangwa, (2019)

4.2.3. Household size

Household size was an important determinant for the researcher understanding that as the household size increases so does the livelihood assets and the need for more income and food. Out of the semi-structured interviews conducted, 55% (n=22) of aquaculture farmers had a household size of 4-8 people, this enabled them to have more human and social capital. 32.5% (n=13) had a household size of between 1-4 people while 12.5% (n=5) of the households had more than 8 people. From interviews done farmers highlighted their average household size of 6.3 and they have managed to sustain their families through the integration of aquaculture production. 20% (n=8) of females have completed secondary education whilst 70% (n=28) of males have completed secondary to the tertiary level of education. This indicated the continuity of aquaculture production due to better literate levels. Figure 4.2 shows the household size of the respondents in percentage form:

Figure 4. 2: Nature of household size of Tongogara smallholder farmers



Source: Mhangwa, (2019)

4.3 Livelihood assets gained after venturing into aquaculture production.

Tongogara smallholder farmers through key informant interviews, semi-structured interviews and focus group discussions highlighted livelihood assets that smallholder farmers gained through the integration of aquaculture production in improving farm productivity and achieving food security.

4.3.1 Human capital

4.3.1.1. Skills training and Extension services

During interviews, 70% (n=28) of Tongogara smallholder farmers highlighted that they have been exposed to aquaculture skills training. Before they were trained they experienced high mortality rates and low fish yields. Training was primarily done to improve productivity and knowledge as it boosted their management practices to reduce mortality rates. 25% of male farmers highlighted that they were trained on sampling of fish checking whether fish is gaining weight or eating properly, 15% of women were also trained. On Sampling, weeding and processing it can be noted from Table 4.2 that only a few farmers were trained with 80% (n=32) not trained as the training dates clashed with presidential inputs distribution programme.

Table 4. 2: Skills training and frequency of respondents

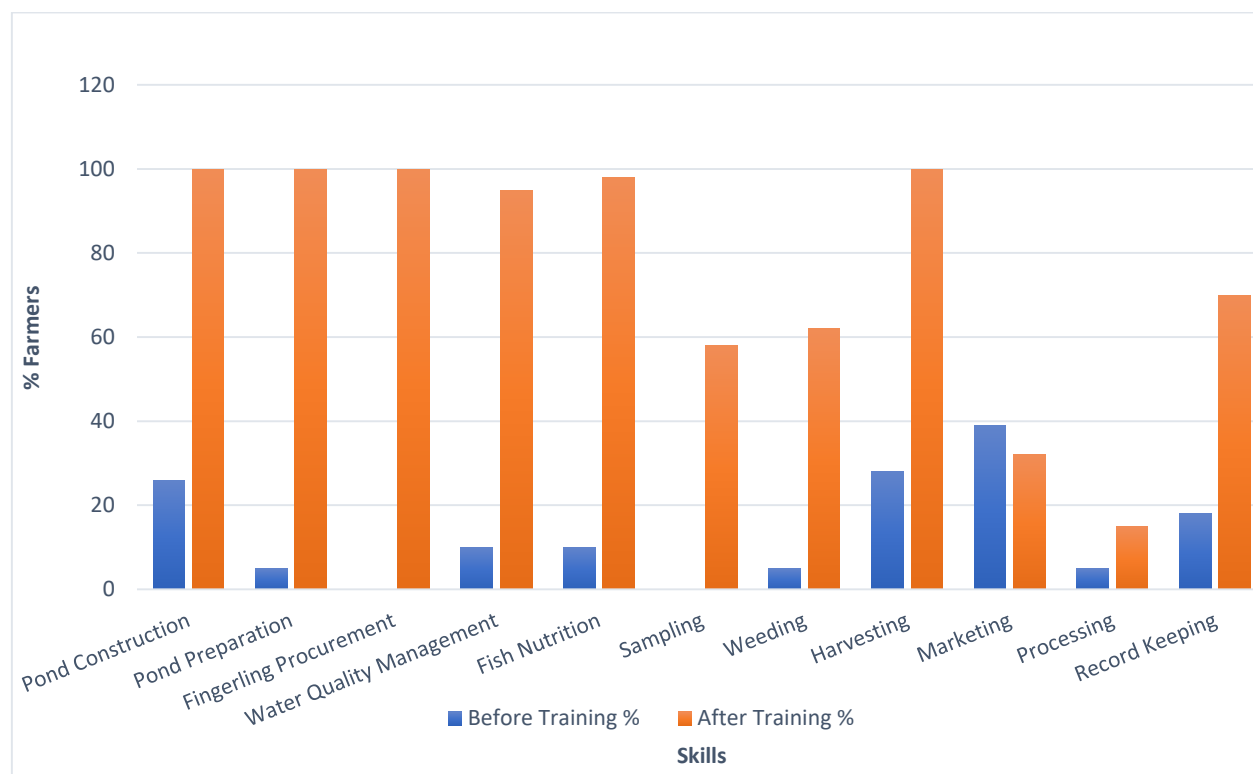
Skills Training	Total	Male		Female	
		Frequency	Percentage	Frequency	Percentage
Pond construction	95%	20	100%	18	90%
Pond preparation	100%	20	100%	20	100%
Fingerling Procurement	72.5%	15	75%	14	70%
Water Quality Management	42.5%	12	60%	5	25%
Fish nutrition	67.5%	15	75%	12	60%
Sampling	20%	5	25%	3	15%
Weeding	30%	6	30%	6	30%
Harvesting	100%	20	100%	20	100%
Marketing	90%	16	80%	20	100%
Processing	42.5%	4	20%	13	65%
Record Keeping	92.5%	18	90%	19	95%

Source: Mhangwa, (2019)

‘During trainings on Fish sampling, pond weeding and fish processing, the programme would clash with maize planting and as for me I would create time to come and attend as I wanted to know and understand on all the required topics that a farmer should know’. (Respondent 8)

Both males (n=20) and females (n=20), indicated that they have been trained on pond construction and pond preparation. This improved on their ability to carry out on proper pond dimensions that will make them manage the fish and fish feed that accommodates the required measurements. 100% of both males and females gained knowledge on good harvesting practices in order to reduce mortality rates during harvesting times. 55% of the aquaculture farmers have Master Farmer Training certificates and they can even now train other aquaculture farmers from the skills acquired. Fig. 4.4 shows the skills training that were done and the farmers who benefitted from it.

Table 4. 3: Farmers involved in skills training and extension service before and after aquaculture production



Source: Mhangwa, (2019)

It can be noted from the graph that there was a significant difference before and after farmers were trained on most skills and aquaculture knowledge. From the first focus group discussion done farmers positioned skills that they perceived important for them in aquaculture production. After training 95% farmers indicated that it is easier for them to work even on their own,

During an interview with key informant 2 (Extension worker) highlighted that they are always on the ground offering free services to the farmers. Extension services have been offered before and after the implementation of aquaculture production.

'Before and after aquaculture production our main role has and is to offer advisory, technical and supervisory services to our farmers. Whenever a need arise I am always available to offer my services freely and I live nearby in a government house.'
(Extension worker)

75% (n=30) of respondents acknowledged that they are free to consult the officers from time to time when the need arises or when they are faced with a challenge that needs technical expertise. 80% of respondents claimed to consult mostly on pond management, feeding and harvesting.

Picture 3& 4: Fish pond construction demonstration and training by extension worker



Source: Field data, (2019)

'I recently had a problem with my fishpond the algae in the pond was too green and every time I fed the feed will be left floating for days', (Respondent 28) whereas Respondent 13 said, 'I was used to seeing my fish play all the time then one day I was feeding them I realized they were not as jovial as usual and this got me worried but when I called the extension officer he was able to help me and now my fish are playing.'

These two are isolated cases of how the farmers in the area receive extension services making it a least challenging factor since they can get an extension as the need arise. Satisfaction with extension services was also considered and the research found that 75% of respondents were satisfied while 25% were not satisfied with the extension services offered. 5 females highlighted that they were not satisfied with extension services as they have to constantly contact the extension worker due to their location which is far from where the extension worker lives. From the interview contacted with the key informant 2, he highlighted the challenges he also faces due to some sections of the road in the area that are in bad condition and his mobility is quite difficult.

Table 4.3: Satisfaction of Extension Services

Extension services	Total	Males		Females	
		Frequency	Percentages	Frequency	Percentages
Satisfied	75%	15	75%	15	75%
Not Satisfied	25%	5	25%	5	25%

Source: Mhangwa, (2019)

4.3.2 Natural Capital

Natural capital refers to the natural resource stocks that people can draw on their livelihoods including land, forests, water, air and soil. Natural resources used in aquaculture production are water bodies such as rivers, dams and weirs. Branches of trees and elephant grass are used by Tongogara smallholder farmers to construct fish aggregating devices in those water bodies. The water bodies are also a source of fingerlings for pond production. Natural resources, such as cow dung and poultry droppings are used in fertilizing and culturing of fish ponds.

During a focus group discussion that was conducted with all the sampled farmers, an asset ranking exercise was done. It was noted that 62.5% of males responded that they owned land while 15% of females particularly widows who inherited land from their late husbands owned land. 15% highlighted that they rented land from farmers who owned bigger land sizes. 7.5% of the respondents leased land to other farmers whereby, the land owner makes a contract with the user for a certain period. The contract that would principally be between farmers who would want to venture only in smaller livestock projects due to small land size availability Table 4.5 highlights the male and females owning land.

Table 4. 4: Land Ownership of Tongogara smallholder farmers

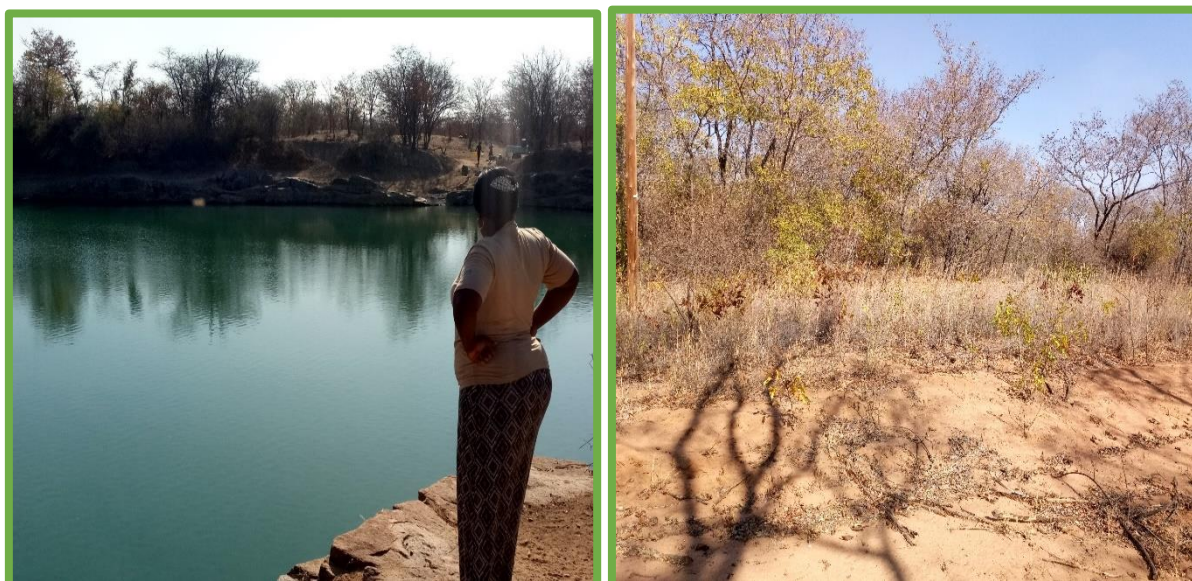
Land Ownership	Total	Males		Females	
		Frequency	Percentages	Frequency	Percentage
Owned	80	20	100%	11	55%
Rented	15	6	15%	0	0
Leasing	7.5	3	7.5%	0	0

Source: Mhangwa, (2019)

Each household had access to at least 6ha – 10 ha of land. Access to land has made farmers become less vulnerable and venture into various projects on their homesteads. Respondents highlighted that they had access to water from their nearby Tongogara dam and weirs that will have water during the rainy season.

‘Land ownership has never been an issue to most farmers around this area since it is a communal land and the government even allows us to lease and subdivide small pieces of land on monetary terms. One is entitled to access only 6-10ha of the land but some farmers have been in a position of buying more land somewhere and venture into various projects to reduce poverty amongst themselves.’ (Respondent 4)

Picture 5 & 6: Researcher observing water sources and vast land for Tongogara smallholder farmers



Source: Field data, (2019)

4.3.3 Social Capital

4.3.3.1 Access to information on aquaculture production

Access to information is considered as a significant social capital which depends largely on non-formal relationships among farmers at the village level and their linkages with local and national organizations. During the interviews, farmers were asked who their main information providers were, what sort of information they received and usually who in the household received the information. 80% indicated that they had access to information on aquaculture production. Before the project was implemented they faced challenges on how to access information and one farmer indicated that he could not access enough information due to the limited access of household assets such as radio, mobile telephone and television.

From the focus group discussion, farmers indicated that they also rely more on other fish farmers as they usually work together giving each other relevant information. Extension workers play a key role in aquaculture production. They act as the main source of information. 75% of respondents indicated that they rely on information from extension workers, feed suppliers and hatcheries.

'When you don't have adequate access to radio or even television you tend to miss out on the most important information. Soon after venturing into aquaculture production I got into a position of acquiring telephone and radio as they are lots of farming programs that specifically discuss and teach on aquaculture production and agriculture production as a whole.' (Respondent 12)

Table 4. 5: Sources of information for Tongogara smallholder farmers

Source of information	Total	Male		Females	
		Frequency	Percentage	Frequency	Percentage
Social media	87.5%	20	100%	15	75%
Extension worker	75%	20	100%	10	50%
Association members	92.5%	17	85%	20	100%
Seed companies	82.5%	20	50%	13	65%%

Source: Mhangwa, (2019)

During interviews, it was noted that a total of 85% of farmers gained information through different social media platforms, whereas 75% indicated that they gained information from their extension workers and the project officer. 32.5% of females highlighted that they also acquire information from seed companies where they buy their fingerlings and fish feed. Respondent 21 (Female), highlighted that it is beneficial to her when she goes to purchase her feed and fingerlings the supplier mostly give advice and in form of fliers which she could easily read when she gets home. This reduces the vulnerability of getting inadequate information even if the extension worker is far away to advise.

Picture 7: Respondent 13 and 29 showing their weekly update on water quality management from Aquaculture Zimbabwe project officer.



Source: Field Data, (2019)

4.3.3.2 Association membership

From the interviews, 92.5% (n=37) of respondents perceived that it is beneficial to be a member of a cooperative or association whereas 7.5% (n=3) indicated that they are still to join the cooperative since they had not yet paid monthly subscriptions. The cooperative is a membership society and farmers have to pay a fee which also allows them to buy shares that gets dividends at the end of the year.

Social capital reduces the vulnerability of farmers and due to aquaculture production farmers in the Tongogara area have grown to work together in most production activities.

'I first joined the cooperative in December 2015 when the extension worker encouraged and trained us on the benefits of social capital. Being a member of the cooperative helps you in many ways that could be the marketing of fish, harvesting even when facing challenges members in the association tend to be of great help.' (Respondent 4)

4.3.4 Financial capital

4.3.4.1 Access to credit

Financial capital denotes the financial resources that people use to achieve their livelihood objectives. The dimensions of financial capital on aquaculture production farmers represents income, employment creation, savings, credit and livestock ownership. Aquaculture production has the potential to generate considerable amounts of the financial capital of associated groups. In the Tongogara area, it was noted that 15% of smallholder farmers were in the disadvantageous situation with 5% (2) widows due to poor financial resources as collateral security from formal institutional credit. 60% of farmers indicated that they could access credit from different formal since they were formally employed could use acquired assets as collateral security. During interviews, 100% indicated that they could borrow from their association membership at a reasonable interest rate. 65% of respondents that they could borrow from relatives or friends and this promoted trust amongst themselves. Table 4.7 depicts the males and females with access to credit.

Table 4. 6: Access to credit of respondents

Access to credit	Total	Males		Females	
		Frequency	Percentage	Frequency	Percentage
Formal Institutions	60%	15	75%	9	45%
Association cooperative	100%	20	100%	20	100%
Relatives/ Friends	65%	16	80%	10	50%
No access	15%	4	20%	2	10%

Source: Mhangwa, (2019)

4.3.4.2 Livestock Ownership

Livestock is the main form of savings for many poor households and as a liquid asset can be easily sold to generate income during times of need.

‘Livestock is also a form of physical capital and can be a form of social capital for example by increasing wealth and prestige, and strengthening networks as livestock are often given as gifts’ (Respondent 1).

From the research findings, 97.5% (n=39) of respondents indicated that there was a significant difference before and after the integration of aquaculture production. It was observed that farmers gained an increase on the numbers of draught animals, sheep, goats, pigs, rabbits and poultry as this makes them resilient to continue even funding from government and non-governmental organisation stops. Table 4.7 depicts how male and female responded on livestock acquired.

Table 4. 7: Livestock Ownership according to Gender

Livestock Ownership	Total	Male		Female	
		Frequency	Percentage	Frequency	Percentage
Draught animals	57.5%	19	95%	4	20%
Cattle	87.5%	20	100%	15	75%
Sheep	30%	5	25%	7	35%
Goats	65%	6	30%	20	100%
Pigs	35%	10	50%	4	20%
Rabbit	45%	4	20%	14	70%
Chicken	87.5%	15	15%	20	100%

Source: Mhangwa, (2019)

The above table highlights livestock ownership according to gender. From the interviews conducted, it is highlighted that men (n=19) own more of the draught animals and cattle (n=23) than women. Women gained more numbers of chicken and goat production. The distribution indicates the positive impact of aquaculture production on the livelihood asset base of Tongogara smallholder farmers.

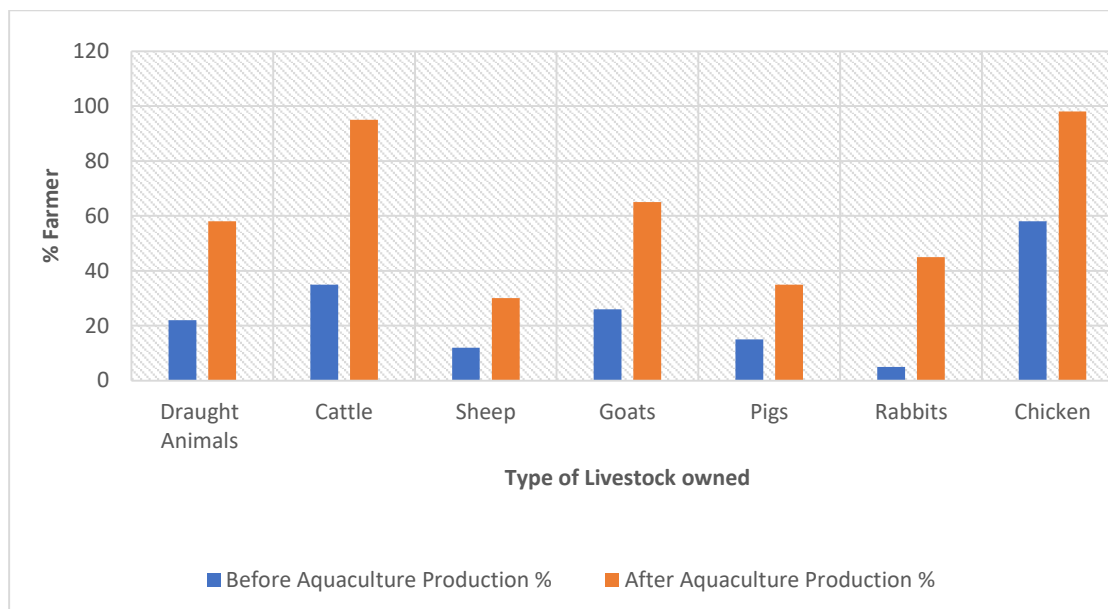
Picture 8: Cattle in a pen as financial capital



Source: Field Data, (2019)

Respondent 23 highlighted that due to aquaculture production he has managed to venture into different enterprises as he is also capable of selling and buying livestock of his choice. This reduced vulnerability thereby promoting food security.

Figure 4. 3: Respondents owning different types of livestock



Source: Mhangwa, (2019)

4.3.4.4 Savings

From the focus group discussion done, 60% (n=24) of respondents indicated that 3years after aquaculture production they could save money from their harvest sales, 25% (n=10) indicated that they saved money from off-farm income and 30% (n=12) saved money from their salaries.

4.3.4.5 Employment creation

'When I started aquaculture production I could save money from both fish harvests and my salary but due to economic hardships we are now facing it is now difficult for me to save even a cent. I am only surviving on hand to mouth the money that I get from my sales and pension mainly cater to our food consumption. Unfortunately, our country is going through an economic meltdown and this has affected everyone as it is now difficult to save and venture into more income-generating projects.' (Respondent 40) a retired nurse

During the interviews, 45% (n=18) of respondents highlighted there was employment creation due to aquaculture production thereby reducing vulnerability as they could earn money from it. 38% of respondents stated that they are employed as security officers and mostly during pond construction and harvesting. Aquaculture production created employment thereby reducing vulnerability and promoting food security to workers as 13% indicated that they sometimes get paid their income with fish and this will go towards their home consumption.

Picture 9: Employment creation during harvesting of fish



Source: Field Data, (2019)

4.3.5 Physical capital

4.3.5.1 Ownership of Household assets

Physical capital entails of the producer goods and basic infrastructure needed to support livelihoods. During the research, it has been observed that respondents owned various household assets radio, television, water pumps, bicycles, refrigerator, truck and modernized toilets. 75% (n=30) of the respondent indicated that they also had access to different infrastructure. Before farmers ventured into aquaculture production the essence and need for physical assets was significantly low. 95% (n=38) of respondents indicated that they now own radio as it is mainly used to find out information on different agricultural activities even adverts. 52.5% (n=21) of the respondents highlighted they have managed to acquire a television where different farming shows are broadcasted.

'Before we ventured into farming specifically aquaculture production we didn't see the essence of getting a television but this is where we learn every Tuesday and Friday of the week at 1900hrs there is a program called Talking Farming and various agricultural topics are discussed and we learn a lot from it. Radio and television have become part of us as a source of information again.' (Respondent 15).

During interviews 37.5% indicated that they own a water pump and water tanks for easy storing of water. They will not face difficulties in accessing water from the community dam as they have managed to drill boreholes and put up water pumps on their homesteads. 5% indicated that they have managed to buy a truck for easy transportation of fish and other fresh produces to the nearby market.

65% (n=26) of females indicated that they also acquired a gas refrigerator.

'If you are fish farmer one definitely needs a refrigerator for storing and preserving the harvested fish before selling. (Respondent 12).

Picture 10: A Gas refrigerator acquired after venturing in aquaculture production



Source: Field Data, (2019)

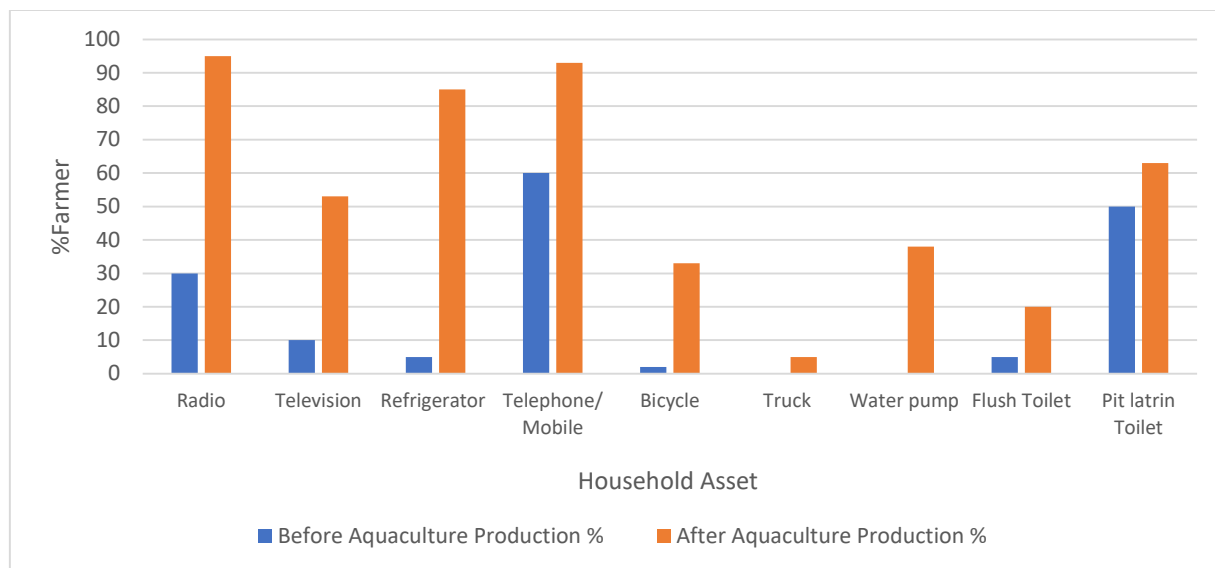
The table below depicts the frequency of respondents who indicated that after venturing into aquaculture production they have managed to acquire different household assets. From the interviews conducted it could be noted that no female could not acquire resources such as bicycles and trucks. Only males could acquire such assets. From the table below females played an important role in construction of toilets. This has been a necessity for most households and women could highlight that they put extra effort in constructing a toilet at their homestead.

Table 4. 8: Ownership of household assets of males and females

Ownership of Household assets	Total	Males		Female	
		Frequency	Percentage	Frequency	Percentage
Radio	95%	20	100%	18	90%
Television	52.5%	12	60%	9	45%
Refrigerator	85%	14	70%	20	100%
Mobile phone	92.5%	20	100%	17	85%
Bicycle	32.5%	13	65%	0	0
Truck	5%	2	10%	0	0
Water pump	37.5%	10	50%	5	25%
Flush toilet	20%	5	25%	3	15%
Pit latrine toilet	62.5%	12	60%	13	65%

Source: Mhangwa, (2019)

Figure 4. 4: Farmers who owns household assets before and after aquaculture production



Source: Mhangwa, (2019)

The graph above indicates the household assets farmers had before and after venturing into aquaculture production. 20% of respondents highlighted that they have managed to improve their livelihoods by constructing flush toilets while 62.5% indicated that they either built or reconstructed a pit latrine toilet. 92.5% indicated that they now own a mobile phone for easy communication especially with their extension workers, feed supplies, hatcheries and customers. Pictures below show farmers who have managed to put up a water pump and tanks that they use for storing water and watering their gardens.

Picture 11 &12: Water pumps and tanks put up for storing water

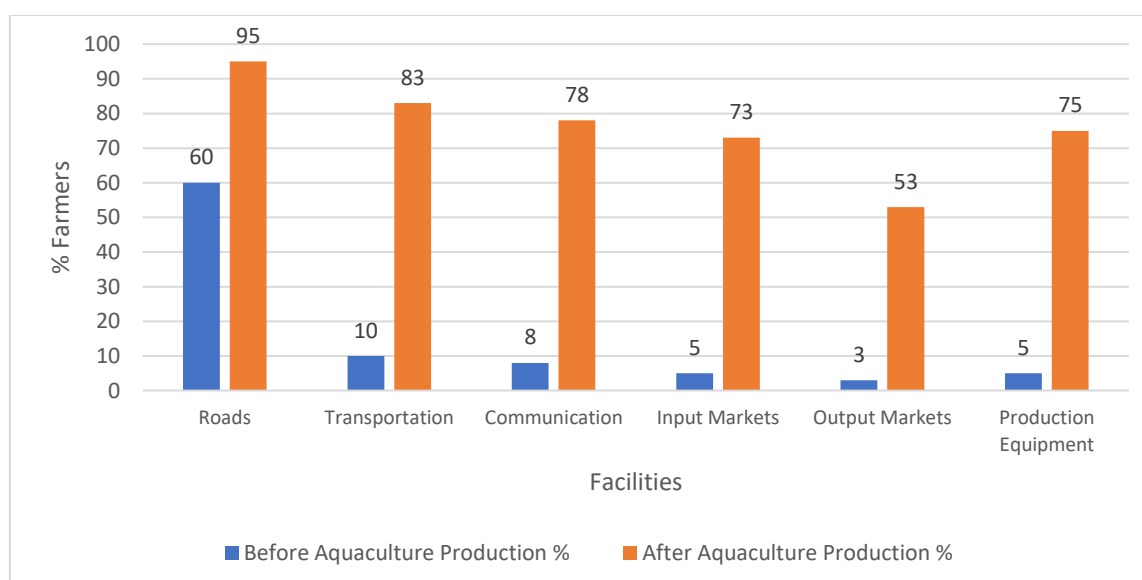


Source: Field Data, (2019)

4.3.5.2 Access to infrastructure, transport and communication facilities

During interviews, farmers perceive that before the implementation of aquaculture production their access to roads has been a challenge as most roads leading to the main road were in a bad state. 60% (n=17) of respondents highlighted that the roads were in a bad state before implementation of various projects that improved their livelihood but after the aquaculture production buyers and suppliers managed to service the main road for easy access and transportation of goods. 95% (n=37) highlighted that they can easily access roads at any given time and transportation of goods is no longer a big challenge as two of the farmers have managed to acquire trucks, are part of their association and are always willing to help and facilitate transportation of goods at a reasonable fee. 8% indicated that before project implementation they had a challenge in communicating with customers, suppliers or even extension workers as they had no proper means of communication. During a focus group discussion, 78% highlighted that now they can communicate well with the use of telephones and roads are easily accessible.

Figure 4. 5: Farmers with access to infrastructure, transport and communication facilities



Source: Mhangwa, (2019)

'Before venturing mainly into aquaculture production it was difficult for most of us even to own important production equipment. Most of the time we could not perform to our expected standard due to limited financial capital to purchase or even hire equipment especially for pond construction' (Respondent 18).

75 % of respondents indicated that they have managed to access production equipment such as cast nets, outlet pipes, cement and hiring of excavators for pond construction. One respondent explained that it is easy to hire an excavator as it does not take minutes to dig up the pond, unlike hiring people for labour as they tend to take more days consuming lots of money. The picture below shows a pond being constructed using an excavator.

Picture 13: Construction of a 30m X 40m pond



Source: Field data, (2019)

4.4 The vulnerability context affecting the sustainability of the aquaculture production.

Tongogara aquaculture production farmers are exposed to different vulnerabilities that involve shocks and stresses like episodes of droughts, pests and disease outbreaks with fall army-worm been a recent outbreak in the past four seasons. The outbreak has brought in stress on their grasslands as most veld pastures for their livestock have deteriorated. From the interviews conducted 80% of farmers indicated that they have been affected by drought for the past four years since they have ventured into aquaculture production.

Picture 14: Lean cows due to drought



Source: Field Data, (2019)

30% of farmers also indicated that they have been exposed to predation and theft. This attributes to affect the sustainability of aquaculture production as they tend to have losses during harvesting thereby reducing their food security. Tongogara smallholder farmers face a challenge in trends they also encounter. There is an increase in land pressure due to the high unemployment of youth as farmers are forced to subdivide their land to accommodate their children with their families.

Table 4. 9: Challenges faced by Tongogara smallholder farmers

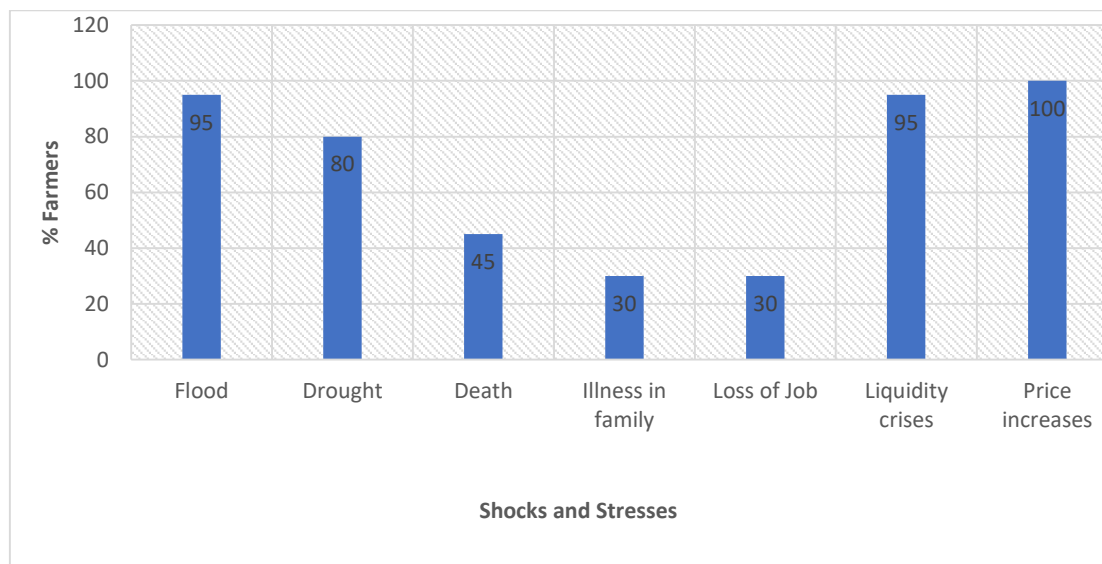
Challenge faced	Total	Male		Female	
		Frequency	Percentage	Frequency	Percentage
Drought	80%	15	75%	17	85%
Predation & Theft	30%	4	20%	8	40%
Land fragmentation	45%	13	65%	5	25%
Poor soil quality	20%	4	20%	4	20%
Poor market linkages	65%	10	50%	16	80%
Dependency on government inputs	20%	2	10%	6	30%

Source: Mhangwa, (2019)

45% of farmers highlighted that their land has been subdivided thereby limiting the expansion of various projects that will enable them to become resilient. This is increasing pressure on the ability of

natural resources to sustain livelihoods. Tongogara smallholder farmers claim of having access to land and water as their natural assets, which they have been using for pond construction and growing of different crops.

Figure 4. 6: Shocks and Stresses experienced during project phase



Source: Mhangwa, (2019)

20% of farmers highlighted that their soil quality is deteriorating and thereby they are primarily relying on livestock production as they are forced to sell so they can pay for their children's school fees and investing in aquaculture production. Like most rural areas in the country, a poor road network exists which also affects the access to markets. 65% of farmers face a challenge in accessing markets and they have resorted to using their cooperatives from farmers who have managed to acquire vehicles. 7% of farmers own physical assets such as vehicles making them more resilient as they can transport their farm products at any given time after their harvest. 20% of farmers indicated that they highly depend on government to provide inputs for every agricultural season and due to lack of collateral security they practise group credit sourcing. The current economic meltdown in the country has led to high-interest rates and liquidity crunch. This affects their ability to employ workers during harvesting periods. During a focus group discussion 90% of farmers highlighted that they face challenges that affect the sustainability of aquaculture so they could continue with various agricultural activities in their seasonal calendar. Table 4.8 below shows the main activities Tongogara smallholder farmers practice and the challenges they face during their farming seasons. From the table it can be highlighted that farmers suffer more from natural disasters such as pest and disease incidences, erratic rainfall, livestock deaths and high incidences of crop failure.

Table 4. 10: Activities and challenges encountered during agricultural seasons.

Activity	January- March	April-June	July-September	October-December
1. Maize production	-Pests and diseases (Fall armyworm) -Crop failure	-wet spells -floods	-Post-harvest losses	-increased input prices.
2. Horticulture production	-Pests and diseases -Low market prices	-High input prices	-Poor soil quality	-limited water availability
3. Beef production	-Poor veld and pasture condition	-Tick infestations -Limited acaricides	-Drought - low water availability	-Low market prices -High prices for acaricides
4. Aquaculture production	- Theft -Predation	-Diseases	-Off fish season	-Low market prices
5. Bee keeping	-Theft	-Veld fires	-Off bee season	-Low market sales
6. Rabbit production	-High mortality rates	-Diseases	-Low market sales	-High feed costs

Source: Mhangwa, (2019)

During the second focus group discussion, farmers highlighted that they have also faced challenges after implementing coping strategies to curb the challenges that they face. 35% indicated that they suffer from loans that they borrow from money lenders after they borrow to cover up difficulties or challenges that they face.

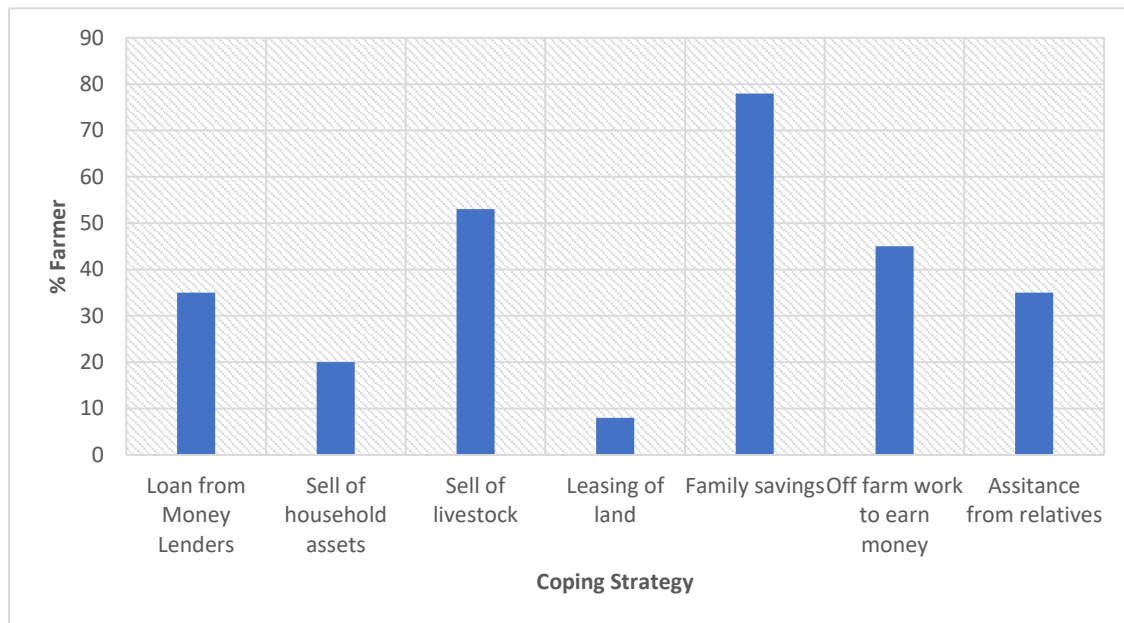
‘This year has not been a good one for me, most of my activities have not been giving me enough to save and I have to stay in business. I am forced to go and borrow money at an interest so that I keep myself up and running, but sometimes I don’t get much because of economic hardships we are facing and I will end up paying back all the profit that I get and still I will be left with nothing and I am forced to go and borrow again.’ (Respondent 37).

78% of farmers highlighted that the highest coping strategy they use is from the family savings with and this affects the sustainability of most agricultural activities and they suffer from stress as they will not be in a position to venture or start-up on new projects.

'Before Aquaculture Zimbabwe introduced aquaculture production we used to sell livestock as a coping strategy and this would put a lot of pressure on us as we would sell our livestock at very low prices especially in the dry season.' (Respondent 16)

53% indicated that they are still selling their livestock as a coping strategy though this will leave them more vulnerable. The challenge of economic challenges is now reducing agricultural production and the sustainability of more agricultural activities. Fig below shows the percentage of respondents who are still facing stress by coping strategies that they employ in curbing challenges.

Figure 4. 7: Categories of coping strategies experienced



Source: Mhangwa, (2019)

4.5 Upscaled agricultural activities through aquaculture production.

The results have been presented based on the livelihood assets Tongogara smallholder farmers have acquired after venturing into aquaculture production. These livelihood assets have enabled upscaling of other agricultural activities in maintaining long term productivity of aquaculture production. Due to control and access to land and water, 95% (n=37) of respondents indicated that they managed to venture in more agricultural activities that will help them maintain long term productivity of aquaculture production.

‘When we started having training from the extension workers they did not only teach us aquaculture production but rather taught us on activities such as the production of horticulture crops whereby we can always integrate watering our gardens using fertile water from ponds after harvesting.’ (Respondent 3)

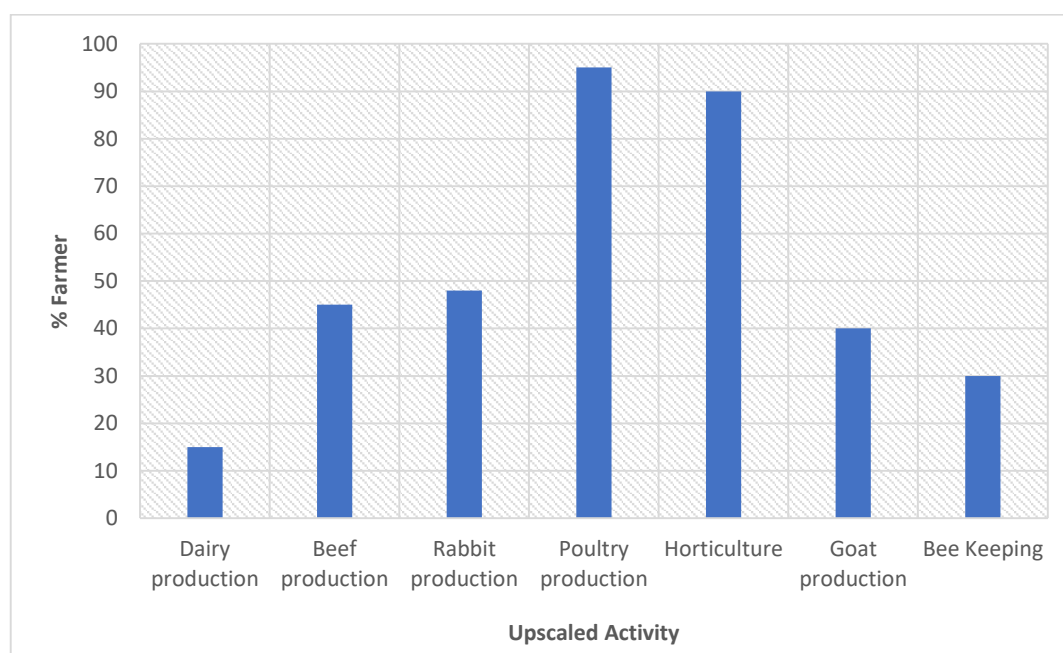
90 % of respondents indicated that they managed to start up horticulture since they had put up tanks and water pump mainly for pumping water into the fish pond but now they could integrate with other income-generating activities since they now are in a position of more physical assets. From the 90% who indicated venturing into horticulture 80% (n=30) are women. This has contributed a stronger asset base especially for vulnerable women as they can both sell vegetables thereby improving their food consumption.

Picture 15: Woman farmer showing her vegetable field she waters with water from fish ponds



Source: Field Data, (2019)

Figure 4. 8: Upscaled Agricultural activities through Aquaculture production



Source: Mhangwa, (2019)

60% of respondents highlighted that they are capable of saving money. Financial capital has enabled upscaling of agricultural activities such as Rabbit production with 48% indicating that they have a rabbit on their farms and they have quick sale returns as the market demand is quite high. The image below shows the rabbits that a farmer has upscaled and could return in maintaining aquaculture production boosting food security and reducing the vulnerability of farmers.

Picture 15: Upscaled rabbit production to run parallel with aquaculture production



Source: Field Data, (2019)

95% indicated that they have ventured and upscaled their poultry production due to aquaculture production.

'Poultry production gives quick returns and with economic hardships, people are now facing, beef is now very expensive to buy leaving most people with no option but to eat chicken. From the savings I made I managed to build a fowl run that accommodates 200 birds. When fish is off-season I concentrate more on broiler production making me less vulnerable to challenges we used to face.' (Respondent 29).

Table 4. 11: Upscaled activities done by men and women

Upscaled activity	Total	Male		Female	
		Frequency	Percentage	Frequency	Percentage
Dairy production	30%	8	40%	4	20%
Beef production	45%	13	65%	5	25%
Rabbit production	47.5%	5	25%	14	70%
Poultry production	95%	18	90%	20	100%
Horticulture	90%	16	80%	20	100%
Goat production	40%	2	10%	14	70%
Bee keeping	30%	12	60%	0	0

Source: Mhangwa, (2019)

The image below shows a batch of 200 broiler chickens and another batch that is being slaughtered during aquaculture off-season to reduce the vulnerability of farmers. 95% of respondents with 85% (n=34) being women who have broilers indicated that they get quick and higher returns. This makes them continue more with the construction of fish ponds promoting the sustainability and long productivity of aquaculture production. During interviews women who have ventured into broiler production indicated that they perceive a continuation of aquaculture production as it has created many agricultural activities. The fact that Aquaculture Zimbabwe helped them start aquaculture production with most inputs, it has paved way for the upscaling of more projects thereby reducing their vulnerability and promoting their food security.

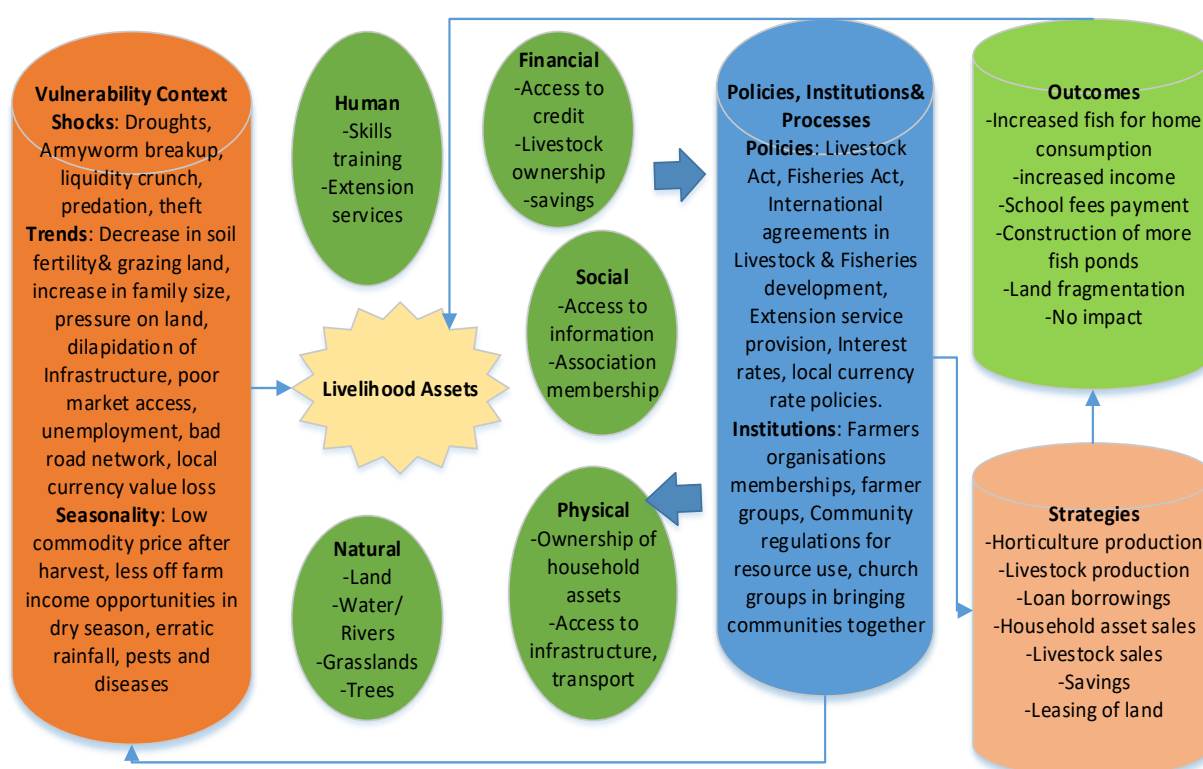
From the interviews conducted men tend to upscale more in beef cattle than women. 32.5% (n=13) men have upscaled in beef production as compared to 12.5% (n=5) women. This still shows that women are still regarded as not to own and control large stock in society as men perceive beef and dairy animals for prestige.

Picture 16 &17: Upscaled broiler production



Source: Field Data, (2019)

Figure 4. 9: Tongogara smallholder farmers- Sustainable Livelihood Framework



Source: Mhangwa, (2019)

Figure 4.10 summarises research question one, two and three. Tongogara smallholder farmers have capabilities, assets and activities required for their means of living. The results fits perfectly in the

Sustainable Livelihood Framework addressing the vulnerability context, livelihood asset, strategies and outcomes of aquaculture production. The results indicated that Tongogara smallholder farmers coped with droughts, pests and diseases, crop failure, erratic rainfall and deaths. Results also highlighted that they can maintain their capabilities and assets both now and in the future thereby sustaining aquaculture production. A strong asset base was highlighted, addressing all the five capitals. Respondents gained and improved on most of the capital such as financial capital, physical capital and social capital. Asset ownership influenced a wide range of livelihood options such as horticulture and livestock production. Tongogara smallholder farmers had an enabling policy and institutional environment that made it easier for farmers to venture into more agricultural activities. This reduced their vulnerability and promoted food security. Government and non-governmental organisations such as Aquaculture Zimbabwe, Lake Harvest Company and Aquafeeds played a great role in providing the technical expertise through extension services and input injections. The research questions thereby answer all the elements studied from the Sustainable Livelihood Framework.

4.6 Control and access over assets in effecting the sustainability of aquaculture production system.

Society is a construct of both men and women. Both men and women have a share in the production of goods and services and the management of natural resources. During focus group discussions, 56% indicated that women have less decision making power although they have access to most of the resources. 23% of women especially single and widows highlighted that they have control over their resources and this enables them to make decisions on issues that they perceive to be as of more priority. 12% of married women indicated that they both have access and control resources in their households working closely with their husbands. Single women and widows highlighted that they usually get assistance from relatives and friends in reducing their vulnerability. The research found out that women and men are allocated the same responsibilities in their fieldwork as work is given per individual farmer household representation. 35% of men indicated that heavy work that involves more power is done by men and women will carry out lightweight roles such as household chores. However, single women and widows indicated that they work despite the heaviness of work since they do not have assistance in most times.

'My husband passed away 3 years ago and I am left alone to carry out all the duties in the house so that I will be able to send my children to school and put food on the table for them. I control and own all the resources that I have and sometimes when I have extra savings I hire 2 women to come to assist me in harvesting my crops.' (Respondent 20).

Pictures below show a focus group discussion with men and women where information was gathered collectively and extensively.

Pictures 18 &19: Female and male focus group discussions



Source: Field Data, (2019)

From the interviews, it has been noted that there is a gender gap in the control of resources such as land, livestock and income.

'Of course, my wife has access to all the resources in our household when it comes to land, livestock and income all decisions are made and passed by me because I am the one who knows what needs to be done. My wife, she can also make her own decision on what to eat and cook.'
(Respondent 15)

Table 4. 12: Harvard Analytical Tool

Asset	Men	Women	Comments
Land	A	A	Men and women have access to the vast land. Men control decisions on subdivisions and leasing of land owned. Widows have access and control inherited land from their husbands
Water	A/C	A/C	Water is available in abundance. Both men and women have access to and control over water. Everyone is entitled to use available water from dams and boreholes
Cattle	A/C	A	Men and women can both access cattle. Cattle could be both physical and financial capital and men have control over decisions towards cattle. They are valued as a source of prestige. Women, they do not have control over sales or income from cattle
Goats	A	A/C	Women in Tongogara own small stock and they have access and control them. Men can also access but no say over sales made from goats
Sheep	A	A/C	According to tradition small stock gives power to women though men could claim that they are overall custodians of all livestock on the farm
Poultry	A	A/C	Women have control over poultry. However, money they make from salesmen can control on what needs to be done with it.
Credit	A/C	A/C	Both men and women have access and control of credits especially from association membership (Informal credit sources). Lack of collateral security outlaws accesses to formal credit for both men and women
Extension services	A/C	A/C	Both men and women have control and access to extension services at any given moment or time.
Income	A/C	A	Head of household usually makes decisions on how income is used.
Aquaculture production	A/C	A/C	Both men and women could access and control all resources that have to do with aquaculture production as it benefits the household
Association membership	A/C	A/C	Both men and women could access and control all resources that have to do with aquaculture production as it benefits the household.
Training/ Education	A/C	A/C	Women's education is low in society though they have access and control over training and education. Society still regards education as a priority of men rather than women.
Savings	A/C	A	Women are known for saving and they have access to money they get from sales. Control and usage of savings is usually at the discretion of men.

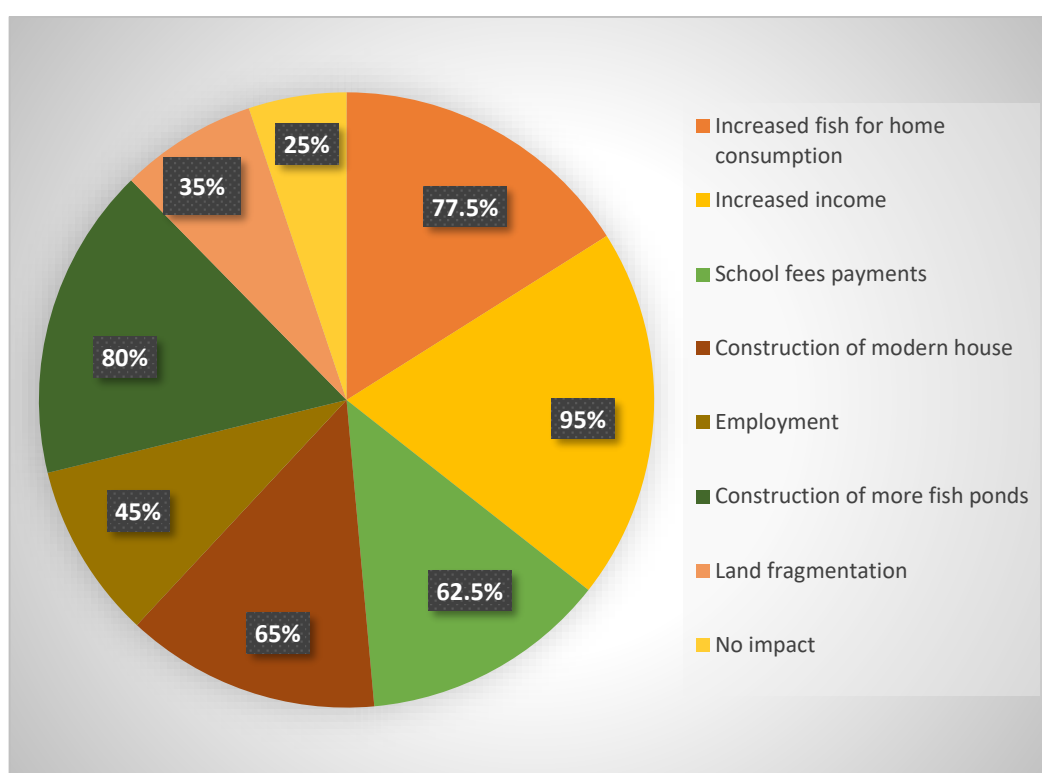
Source: Men and Women Focus Group Discussion, (2019)

The Harvard Analytical tool was used to highlight who has control and access of resources. Focus group discussions clearly elaborated how both men and women feel towards access and control of different assets. Through the integration of aquaculture production both men and women have full access and control to training and education. Gaining of skills and knowledge makes respondents more resilient and continue with different activities so as to improve on their food and nutrition status. The Harvard analytical tool also analysed that men still have control over income, savings, cattle and land. Society has always looked down upon women as they could not control such assets unless a woman is single or a widow.

4.7 Perceived impacts of Aquaculture production

During interviews respondents highlighted they perceived both direct and indirect impacts on their livelihood asset base through aquaculture production. From the interviews, 77.5% with 65% (n=26) being women perceived that due to aquaculture production there has been an increase in fish for their home consumption thereby improving their diets promoting food security. 95% highlighted an increase in income. Through skills training and exposure to extension services, both men and women could now minimize mortality rates that will enable more harvest thereby more fish yield would increase income. This allowed farmers to be able to save money to venture into more projects that could run parallel with aquaculture production promoting sustainability if aquaculture production even if the funding stops. An increase in income enabled 62.5% of farmers in paying school fees for their children in school.

Figure 4. 10: Perceived impacts of aquaculture production



Source: Mhangwa, (2019)

Integration of aquaculture production with other agricultural activities such as horticulture crops allows each element in a household to set up benefit from each other thereby reducing the production costs of the farmer. This practice has made me construct two modern houses as aquaculture production has made me utilize available resources benefitting me and my family. (Respondent 40)

Despite positive impacts, 35% indicated that they suffered from land fragmentation due to aquaculture production.

'When I discovered that Aquaculture Zimbabwe in conjunction with the government were venturing into aquaculture production providing inputs for interested farmers, I had to get his piece of land from his father. The piece of land I got was part of the maize field. The land had to be subdivided to cater for more people who wanted to venture into aquaculture production. (Respondent 13, a youth aged 28)

25% of the respondents with (n=4) male perceived no tangible impact as they were still to achieve positive impacts like acquiring livestock. Their harvests were mainly for home consumption. 15% (n=6) women highlighted that they still have to wait for their husbands to make decisions for them in terms of money. No tangible impact has been achieved as most times they quarrel after getting money from the fish harvests. Table 4.12 illustrate male and females who perceived on different elements from aquaculture production.

Table 4. 13: Perceived Impacts of Respondents

Perceived Impact	Total	Male		Female	
		Frequency	Percentage	Frequency	Percentage
Increased fish for home consumption	77.5%	11	55%	20	100%
Increased income	95%	19	95%	19	95%
School fees payments	62.5%	10	50%	15	75%
Construction of modern houses	65%	17	85%	9	45%
Employment	45%	11	55%	7	35%
Construction of more ponds	80%	16	80%	16	80%
Land Fragmentation	35%	10	50%	4	20%
No impact	25%	4	20%	6	30%

Source: Mhangwa, (2019)

Chapter 5- Discussion

5.0 Introduction

This chapter will discuss the results of the research making use of relevant literature from chapter two of this report. The baseline information helped to develop an understanding of the impact of livelihood assets on aquaculture production in achieving food security and sustainable livelihoods. Using the Sustainable Livelihood Framework in analysing the impact of livelihood assets on aquaculture production it provided an understanding of different contextual factors that include Tongogara smallholder farmers' vulnerability context and their livelihood asset.

5.1 Livelihood assets gained after venturing into aquaculture production.

The research revealed that there was an impact of aquaculture production on the livelihood assets of the Tongogara smallholder farmers. The researcher identified the most important livelihood assets such as natural capital, physical capital, human capital, social capital, and financial capital. It has been noted from the reviewed literature that aquaculture has a significant role to play in rural development and poverty alleviation (IFAD, 2011). The review of literature related to aquaculture production and sustainable livelihoods is limited in Sub-Saharan Africa (Cook, 2017). It showed even though there are some examples of aquaculture influence on livelihood assets and reduced vulnerability (De Haan, 2010). This concurs with results from the Tongogara smallholder area as before venturing into aquaculture production farmers had little or no knowledge.

A greater number of active farmers had more access to skills training and extension services which seemed an important factor for adopting aquaculture production. It was revealed that before aquaculture production no or little knowledge was there and extension workers played a significant role in imparting knowledge and training farmers. Local networks to disseminate information have been advocated (Sen et al, 2007).

It was observed that Tongogara smallholder farmers have access to land and water availability. Natural capital was seen to be of less challenge and this promotes intervention programs such as aquaculture production that was introduced by Aquaculture Zimbabwe in the area. Due to its smallholder operating size and lack of high advanced-technology machinery, the researcher concurs that aquaculture is labour-intensive (Mufudza, 2015) as farmers use nets for harvesting, digging of fish ponds and they do not have pumps to drain water from fish ponds. Account to this, villagers who do not have access to land can at least earn a living by providing manpower to other aquaculture farms (Ahmed & Lorica, 2012). Land ownership was identified as relatively important and a higher proportion of farmers and better-off households were landowners which seems to be an important factor for adopting integrated farming systems in the Tongogara area. The existing use of water bodies on pond construction has made aquaculture production to retain positive results. Aquaculture production creates an 'own enterprise' employment, where the entire family devotes to the business (Edwards, 2000). This could be seen in the Tongogara area as aquaculture brought in employment during pond construction and harvesting period. Occasionally, during the harvesting season or net changing period, extra hands are needed from casual or occasional labourers' (Ahmed & Garnett, 2010). The household size in the Tongogara smallholder farming area enabled off-farm season as most families comprised of 4- 8 people. Aquaculture production then creates job opportunities for illiterate women to earn side income for their household. As noted from a recent study of several fish farmers in Ghana, Nigeria,

and Kenya, it is reported that every single individual who gets involved in this sector, has three family members to support financially (Edward, 2000).

Farmers in Tongogara were in a position to improve on their financial capital through aquaculture production. This is also reported by Ahmed & Garnett (2011), that after the farmers' income has increased, they reflected stronger purchasing power than before and have better access to the resources, which includes sanitary, transportation, housing, health services, and communication technologies, all are credited to integrated farming. Aquaculture production was perceived as more likely as primary activity by most farmers, reflecting similar importance (Bestari et al, 2005). The contribution of aquaculture production to the total income of the households was primary, a finding similar to that of another study carried out in Kenya (Hallman et al, 2003). The successful aquaculture in the Tongogara area has significantly improved the living standards of the locals. Although aquaculture provides fewer advantages to the poor communities in absolute terms, it benefits much more in terms of relative terms via poverty reduction and relative inequality (Irz et al, 2007). Physical capitals presented in the research included ownership of radio, television, gas refrigerators, mobile phone, bicycles, water pumps, and trucks. Radio turned out to be a common item as this enabled most farmers to access to information. Independent means of transportation were also significantly higher as most farmers owned a bicycle and a truck that helped them to access the market and other facilities. A similar finding of physical assets was reported in a recent study carried out in Uganda (Ahmed et al, 2005). Overall, almost all farmers were involved in association membership and this enabled farmer to be less vulnerable as help could come anywhere.

5.2 The vulnerability context affecting the sustainability of the aquaculture production.

A double causality between the vulnerability context and asset ownership could be highlighted from the results as smallholder farmers suffered from shocks losing their assets. On the other hand, acquired assets helped protect people's livelihoods against shocks. The vulnerability context had critical implications for Tongogara smallholder livelihood opportunities. Tongogara smallholder farmers have been exposed to unpredictable events that undermined and caused households to fall into poverty. Some of the factors were drought, the prevalence of pests and diseases, land pressure due to high population growth, price increases, and liquidity crises. Results highlighted that there were exposed to idiosyncratic shocks that principally affected only individually households such as deaths and sickness.

In general, livelihoods are sustainable when they are resilient in the face of shocks and stress, do not depend on external support, maintain the long term productivity of the natural resources and do not undermine the livelihoods options of others (DFID, 1999). In the Tongogara area, farmers suffer from various shocks and this hinders the sustainability of aquaculture production. Many farmers portrayed that aquaculture production had brought a positive impact with increased income to curb different challenges, however, liquidity crises have been hindering their production. This concurs with DFID 1999, as it notes that peoples' livelihoods and asset availability are fundamentally affected by the vulnerability context. Tongogara smallholder farmers face challenges after they implement coping strategies to reduce their vulnerability. Farmers suffer from stress after getting loans from money lenders or after being assisted by relatives or family members. Climate change can cause both trends in the form of changing weather patterns or shocks in the form of an unpredictable rainy season or droughts. The effects of climate change were according to the farmers in Tongogara already evident, challenging alternative agricultural practices.

From the results as observed by (Collier et al. 2008), farmers suffer from stress after employing a coping strategy. More assets enabled Tongogara smallholder farmers to lose or sell a few animals and still have enough breeding animals to build up their herds again after the emergency passes.

5.3 Upscaling of other agricultural activities in maintaining long term productivity.

Engaging in aquaculture production has been recognized as a primary livelihood strategy (Hallman et al, 2008) of farming households. Usually, farmers whose primary source of income is agriculture are more concerned about land accessibility (Ervin et al, 2008). Overall aquaculture played an important role in income generation in all interviewed households. The livelihood asset enabled the upscaling of different agricultural activities such as dairy production, beef production, poultry production, mostly horticulture (Aiga et al, 2009), goat production and beekeeping. On most interviewed farmers, aquaculture production was self-supportive. Similar observations on livelihood asset upscaling and combining other agriculture activities and aquaculture were made by Kawarazuka and Bene (2010).

The overall high importance of farmers who received pension and salary as they would plow into aquaculture production. Farmers with no support relied most on aquaculture as their primary source of income. Due to the livelihood assets, farmers integrate aquaculture with several activities and this concurs with FAO, 2016, which notes that in Nigeria 50% of aquaculture production integrates poultry, piggery or livestock and additionally integrated crop farming. FAO, 2016 observes that aquaculture production was enabled farmers to become resilient and sustain aquaculture production through the integration of other activities.

5.4 Control and access over assets affecting the sustainability of aquaculture production system.

The overall high importance of farmers who received pension and salary as they would plow into aquaculture production. Farmers with no support relied most on aquaculture as their primary source of income. Due to the livelihood assets, farmers integrate aquaculture with several activities and this concurs with FAO, 2016, which notes that in Nigeria 50% of aquaculture production integrates poultry, piggery or livestock and additionally integrated crop farming. FAO, 2016 observes that aquaculture production was enabled farmers to become resilient and sustain aquaculture production through the integration of other activities.

Concerning livelihood assets, the research revealed that control over assets has been successful in combining different types of capital in effecting the sustainability of aquaculture production. It is having been noted that social capital and physical capital have been most important as explored in the findings. As discussed by, Huatala, 2010, women play a key role and both formal and informal sectors are hampered by their limited ownership and access to resources like land and financial capital. This research revealed that both men and women had access to most resources. However, financial capital was mainly controlled by men giving women less power in decision making, this concurs by a study in Bangladesh as women who want to start aquaculture production may be limited by their poor access to financial capital.

Tongogara men and women could have an adaptive strategy of forming an association that they could borrow credit at reasonable interest and most women had control over social capital though men were also included in such activities. It is, therefore, necessary to understand gender issues because, on basic needs, livelihood and assets, women and men's differential access to and control of assets has varied implications. Men's and women's differential access to resources is explained by implications of

policy, processes, and institutions. According to culture and norms in the Tongogara area, women do not control natural capital such as land or even financial capital such as livestock. However, it was noted that women could also control small stock livestock such as poultry and goats (Helmer & Singh, 2001). This is supported by Devendra, 2012, with a study in Uganda whereby women can only access resources but they cannot have control or make a decision on their own unless the women are single or widowed.

On human capital such as skills training and extension services, women and men in Tongogara they both have control and can access such services. Extension service delivery in the Tongogara area is not gender-biased because skills training and extension services offered both targets all farmers unlike, Cook, 2017, notes a study in Uganda where extension service delivery is gender-biased because services are offered by men who target mainly male farmers. On the other hand, it is argued that women access less service from extension workers because they cannot afford the cost of hiring them. It is evident in the Tongogara smallholder area that gender equality in accessing all livelihood assets, control and ownership are prerequisites to agricultural mechanization as well as affecting the sustainability of aquaculture production. Alal, (2012), observed with a study in Bangladesh, that without commitment to improving women's ability to access and own land, including action and co-ownership clause, the contribution of a modern agriculture sector to poverty eradication in Uganda will be seriously compromised.

5.5 Reflection as a researcher

The research entails an iterative process and one could think he or she has come to the conclusion. In research, one can move back and forth when conducting research. Conducting research was a big task and sometimes tiresome. During my proposal writing, I would go for days without sleeping getting worked up most times. When I wrote my proposal draft for submission to my supervisor, I would be thinking I have given it all but during and after the feedback, I would realize most of the things I would have overlooked and how significant an impact they were. The process of feedback could be quite draining and sometimes frustrating, but as a researcher, I learned to be patient taking time in understanding how to make corrections. It is from the feedback that we get to learn our pitfalls and blindspots. I have learned a lot not only during the research period but the masters' program as a whole.

From the research, I got the impression that although women strive to uplift their status in both households and community, they do not do this in isolation but recognize the role men play towards their empowerment thus their reason for including them in some of their activities. From my analysis as a researcher from documents, interviews with key informants (extension workers and project officers), they promoted aquaculture production in different ways such as training, demonstration, field visits providing technical information to aquaculture farmers. On the other hand, the level at which policies are implemented requires further research. Tongogara aquaculture project was mainly guided by policies from the Department of Livestock Production and Development and Aquaculture Zimbabwe. As a researcher, I noted that policies that were put in place mainly emphasized on continuity and sustainability of aquaculture production.

During my focus group discussion with women, most of them revealed that with time and more experience they would be able to transfer the skills they have from aquaculture production and other

agricultural activities to the rest of the community members that are not currently into aquaculture production. During my research period, I can reflect on how farmers are so eager to pursue more agricultural activities but due to Zimbabwe economic meltdown, a lot of challenges are being faced. I struggled to cope up with the high prices of goods and services when I went back home for my research. There is a time I would struggle to travel daily to the Tongogara area from my home that was 80km away. But as a researcher who was determined to carry out my research effectively, I would stay up in one of the farmers' house and I would buy groceries for the family. As a researcher buying of groceries for farmers could create biasness, but my situation had to allow me to appreciate people who had taken me as a visitor. As a researcher who wanted to fulfil the obligations, I ended up borrowing a loan for transport money due to high transport fares. It takes one to sacrifice for something good to come out.

During my research, I felt that some farmers were hesitant to give me all the information but yet guarding themselves on giving out information that would be deemed against governmental programs. However, I tried to give assurance of confidentiality to my respondents but being a government worker is also a disadvantage as they somehow felt I might be spying on the departments' behalf. As a woman undertaking men focus group discussion was a challenge. Some men from the focus group discussion were not open enough to discuss especially on decision control in their households and there was less active participation. I quickly thought of the power of a pen. I gave out pens and papers to all men and assured them that it was confidential. I got more information as men wrote down their feelings and how they perceived some questions.

During data analysis, it would prove to be quite challenging for me as I had never done qualitative research before. I had a lot of data that all needed triangulation. Leaving some data that you find interesting but not addressing the research questions was hard to do making me realize areas of further research. From the data, I collected I go to learn more about what farmers perceived as impacts due to aquaculture production. It proved to be quite difficult to drop the answers as they had the main answer to all the questions overall. I had to incorporate the aspect of perceived impacts of aquaculture production by Tongogara smallholder farmers.

Chapter 6: Conclusion and Recommendations

6.1 Conclusion

In conclusion, it was elaborated that there was a significant impact of aquaculture production on livelihood assets. Access and control of all the livelihood assets enabled Tongogara smallholder farmers to invest in more assets than they had before. Through a strong base of the livelihood asset, there was increased fish production for home consumption and increased income for the household. It is clear from the research findings that outcomes from aquaculture production improve most livelihoods of those engaged in it. Outcomes of aquaculture production are either through an improved through employment and increased incomes. From this research, it is evident that Tongogara smallholder farmers benefitted from tangible and intangible outcomes of not only aquaculture production but also from upscaled agricultural activities.

Concerning livelihood assets, the study revealed that Tongogara smallholder farmers have been successful in combining different types of capitals to achieve their outcomes. It is important to remember that social capital, financial capital and human capital (Extension services) has been the most important as revealed in the results. The study presented that both men and women in Tongogara formed cooperatives as a way of sustaining their livelihoods. Social capital came out to be a strong base as all farmers involved in aquaculture production were part and parcel of association membership.

This study has shown that the drawbacks of Tongogara smallholder farmers have stemmed from shocks and stresses they encountered such as droughts, erratic rainfall, pests and disease infestations, predation and theft. However, both men and women reacted differently to shocks and stresses to their livelihoods. Tongogara smallholder farmers tend to cope with shocks more successfully even though some would suffer from stress. Some of the coping strategies identified were, borrowing loans from relatives, selling of household assets, livestock and off-farm activities even though this substantially increases their workload. Tongogara smallholder farmers were found to be involved in various activities both as a group and individuals. It is revealed that extension workers and project officers in aquaculture production have been acquainted with most challenges encountered by farmers. The results attest that extension workers would be on the ground to help minimize mortality rates of fish. Theft and predation of fish in ponds have been a challenge and farmers have put up security structures such as fences and nets to control and secure ponds.

The land which was not fit for crop production was put to use by Tongogara smallholder farmers introducing ponds and thus maximizing land utility. Integration of aquaculture production with other agricultural activities such as horticulture production, poultry production, rabbit production, and beekeeping benefitted farmers as this reduced production costs of the farmer in setting up a new enterprise. This has enabled farmers to maximize the optimal utilization of available resources to their benefit on a cost-effective basis. On-farm and locally produced materials like green leaves, maize bran from their farms it has been used to supplementary feed fish in ponds while cow dung, chicken manure, and rabbit manure has been utilized to fertilize and culture the ponds.

It is evident that gender equality in livelihood asset control, access and ownership are prerequisites to agricultural modernization. The research pointed out the active participation of both men and

women in aquaculture production. It can be concluded that men in Tongogara still have control over decisions concerning land, livestock (large stock) and income from agriculture. However, widows who have inherited assets from their late husbands have control means of production enabling them to participate in more agricultural activities. The research findings reflected that there was equal representation in shared responsibilities and benefit-sharing by both men and women thus help reduce the vulnerability mostly by women. Emphasis on both men and women is based on the fact that they are usually the central engine of development in their households. Women from Tongogara could easily implement action plans in their households.

Overall, an insight is given on how Tongogara smallholder farmers have come together for poverty alleviation and sustainability of aquaculture production.

6.2 Recommendations

The main objective of the research was to assess the impact of aquaculture production on the livelihood asset base in achieving food security, resilience and not to depend on external support of Tongogara smallholder farmers in order to provide recommendations to the Ministry of Agriculture, Department of Livestock Production and Development for upscaling of aquaculture production in similar drought risk areas.

1. The Ministry of Agriculture should institute policies that educates farmers in fingerling production to solve the problem of limited fingerlings, educating the farmers on fingerling breeding programs and to encourage the associations to invest in infrastructure for hatcheries instead of relying on donor funds and government projects.
2. Farmers should be taught how to produce their high-quality fish feed from locally available raw materials such as soya bean and cotton seeds.
3. Local feed mills and local hatcheries should be promoted to reduce costs for important fish farm inputs and high mortality rates of fingerlings
4. Encourage aquaculture farmers to be members of Association groups and cooperatives to improve on social capital amongst each other which may prove to be helpful in problem-solving and being interdependent.
5. The reliance on aquaculture production on natural water resources needs to be alleviated through the construction of dams and drilling of boreholes, use of solar-powered water pumps to secure water supply during droughts.
6. There is a need for further awareness programs and sensitization that encourage involvement of women in aquaculture production.
7. There is a need to create strong linkages and collaboration among research institutions (Zimbabwe Fish Producers' Association) and individual aquaculture farmers as well as potential farmers creating a strong forum for the exchange of information.

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APPENDICES

Appendix 1: Semi structured interviews for Project members

#.....

Date /..... / 2019

My name is Grace Mhangwa. I am a Masters student doing Food Nutrition and Security at Van Hall Larenstein University. I am requesting for your participation in this research by answering the semi structured questions below on the research study on **Assessing the Impact of aquaculture production on the Livelihood asset for promoting food security and sustainable livelihoods: Case study of Tongogara Smallholder Farmers**. Information collected will be strictly for academic purposes and will be treated with utmost confidentiality. Your cooperation is appreciated.

Section A: Demographic Data

1. Gender

MALE		FEMALE	
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2. Age

18-20yrs	21-30yrs	31-40yrs	41-50yrs	+50yrs

3. Marital status

Single	Married	Divorced	Widowed

4. Household size

1-4 people	4-8 people	8 people and Above

SECTION B: RESEARCH QUESTIONS

a. Which livelihood assets were influenced by aquaculture production on farmers' livelihood in achieving food security?

1. When did you start aquaculture production?
2. What livelihood assets did you have before venturing into aquaculture production?
3. What household assets have you acquired after venturing into aquaculture production?

4. What was your household source of income before aquaculture production?
5. Was the income sufficient for all the needs of the household to depend on for survival?
6. How many people were formally employed in your household before aquaculture production?
7. How many people are employed due to aquaculture production?
8. Does aquaculture provide additional income to your household?
9. What are you using income from aquaculture production for?
10. Do you have access to credit facilities? Which financial institutions have assisted you?
12. Are you capable of making savings? If so, from what source?
13. Do you own livestock? If so, which livestock do you have?
14. Who owns the piece of land you are using for aquaculture?
15. How many hectares of land do you have?
16. What is your source of water supply for aquaculture production?
17. Where do you buy your inputs from?
18. Where do you sell your fish produce at?
19. How do you market your fish produce?
20. How do you transport your inputs and outputs?
21. How do you communicate with suppliers and customers outside Tongogara?
22. What aquaculture production equipment do you have?
23. How many constructed fish ponds do you have?
24. Have you ever received any form of training in Aquaculture production?
25. How do you access your extension services?
26. How do you access to information on aquaculture production?
27. Are you a member of any association or cooperative? If yes, why?
28. What are the benefits of being a member of an association or cooperative?

b. How does the vulnerability context effect the sustainability of the aquaculture production for farmers to become more resilient?

29. What are the challenges you have faced before venturing into aquaculture production?
30. How have you tried to adapt to these challenges?
31. Have you been experiencing water challenges especially during the dry season?
32. What is your proximity to your water source?

33. Please give a summary of your seasonal calendar indicating the time and the challenges you have faced as a farmer.

Activity	January- March	April-June	July-September	October-December

34. What shocks and stresses do you still experience that affect the sustainability of aquaculture production?

35. Do you have coping strategies? If yes, what are these strategies?

36. What other problems have you faced after implementing the coping strategies?

c. How has the livelihood asset base upscaled other agricultural activities in maintaining long term productivity of aquaculture production?

37. Are you involved in other agricultural activities for you not to depend on external support?

38. What other agricultural activities are you involved in that have been upscaled by aquaculture production?

39. Do you have plans to continue with aquaculture production in the next 5years? Why?

40. In your own opinion, what are the perceived impacts of aquaculture production in promoting food security?

41. What do you think could be done to maintain the long term productivity of aquaculture production?

d. How does control over assets effect the sustainability of aquaculture production system?

42. Who has access to all the livelihood assets in your family for sustainability of aquaculture production?

43. Who has access and control of information, association membership for sustainability of aquaculture production?

44. Do you have access and control to extension services for you to become resilient?

45. Do you include women in all your activities? If yes, why?

46. Who has control over financial capital?

47. Who controls labour allocation in your family?
48. Who makes production decisions in your family?

Thank you for your participation in this study

Appendix II: Interview guide for Aquaculture Zimbabwe project officer

Good day. Thank you for taking your time to participate in this interview. My name is Grace Mhangwa and I am a Masters student at Van Hall Larenstein University. The purpose of this interview is to gain knowledge and understanding of the baseline information on the implementation and impact of aquaculture production on the livelihood asset of Tongogara smallholder farmers.

Name:

Position in office:

Research Questions

a. Which livelihood assets were influenced by aquaculture production on farmers' livelihood in achieving food security?

1. How has Aquaculture Zimbabwe been involved with Tongogara smallholder farmers?
2. What made your organisation choose Tongogara smallholder area to be involved in aquaculture production?
3. Which livelihood assets did Tongogara smallholder farmers have before the implementation of the project?
4. What type of assistance have you provided in the implementation of aquaculture production in Tongogara area?
5. Do you offer extension services to Tongogara smallholder farmers?
6. How do Tongogara smallholder farmers access information from your organisation?
7. How many farmers are involved in aquaculture production? And why?
8. Do Tongogara smallholder farmers have access to credit facilities?
9. Are you involved in forming of fish cooperatives and associations for management of constructed ponds?
10. Do farmers have access to communication facilities, market facilities and transport facilities?

b. How does the vulnerability context effect the sustainability of the aquaculture production for farmers to become more resilient?

11. What challenges were being faced by Tongogara smallholder farmers before venturing into aquaculture production?

12. What has your organisation done to curb these challenges?
13. Are there any challenges that have been faced by your organisation that affect aquaculture production?
14. What challenges were faced by your organisation during project implementation?
15. What challenges are being faced by Tongogara smallholder farmers for sustainability of aquaculture production?
16. What shocks do farmers face in setting up aquaculture production facilities?
17. How does the seasonality affect the sustainability of aquaculture production?
18. Do farmers face difficulties in harvesting and selling of their fish produce?

c. How has the livelihood asset base upscaled other agricultural activities in maintaining long term productivity of aquaculture production?

19. What are other agricultural activities done by Tongogara smallholder farmers in achieving food security?
20. Do you offer any assistance to farmers in securing other agricultural activities mentioned above?
21. In your own opinion, will Tongogara smallholder farmers maintain aquaculture production?
22. In your own opinion, what should be done for Tongogara smallholder farmers in maintaining aquaculture production and not to depend on external support?

d. How does control over assets effect the sustainability of aquaculture production system?

23. Does your organisation play a role in educating farmers on control over assets for sustainability of aquaculture production?
24. Who has more control over assets in Tongogara households for sustainability of aquaculture production?
25. Are women given the priority in accessing and control over assets in achieving food security?

Thank you for your participation

Appendix III: Interview guide for Agritex extension officer

Name:

Position in the Office:

Good day. Thank you for taking your time to participate in this interview. My name is Grace Mhangwa and I am a Masters student at Van Hall Larenstein University. The purpose of this interview is to gain knowledge and understanding on the impact of aquaculture production on the livelihood asset base of Tongogara smallholder farmers. As an extension worker you are involved in the day to day running of aquaculture production with Tongogara smallholder farmers.

a. Which livelihood assets were influenced by aquaculture production on farmers' livelihood in achieving food security?

1. How have you been involved in aquaculture production on Tongogara smallholder farmers?
2. Which livelihood assets did Tongogara smallholder farmers have before project implementation?
3. Which livelihood assets are now in possession of Tongogara smallholder farmers?
4. What type of assistance have you provided in the implementation of aquaculture production in Tongogara area?
5. What type of extension services do you offer to Tongogara smallholder farmers?
6. How accessible are you as an extension worker to Tongogara smallholder farmers?
7. How do Tongogara smallholder farmers access information?
9. What are other sources of information for Tongogara smallholder farmers?
10. How many farmers are involved in aquaculture production? And why?
11. Do Tongogara smallholder farmers have access to credit facilities?
12. Are you involved in forming of fish cooperatives and associations for management of constructed ponds?
13. Do farmers have access to communication facilities, market facilities and transport facilities?

b. How does the vulnerability context effect the sustainability of the aquaculture production for farmers to become more resilient?

11. What challenges faced by Tongogara smallholder farmers in maintaining aquaculture production?
12. What have you done as an extension worker to curb these challenges?
13. Do you as an organisation have challenges that affect sustainability of aquaculture production?
14. What shocks do farmers face in setting up aquaculture production facilities?
15. How does the seasonality affect the sustainability of aquaculture production?
16. Do farmers face difficulties in harvesting and selling of their fish produce?

c. How has the livelihood asset base upscaled other agricultural activities in maintaining long term productivity of aquaculture production?

17. What are other agricultural activities done by Tongogara smallholder farmers in achieving food security?
18. Do you offer any assistance to farmers in securing other agricultural activities mentioned above?
19. What other coping strategies do Tongogara smallholder farmers have in achieving food security?
20. In your own opinion, will Tongogara smallholder farmers maintain aquaculture production?
21. In your own opinion, what should be done for Tongogara smallholder farmers in maintaining aquaculture production and not to depend on external support?

d. How does control over assets effect the sustainability of aquaculture production system?

22. Does your organisation play a role in educating farmers on control over assets for sustainability of aquaculture production?
23. Who has more control over assets in Tongogara households for sustainability of aquaculture production?
24. Are women given the priority in accessing and control over assets in achieving food security?

Thank you for your participation

Appendix IV: Observation checklist

What to Observe	Comment
a. Which livelihood assets were influenced by aquaculture production on farmers' livelihood in achieving food security?	
Physical Capital Household assets acquired after aquaculture production Physical markets for selling fish harvests Accessible Roads Production equipment acquired after aquaculture production Constructed fish ponds Financial capital	

<p>Credit facilities</p> <p>Livestock owned by farmers</p> <p>Natural Capital</p> <p>Land owned</p> <p>Water facilities/ sources</p> <p>Human</p> <p>Extension workers</p> <p>Social capital</p> <p>How project members are working together and interacting</p> <p>Expression of emotions and feelings by project members</p>	
<p>b. How does the vulnerability context effect the sustainability of the aquaculture production for farmers to become more resilient?</p>	
<p>Shock and stress indicators</p> <p>Graves</p> <p>Affected crops</p> <p>Affected livestock</p> <p>Quality of grazing land and pastures</p> <p>Proximity of sources of water</p> <p>State of roads</p>	
<p>c. How has the livelihood asset base upscaled other agricultural activities in maintaining long term productivity of aquaculture production?</p>	
<p>Livestock</p> <p>Crops being grown in gardens</p>	

d. How does control over assets effect the sustainability of aquaculture production system?	
Asset control and access in households	

Appendix V: Focus Group Discussion Schedule

Good morning. Thank you all for taking your time to participate in this Focus Group Discussion. My name is Grace Mhangwa and I am a Masters student at Van Hall Larenstein University. The purpose of this Focus Group Discussion is to discuss on the Impact of aquaculture production on the livelihood asset base of Tongogara smallholder farmers in achieving food security and sustainable livelihoods. My role is to facilitate the proceedings of this discussion.

a. Which livelihood assets were influenced by aquaculture production on farmers' livelihood in achieving food security?

1. How did you get involved in aquaculture production?
2. Which livelihood assets did you acquire after venturing into aquaculture production?

An asset ranking exercise will be done with the whole group as all members are expected to participate.

3. How has aquaculture production impacted on your financial capital?
4. What are you mainly using your income for?
5. Have you received training? If yes from who?
6. How effective has training been on the sustainability of aquaculture production?

b. How does the vulnerability context effect the sustainability of the aquaculture production for farmers to become more resilient?

7. What are the challenges you face as aquaculture producers?
8. How has aquaculture production helped you to overcome above challenges?
9. What are your seasonal challenges?

Farmers will participate in coming up with their seasonal calendar and challenges they face during that time

c. How has the livelihood asset base upscaled other agricultural activities in maintaining long term productivity of aquaculture production?

10. List the agricultural activities done for long term productivity of aquaculture production.
11. What are your perceived impacts of aquaculture production in achieving food security?

d. How does control over assets effect the sustainability of aquaculture production system?

12. Who has control and access over assets in households?

Harvard Analytical Tool will be used to answer this question.

13. List the assets in possession of farmers indicating who has control and access over.

Thank you for your participation and cooperation

Appendix VI: Pictures









Appendix VII: Research Clearance Letter

All correspondence should be addressed to the DCLEO
Department of Agricultural Technical and Extension Services

CLPD **MINISTRY OF LANDS, AGRICULTURE, WATER, CLIMATE AND RURAL RESETTLEMENT**

P.O. Box 912, Gweru District, Telephone 0542221936 / 22253038

Ref: 5900751J

03 March 2019

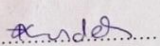
The DCLDO
SHURUGWI

RE: NOTIFICATION OF THESIS RESEARCH IN TONGOGARA RURAL DISTRICT COUNCIL: MHANGWA GRACE: EC. 5900751J

To whom it may concern,

Mrs Grace Mhangwa is currently pursuing her studies in Management of Development-Food and Nutrition Security at Van Hall Larenstein University, Netherlands. She is here to conduct a research on the **Impact of Aquaculture production on the Livelihood asset base of Tongogara smallholder farmers.**

We kindly ask you to support Grace Mhangwa during conduct of her research from the 1st of July 2019 to 13th of August 2019


V. MANDEBVU
FOR THE PROVINCIAL CROP AND LIVESTOCK DEVELOPMENT OFFICER- MIDLANDS PROVINCE

