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Sustainable Livelihoods: The Role of Small-Scale Aquaculture to Food Security in Malawi

by

Alison Simmance

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ABSTRACT

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The rapid rise and evolution of aquaculture over the past few decades has led to both optimism and apprehension regarding the sector's sustainability and role to food security. Comprised predominantly of small-scale operators, the sector is recognised to play a critical role in supporting livelihoods, contributing to food security and alleviating poverty. However, the ability to achieve these potential benefits is not a given and the transformation of communities adopting aquaculture can be positive, neutral or negative. Assessing the sectors contribution in a systematic way has been an uphill challenge due to the typical part-time and dynamic temporal engagement of operators as well as the complex socio-ecological factors that mediate aquaculture development outcomes. Moreover, the multidimensional concept of food security presents challenges to the assessment of the role of aquaculture to food security. The aim of this thesis is to explore and assess the role of small-scale aquaculture to food security. This thesis adopts a mixed methods approach and is guided by the Sustainable Livelihoods Approach framework. This thesis's contribution to the debate focuses on Malawi, a country where the potential for aquaculture development is reported considerable. Drawing on mixed qualitative and quantitative methods, overall findings reveal that small-scale aquaculture contributes marginally but positively to local livelihoods through complex pathways to improved food security, improved well-being and reduced vulnerability. However, the type of aquaculture development, gender relations and cultural norms shape development outcomes. Significant social, environmental and economic constraints are also identified that negatively affect the sustainability of aquaculture. Findings presented have important policy implications and make novel contributions to the on-going debate concerning aquaculture's future and its role to food security.

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Declaration of Authorship

I, Alison Simmance

declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

The Value of Small-scale Aquaculture to Food Security in Malawi

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
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Signed: ....

Date: 01.09.17

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"If you want to go fast, go alone. If you want to go far, go together". African Proverb.

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Finally, and most importantly, eternal thanks to my husband James Budden for being my navigator and rock throughout this entire journey and for believing in my ability and passion.

Zikomo Kwanbiri.

Definitions and Abbreviations

Definitions

Food and nutrition security:

The term ‘food security’, was defined by FAO (1996) as ‘Food security is a condition when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life’. This definition includes the nutritional aspect which is described as ‘access to nutritious food to meet their dietary needs’ (HLPE, 2014).

Under-nutrition:

This review uses the term ‘under-nutrition’, as described by Kawarazuka and Bene (2010), as the outcome of insufficient food intake (hunger) and repeated infectious diseases. Under-nutrition includes being underweight for one’s age, too short for one’s age (stunted), dangerously thin (wasted), and deficient in vitamins and minerals (micronutrient malnutrition).

Abbreviations

ADD Agricultural Development Divisions

AEDC Agricultural Extension Development Coordinator

ARDEC Aquaculture Research and Development Centre

ANOVA Analysis of Variance

CGIAR Consultative Group for International Agricultural Research

CIA Central Intelligence Agency USA

CBRM Community-Based Participatory Research method

CSI Coping Strategies Index

DFID UK Department for International Development

DHS The Demographic and Health Surveys Program

DoF Department of Fisheries Malawi

EU European Union

FAO Food and Agricultural Organization of the United Nations

FSRP Farmer–Scientist Research Partnership

FCS Food Consumption Score

FCGs Food Consumption Groups

GDP Gross Domestic Product

GoM Government of Malawi

GTZ Deutsche Gesellschaft für Technische Zusammenarbeit

HLPE High Level Panel of Experts

HIV/AIDS Human immunodeficiency virus infection and acquired immune deficiency syndrome

IAA Integrated Agriculture Aquaculture

IDRC International Development Research Centre

IDS Institute of Development Studies

IFAD International Fund for Agricultural Development

IIED International Institute for Environment and Development

IMTA Integrated Multi-Trophic Aquaculture

HHS Household Survey

MKW Malawian Kwacha

NGO Non-Governmental Organisations

KII Key Informant Interviews

MANOVA Multivariate Analysis of Variance

MoMN&E Ministry of Mines, Natural Resources and Environment

NASP The National Aquaculture Strategic Plan

NCST National Committee for Science and Technology Malawian

NEPAD New Partnership for Africa's Development

NFP National Fisheries Policy Malawi

NRCM National Research Council of Malawi

NSO National Statistics Office of Malawi

OECD Organisation for Economic Co-operation and Development

PCA Principle Components Analysis

PRA Participatory Rural Appraisal

PIAD Presidential Initiative on Aquaculture Development in Malawi

SARNISSA Sustainable Aquaculture Research Networks in sub-Saharan Africa

SDG Sustainable Development Goals

SLA Sustainable Livelihoods Analysis

SSA Sub-Saharan Africa

SSF Small-Scale Fisheries

SPSS Statistical Package for the Social Sciences

UN United Nations

UNDP United Nation Development Programme

UNICEF United Nations Children's Fund

USAID United States Agency for International Development

WFP World Food Programme

WHO World Health Organisation

Chapter 1: Introduction

1.1 Overview

Aquaculture, defined as the farming of aquatic organisms, principally fish, molluscs, crustaceans and marine algae (Bunting 2013), has undergone rapid growth in volume and value over the decades provoking both optimism and apprehension among researchers and practitioners concerned with global food security (Troell et al 2014; Bene et al 2015; Bene et al 2016). A milestone was reached in 2014 when the aquaculture sector's contribution to global food fish supply reached 50% and outpaced that of capture fisheries for the first time (FAO 2014). Driven by the high and increasing demand for seafood, the aquaculture sector is the fastest growing food sector world-wide, reaching an all-time high in production estimated at 73.8million tonnes (mt) in 2014 (sale value of $160bn) (FOA, 2016).

Referred to as the 'blue revolution', the aquaculture sector has expanded world-wide to become one of the most vibrant, complex and diverse sectors of the global food system (Ottinger et al 2016). The term 'blue revolution' was originally described by Baily (1985) and referred to the negative effects of technology innovations in capture fisheries on fish stocks. In contrast, in the context of aquaculture development the term refers to the remarkable emergence of aquaculture since the 1990s as an important contributor to global fish consumption (Lucas and Southgate, 2012; Belton and Thilsted, 2014; Ponte et al 2014; Krause et al 2015; Troell et al 2014). However, the general use of the term 'blue revolution' masks two important factors. Firstly, and as increasingly reported in the literature, the blue revolution is not a new phenomenon (Beveridge and Little 2002; Costa-Pierce 2002, 2010). As described by Costa-Pierce (2010), aquaculture has a long history with many periods of growth and current aquaculture development trends reflect an important 'industrial' period. Secondly, the current blue revolution is particularly driven by aquaculture growth in developing countries. For example, as pointed out by Lucas and Southgate (2012), 50 out of 51mt/year increased rate of global aquaculture production during the period 1987-2007 was derived from developing countries. Furthermore, the most recent statistics by the FAO (2016) reveal that in 2014 the distribution of global aquaculture production varied nationally and regionally, predominantly occurring in Asia (65.6mt or 89% share of total world production) driven by growth of the industry in China (45.5mt).

Aquaculture production systems can be classified into inland aquaculture and mariculture, cumulatively cultivating over 600 aquatic species with varying input intensities and technology innovations (FAO, 2012). Inland finfish aquaculture is the most common form of aquaculture globally (FAO, 2016). Global per capita fish consumption has doubled since the 1960s, rising from 9.9kg in the 1960s to a record high of 20kg a year in 2016 (FAO, 2016). The rapid rise in global per capita fish consumption over the past decades is driven by dramatic growth in aquaculture production, increasing demand for fish, improvements in certain capture fish stocks as well as reductions in fish wastage (Ottinger et al 2016; FAO, 2016). Demand for fish is projected to keep rising and emerging consensus points to aquaculture to meet the growing supply-demand gap, which will require the doubling of aquaculture production to an estimated 140mt in 2050 (World Bank, 2013; FAO, 2016).

Capture fisheries and aquaculture are part of a production method continuum, defined by the degree of control and which ranges from traditional hunting to rearing in recycled water systems (Guttman, 1996; Edwards and Demaine, 1997; Edwards et al 2002; FAO, 2004; OEDC, 2011). A common example can be highlighted by small-scale rice farmers who may switch between culture and capture based systems to achieve livelihood needs at certain times of year (Gregory et al, 1996; Gregory and Guttman, 1996, Guttman, 1996). As a result, capture fisheries and aquaculture have some common and very distinct features (OEDC, 2011). A definition of aquaculture and a comparison with fisheries was proposed by FAO (1989): “Aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production such as regular stocking, feeding, and protection from predators etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms, which are harvested by an individual or corporate body, which have owned them throughout their rearing period contribute to aquaculture, while aquatic organisms, which are exploitable by the public as a common property resource with or without appropriate license, are the harvest of fisheries”. Aquaculture more commonly resembles farming, whilst capture fisheries resembles hunting. Distinct differences occur in the primary production phase of both sectors which largely relate to differences in the degree of control (e.g. degree of: dependence on wild fish stock for brood stock/juveniles or feed; confinement; environment; harvest and market management) and property rights (FAO, 2004). These differences in the primary production phase result in different policy constraints relating to the sustainable growth, governance framework and food security contexts. Policy constraints during the post-harvest stages are more similar in relation to both sectors. The characteristics of aquaculture have more commonly been liked to agriculture. Table 1.1. provides a summary of the comparative characteristics and management features of fisheries and aquaculture globally and within Malawi. Interactions between aquaculture and capture fisheries do occur along supply chains which define the relative competiveness of each sector and their respective value to food security (Muir and Young, 1998; Brummet, 2000).

Fisheries and aquaculture provide important sources of food, nutrition, employment and income, supporting the livelihoods for hundreds of millions of people around the world (FAO, 2012; HLPE, 2014; Bene et al 2015, 2016; Thilsted et al 2016). Major growth in global fish supply over the past decades has enhanced the global capacity to consume more diverse and nutritionally rich foods. Best available estimates reveal that fisheries and aquaculture account for 17% of all animal protein and 6.7% of all protein consumed globally (World Bank, 2013; HLPE, 2014; Bene et al 2015; FAO, 2016). This share of the global food basket is expected to increase due to growing demands for high quality foods as a result of rising incomes, urbanisation and population growth (HLPE, 2014; Bene et al 2015; FAO, 2016). In 2014, almost 60 million people were engaged in the primary sector of fisheries and aquaculture and an additional 140 million employed along supply chains, the vast majority residing in developing countries (FAO, 2014). Moreover, fish is a major and unique source of high proteins and essential micronutrients and thus may serve as a nutritional safety net for billions of people world-wide (Roos et al 2007; Kawarazuka and Bene 2010; Thilsted 2012; Beveridge et al. 2013; Bene et al 2015).

In relation to aquaculture, the sector is increasingly being recognised as having great potential in contributing to the stability of the world's food portfolio and alleviating food insecurity (Troell et al 2014). The type of aquaculture and the geographical production of farmed fish as a source of protein are also important in the food and nutritional security discussion. In 2014, over two thirds of farmed fish (estimated 47mt) destined for human consumption came from inland aquaculture, dominated by earth pond culture in developing countries. This dominance in inland aquaculture is due to the relative ease of adoption of the technology in comparison with mariculture. As a result, inland aquaculture is identified as providing the most direct and future potential contribution to the supply of affordable protein as well as employment and wealth generation benefits for much of the developing world (Beveridge et al 2013; Bunting 2013; FAO, 2014).

Table 1-1Comparative characteristics and management features of fisheries and aquaculture globally and within Malawi (Modified from Muir and Young, 1998).

Characteristic	**Fisheries**	**Aquaculture**
Global		
Definition	Fishing refers to all activities to harvest aquatic organisms in marine, coastal and inland areas. It can further be defined by the location, the target species, the technology used (e.g. trawl or beach seine), the social characteristics (e.g. artisanal, industrial), the purpose (e.g. commercial, subsistence, or recreational) as well as the season (e.g. winter) (FAO, 1997).	Aquaculture refers to the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. (FAO, 1995).
Location	Widely variable, though specific nursery, migratory, feeding grounds may be definable.	Defined by site conditions, acceptability for intended stock and social acceptability.
Productive Investment	Vessels and catching gear, highly mobile, adaptable.	Fixed in structures; management systems, only some mobile.
Ownership	Aquatic organisms which are exploitable by the public as common property resources, with or without appropriate licences, are the harvest of fisheries.	Ownership and rights allocation are usually more explicit, typically lease or property ownership of sites.
Management	External regulation of effort/ efficiency to varying degrees, limited *in situ* management of catching decisions.	Internal management of production process, some external regulation of resource access, management practices.

Output	Highly variable within moderately definable stock/year-class boundaries.	Originally seasonal, increasingly controlled and extended, chosen species, size, quality.
Development	Identify/develop new resources better targeting, gear improvement, efficiency, selectivity, more effective management and ownership issues.	Identify/manage more species lifecycles; equipment/systems; genetic improvement, feed and husbandry efficiency; disease control; environmental management.
Production Trends (2014) (FAO, 2016)	Total capture production 93.4mt: 81.5mt marine waters; 11.9mt inland waters.	Total aquaculture production 73.8mt: 47.1mt inland waters; 26.7mt marine waters.

1.2 Research Problem

Globally, Africa has been identified as the region possessing the greatest unexploited potential for aquaculture growth (NEPAD, 2011; FAO, 2014, 2016). Despite suitable natural resource conditions and a growing demand for fish for domestic consumption, realising the potential of aquaculture development in Africa has faced many shortcomings (Aguilar-Manjarrez and Nath, 1998; Hishamunda and Ridler 2006; Brummett et al 2008). Although Africa has improved its share in world total aquaculture production over the past decade, its contribution still remains low, accounting just for 2.3% (1.7mt) of the world total aquaculture production in 2014 (FAO, 2016). At the same time, the continent has one of the lowest reported per capital consumption of fish reported at 9.8kg in 2013, relative to the global average of 19.7kg in 2013 (FAO, 2016). Furthermore, fish per capita consumption has decreased in some countries in sub-Saharan Africa (SSA) where most of the world's undernourished people are still to be found. Despite the relative low levels of fish per capita consumption in Africa, fish is known to provide a major and important source of animal protein, particularly in SSA where estimates reveal that fish contributes more than 50% of total animal protein intake (Brummett, 2000; FAO, 2006).

In finding solutions to achieve global food security and nutrition, increased attention naturally lies with the supply side of the food security equation (Barrett and Palm, 2016). Aquaculture is recognised as having the greatest potential in contributing to the global supply of animal protein and meeting global food fish demand (Natale et al., 2012; Beveridge et al., 2013; Troell et al 2014; Ottinger et al, 2016). This is in light of significant land and water constraints limiting the expansion of agricultural production as well as the ecological constraints to increase capture fisheries production (Perry et al 2010; Blasiak, 2015; Barrett and Palm 2016; Ding et al, 2017). Moreover, the acute shortage of arable land for agricultural expansion, as well as the absence of livelihood alternatives in urban areas across many countries in SSA, renders aquaculture a priority for African development (NEPAD 2011).

Nonetheless, sustainable aquaculture development today faces significant constraints which make meeting rising demands for food fish in conformity with the 2030 Agenda for Sustainable Development as well as the provision of expected social and economic services immensely challenging (FAO 2016a,b). All four factors of sustainable aquaculture development – economic, environmental, social and technical – face challenges. World-wide common external drivers threatening the aquaculture sector include: competition of crucial water and land resources for aquaculture expansion; climate change; disease; poor governance; among other (Hishamundu et al 2014; Macusi et al 2015; Ottinger et al 2016). Moreover, critics of aquaculture point to the need to discuss a number of valid concerns when considering aquaculture's role in the global food system. Aquaculture is highly reliant on natural resources, drawing on freshwater and land resources for a large bulk of production as well as crops and wild fish for feeds for certain cultured species (Hall et al 2011; Klinger and Naylor 2012). As a result, aquaculture can impact negatively on ecosystems (e.g. habitat destruction, pollution of aquatic ecosystems) and diminish resources that support food security (Tacon and Metjan 2013; Beveridge et al 2013; Bene et al 2015). Aquaculture is thus recognised to contribute positively but also negatively to meeting food security at various scales (Troell et al 2014). Importantly, benefits, costs and constraints associated with aquaculture development vary by type of system, scale of intensity, species cultivated, geographical location and site specific contextual conditions; rendering its assessment complex and one which requires a case by case approach.

Despite increasing awareness of the importance of fisheries and aquaculture to food security, empirical evidence remains limited and current understanding of the complexities and role of fisheries and aquaculture to food security incomplete (Muir etal.,2005; NEPAD,2011; Kleiber et al 2014; Kassam, 2013; HLPE, 2014; Villasante et al 2015; Bene et al 2015; Bene et al 2016). For example, the recent scoping review of evidence by Bene et al (2016) identified six key gaps in relation to understanding the role of capture fisheries and aquaculture to food security. This included: 1) a lack of national statistics and accurate data concerning capture fisheries and aquaculture; 2) a lack of rigorous gender and wider socio-economic analyses; 3) limited understanding of conceptual frameworks; 4) limited knowledge of the social and environmental impact (negative and positive) of different scales and forms of aquaculture operations; 5) little studies on how fish contribute to improved nutritional status; and finally, 6) limited understanding of local-level impacts of global drivers of food security. Moreover, the majority of studies to date have been carried out in Asia and far less is known about the role of fisheries and aquaculture in other developing regions, especially Africa. In addition, many inland fisheries and aquaculture systems have not been extensively studied and their significance to supporting livelihoods and food security has usually been overlooked (Kawarazuka, 2010; Welcomme et al 2010; Arthur et al 2013).

In the case of aquaculture, an understanding of the sector's role to food security has been significantly neglected compared to that of capture fisheries. Three key areas of knowledge gaps associated with understanding the importance of the aquaculture sector have emerged from the literature (Bene et al 2015; Bene et al 2016). Firstly, a dearth of aquaculture statistics exists; including gender-disaggregated information, rendering an understanding of the performance of the rapidly evolving sector limited, especially for high priority regions such as SSA (Geheb et al. 2008; Harper et al 2013; Ottinger et al 2016). Secondly, limited attention has been granted to the complexity of aquaculture systems. Aquaculture occurs within a broader dynamic of political, economic, social and environmental parameters contextualising the sector which influence the constraints, benefits and costs associated with aquaculture development (Hishamundu et al 2014; Morgan et al 2016). A growing body of literature highlights that aquaculture's role in household livelihood strategies and supporting community wellbeing is highly complex (Ahmed et al 2009; Kassam, 2013; Paul and Vogl, 2013; Blythe et al 2015). Moreover, it is often assumed that people engaged in food-producing livelihoods, including fisheries and aquaculture, will have improved food security and nutrition (Kumar and Quisumbing 2010; Fiorella et al 2014). However, this assumption has rarely been tested, especially in the context of fisheries and aquaculture. In fact with a few emerging exceptions in the context of capture fisheries (Darling et al, 2014), there are no known studies that comprehensively investigate the complex pathways through which aquaculture can contribute to household food security in fish farming communities. Furthermore, despite the important role of both men and women in fisheries and aquaculture; women's contribution to the sector has been less visible and often overlooked in research and management (Harper et al 2013; Kleiber et al 2015; Kawarazuka and Bene 2010, 2011). Entry into aquaculture is known to have fewer gender barriers than capture fisheries, resulting in more women actively participating in diverse aquaculture activities (including pre-harvest, harvest, and post-harvest activities) (Weeratunge et al 2010; Williams et al 2012b). At the same time, in many societies women are known to contribute significantly to household food consumption (Harper et al 2013). Women's livelihoods and food security are increasingly viewed as interlinked but their needs and constraints in the context of aquaculture have rarely been investigated. Thirdly, growing literature calls for more holistic assessments to assess the role of aquaculture to food security (Krause et al 2015; Bene et al 2016). Local specific case studies have been suggested as a promising research approach to capture the complex and multi-dimensional links between aquaculture and food security (Bene et al 2016). An understanding of the complex role of aquaculture to food security remains unclear and more detailed, nuanced understandings of these pathways are lacking.

Acknowledging the potential contribution of aquaculture to food security and its increasing importance across Africa, many increasingly important questions remain concerning the pathways, constraints and conditions within which aquaculture may contribute to improved food security. Gaining insights into the motivations and perceptions of the constraints, benefits and costs associated with aquaculture from those engaged in the sector is crucial to enhancing knowledge about the sector and unpacking its complex role to food security. The purpose of this thesis is to address these gaps in knowledge by evaluating the complex role of small-scale aquaculture to local food security in Africa using the case study country of Malawi. Given the regional importance of aquaculture development and the decline in per capita fish consumption, SSA is an area of increasing importance to investigate the role of aquaculture to food security. In Malawi, the demand for fish is becoming more urgent and aquaculture has been developed as a means to meet the food fish deficit as well as enhance economic development and improve food security. However, despite a massive support from international donors over the past 30 years, the growth of the aquaculture sector in Malawi has experienced many bottlenecks and its actual contribution to local food security is poorly documented. These conditions make Malawi a particularly interesting case study to investigate the complex and actual contribution of small-scale aquaculture to food security. Given the heightened interest to put fish on the menu in the global debate on food security and aquaculture's increasing contribution to the global food basket, this thesis serves to provide a timely endeavour in addressing knowledge gaps in the literature, contributing to methodological approaches in the field as well as providing policy rich information to support the future sustainable management of the aquaculture sector within the region.

1.3 Research Objectives and Questions

The central aim of this thesis is to understand the complex role of small-scale aquaculture to food security. The aim and objectives of this thesis are explored using the aquaculture sector in Malawi and two communities in the southern district of Zomba as a case study. The research objectives of this thesis are described below.

Research Objective 1

To assess the drivers, barriers and future prospects of the aquaculture sector in Malawi through the perceptions of key stakeholders.

Research Objective 2

To identify gender roles as well as the constraints and benefits associated with aquaculture through the perceptions of women and men fish farmers.

Research Objective 3

To assess and quantify the direct and indirect association of aquaculture to household food security through the comparison of fish farming vs non-fish farming households.

1.4 Thesis Structure

Following chapter 1 of this thesis which introduced the research topic and thesis objectives, chapter 2 provides a literature review which draws on a number of interdisciplinary perspectives concerning the potential role of aquaculture to food and nutritional security. Chapter 3 provides an overview of the research approach and methods adopted within this thesis. Chapter 4 provides a summary of the case study country of Malawi and an overview of the aquaculture sector. Chapter 5 draws on key informant interviews to assess the drivers, barriers and future prospects of the aquaculture sector in Malawi. Chapter 6 presents the results from the Photovoice assessment which aimed to identify gender roles, constraints and benefits associated with small-scale aquaculture in two communities in Zomba. Chapter 7 builds on the previous results chapters and provides a more detailed assessment of the association between small-scale aquaculture and household food security within two communities in Zomba through the analysis of key indicators within the household survey. Finally, Chapter 8 reflects on the major findings of the thesis and provides a final evaluation of results, limitations and implications for policy and further research.

Chapter 2: Literature Review

2.1 The Rise of Aquaculture

2.1.1 Global Trends and Characteristics of the Aquaculture Sector

A milestone was reached in 2014 when the aquaculture sector's contribution to global food fish supply reached 50% and outpaced that of capture fisheries for the first time. Aquaculture provides important trade, improved food and nutritional security and a source of livelihood and income for many millions of people world-wide, particularly in developing countries where over 90% of production occurs (FAO 2016a,b). Despite caution over the quality and interpretation of data on global fisheries and aquaculture from the FAO Fisheries and Aquaculture Department (Paul and Zeller, 2017; Ye et al 2017), the most recent best available aquaculture statistics point to a rapidly growing trend in global aquaculture production from 6.2mt in 1983 to 73.8mt in 2014; at an average rate of 8.6%/yr. (FAO, 2014; FAO, 2016; Ottinger et al 2016). Ottinger and colleagues (2016) provide an excellent description of the most recent global aquaculture statistics, including an outline of the sector's impact on the environment. For the purposes of this thesis, a summary of major global aquaculture trends will be presented to provide contextual information to support the aims of this study.

Today, aquaculture is the fastest growing and one of the most complex food producing sectors world-wide (Lazard et al., 2010; Troell et al 2014). Globally, the aquaculture sector comprises high diversity in terms of culture environments, production practices, farming intensities and species cultivated. Aquaculture is classified into three culture systems: 1) freshwater aquaculture which includes fish cultivation in reservoirs, lakes, ponds, etc.; 2) brackish water aquaculture which includes fish cultivation in estuaries, lagoons, fjords, etc.; and 3) mariculture (marine aquaculture) which includes fish cultivation in seawater such as inshore and open water. The aquaculture sector comprises a large spectrum of species with an estimated 600 species farmed made up of finfishes, molluscs, crustaceans, aquatic plants, aquatic invertebrates, amphibians and reptiles. Aquaculture farming practices are also very diverse and include ponds, cages and pens, raceways, tanks, recirculating systems and rice fields (Troell et al 2014). Moreover, aquaculture systems can be classified by the degree of intensification -extensive, semi-intensive and intensive systems – with increasing intensification characterised as requiring larger inputs and higher costs whilst producing higher yields (Tacon and Metian, 2008; Bunting 2013). World-wide, freshwater aquaculture (also known as inland aquaculture), dominated by earthen pond culture of finfish (e.g. tilapia, catfish, carp), is by far the most common type of aquaculture, representing 63% (47mt) of total world aquaculture production in 2014 (Troell et al 2014; Ottinger et al 2016).

Globally, aquaculture products are one of the most widely traded food commodities and recent trends reveal that developed countries dominate imports whilst developing countries dominate exports of farmed fish products (FAO, 2014). In terms of the distribution of aquaculture production, Asia continues to contribute to the largest share of world aquaculture production (89%) with regions such as Africa and the Americas increasing their respective shares of world total production over the past decade. Although China remains the leading producer of aquaculture, the sector is expanding even faster in other areas, such as all countries within SSA. The aquaculture sector is also dominated by small-scale fish farmers (representing 70-80% of all actors involved in the sector) (FAO, 2013) whereby aquaculture operations are family owned and managed (Lazard et al., 2010; Pant et al., 2014). Thus, small-scale and inland aquaculture is recognised as having great potential in contributing to the supply of affordable animal protein and supporting local livelihoods in much of the developing world. It is widely acknowledged that fisheries and aquaculture provide a source of income and livelihoods world-wide. Recent estimates reveal that fisheries and aquaculture employed an estimated 56.6 million people within the primary sector in 2014 as well as support the livelihoods of between 660-820million peoples along diverse supply chains (FAO, 2012a; FAO, 2016). More specifically, of the total people employed in the sector, an estimated 18million (33%) were engaged in fish farming with the vast majority residing in Asia (94%). The trends in the number of people engaged in the fisheries and aquaculture sector varies by region.

2.1.2 Gender in Fisheries and Aquaculture

Gender plays an important role in fisheries and aquaculture world-wide (Allison and Ellis 2001; FAO 2006; FAO; 2012). Characteristics of gender in fisheries and aquaculture typically comprise the division of labour, gender relations and behaviour which impact on socio-economic benefits arising from the sectors (Harper et al. 2013; Williams et al. 2012a). During the past twenty years, fisheries policy discourses have expanded to include a more holistic approach to fisheries management resulting in an increasing need to include gender in our understanding of both social and ecological systems (Weeratunge et al. 2010; Williams 2010; Harper et al. 2013; HLPE 2014; Kleiber et al. 2014). A gap in understanding gender patterns in fisheries and aquaculture continues to be widely reported in the literature (Neis et al 2005; FAO 2009; FAO 2014; Bene et al 2016). A recent review by Kleiber et al. (2014) highlights that biases in sampling methods and research have led to significant gaps in gender-relevant data in small-scale fisheries. Mills et al. (2011) provided the first known estimate of gender characteristics in the capture fisheries sector worldwide. The authors estimated that 50% of the 120 million fishers employed in capture fisheries, with the vast majority employed in post-harvest activities (such as processing and packaging) of small-scale fisheries in developing countries. A recent publication by Monfort (2015) confirms this estimate, revealing that, globally, when considering the primary and secondary segments of the capture fishery sector, women make up half of the workforce. Recent sector statistics by the FAO (2014) highlight that about 30% of the people engaged in fisheries and aquaculture world-wide are women, predominately engaged in secondary post-harvesting activities. It is widely acknowledged that small-scale fisheries are poorly recorded (Kolding et al, 2014; HLPE, 2014) and thus the actual numbers of women fisher folk may exceed best known estimates. In terms of the aquaculture sector, comparable estimates on gender characteristics to that of capture fisheries do not exist. However, entry into aquaculture is known to have fewer gender barriers than capture fisheries and it is suggested that more women actively participating in diverse aquaculture activities (including pre harvest, harvest and post-harvest activities) (Weeratunge and Snyder, 2009; Williams et al 2012b). A recent study by Monfort (2015) further reveal that engagement of women in aquaculture varies by type and intensity of aquaculture system, with the majority of women engaged in small-scale operations characterised by informal, low or unpaid work. Moreover, women's involvement in capture fisheries and aquaculture varies by country and is known to be influenced by context specific factors such as cultural norms, religion, among others (Geheb et al. 2008; Thorpe et al 2015). In many regions, gender norms are reported to limit women's participation in fisheries by placing constraints on their mobility, time and capacities e.g. in Bangladesh (Jahan et al. 2010; Shirajee et al. 2010); in Nigeria (Fapohunda 2005), in Cameroon (Brummett et al 2011). On the other hand, aquaculture is known to promote opportunities for women due to the homestead and less labour intensive nature of operations (e.g. in Bangladesh (Farnworth et al., 2015), in Tanzania (Luomba 2013), and in Nepal (Bhujel et al. 2008)).

2.1.3 Aquaculture in Africa

Despite suitable natural resource conditions and a growing demand for fish for domestic consumption, realising the potential of aquaculture development in Africa has faced many shortcomings (Aguilar-Manjarrez and Nath, 1998; Hishamunda and Ridler 2006; Brummett et al 2008). Significant funds have been invested by international donors to promote aquaculture development, particularly small-scale production, in Africa over the past few decades. However, many practitioners have expressed disappointment that the expected impacts of donor aquaculture projects in terms of production as well as social and economic services have not been met (JICA, 2003; SARNISSA, 2010; Brummett et al 2008; NEPAD, 2011).

Currently, Africa's share in world aquaculture total production remains low, accounting just for 2.3% (1.7mt) of the total production (73.7mt) in 2014. However, recent statistics revealed that annual aquaculture production growth during 2000 - 2012 was fastest in Africa (11.7 percent). Albeit starting from a low baseline, aquaculture production in Africa is rapidly rising from an estimated 110 tns in 1995 to 1.7mt today. Furthermore, recent future projections of aquaculture growth reveal that aquaculture production in Africa will rise by 35% over the coming decade, reaching 2.3mt in 2025. Recent literature points to rising demands for fish, improvements in aquaculture governance and recent increases in capacity across the sector as some of key drivers of future aquaculture growth in Africa. The largest aquaculture producer in Africa is Egypt (1.1mt), followed by Nigeria (313tt) in 2014. Despite marginal aquaculture production, Sub-Saharan Africa has experienced a growth from 17.4tt in 1995 to 237.7tt in 2014. Inland aquaculture by far dominates African aquaculture production output, accounting for over 90% of total production (1.6mt) in 2014. In correspondence with sustained increases in aquaculture production across the region, the number of people engaged in aquaculture in Africa has increased over the past two decades from 91,000 fish farmers in 2000 to 2.8m fish farmers in 2014 (representing 1.4% of the total 18m fish farmers world-wide). Regional classifications of aquaculture systems have also been established for sub-Saharan Africa in relation to the degree of intensification (Lazard et al. 2010; SARNISSA, 2010). The most recent report by SARNISSA, (2010) identifies three broad aquaculture systems in the region, described as follows:

1. Extensive, small-scale aquaculture systems. Fish cultivation is linked to agriculture/livestock in rural and or peri-urban areas. Pond size ranges between 100 and 200 m². Species such as Nile tilapia (Oreochromis niloticus) and African catfish (Clarias gariepinus) are typically cultivated using on-farm resources (animal wastes, agricultural by-products) with the employment of family labour. Fish production typically ranges from 1-2.5tonnes per ha per year and is for self-consumption and local markets
2. Semi-intensive, small- and medium-scale aquaculture (SME's) systems. Fish cultivation in more specialised, occurring with relatively higher inputs and production (production levels est. 3-8 tonnes per ha per year, (Pouomogne and Diemuth, 2008). Enterprises use artificial feed and adopt a more market-orientated focus with production targeted for local and urban markets. The systems are managed by family and hired labour.
3. Industrial, medium- and large- scale commercial aquaculture. Fish are cultivated with very high inputs and high production levels. Vertical integration with fingerling and feed

production as well as processing and marketing is common. Production is targeted towards the export, regional and national markets. Production systems vary and include: cage culture and large fish ponds.

In reality, many countries across SAA are positioned at different stages in this spectrum, progressing from extensive to industrial in scale.

Despite decades of research and development in aquaculture, the sector has struggled to realise its potential in Africa (van der Mheen, 1999; Brummett et al 2008; Beveridge et al 2010; Elago 2010; Little et al 2012; Toufique and Belton 2014 ; FAO, 2016). Despite suitable land and freshwater for expansion, common constraints identified in relation to aquaculture development in Africa include: economically not viable; limited availability of quality feed and seeds; limited technologies; limited access to capital; weak access to markets; and weak social acceptability, often leading to low retention rates of aquaculture (Brummett, 2000; SARNISSA, 2010; NEPAD, 2011; Beveridge et al 2013; Troell et al 2014 ; Ansah et al 2014). Although data concerning the monitoring of aquaculture operations remains significantly limited across the continent, the poor sustainability of donor projects is recognised to result in high rates of abandonment of fish ponds once donor financial support has ended (Brummett, 2000). Moreover, constraints to aquaculture development are particularly acute in the dry land areas of Sub-Saharan Africa (SSA), which covers half the continent (FAO, 2016). Despite increased attention placed on aquaculture to support the rising demand for protein rich-food for the rising population, the sector has marginal production in SSA due to the prevalence of a number of bottlenecks and increasing threat from climate change (Lazard et al., 2010). Threats to aquaculture development in SSA identified in the literature include: inefficient technologies and limited access to knowledge; impact of drought and floods on water availability and economic viability of operations; lack of available and affordable feed ingredients; and stunted fish growth (Hecht et al., 2005; Tran et al 2013; Connolly-Boutin and Smit, 2016; FAO, 2016). For example, in Ghana heavy flooding was reported to result in the significant loss of fish used for selective breeding trials in the Aquaculture Research and Development Centre (ARDEC) (Attipoe et al. 2013; Ansah et al 2014). Furthermore, although Villasante et al (2015) highlighted the positive impact of rural small-scale aquaculture to food security in northern Namibia in 2012-13, the sector has since been severely affected by recurrent seasonal flooding and drought resulting in the loss of revenue from fish farming, low production and destruction of livelihoods (Mashebel et al 2016; Tuwilika, 2016). These high risks associated with small-scale aquaculture in rural dry land communities of SSA present significant challenges to the retention and expansion of aquaculture across the sub-region.

Nevertheless, recent improvements in aquaculture production, the expansion of sustainable practices as well as aquaculture's increasing contribution to meeting the fish food deficit across the continent have demonstrated the sector's competiveness in the region. A recent review of aquaculture in Africa by SARNISSA (2010) identified a number of common success factors attributed to improvements in the sustainable development of aquaculture in some countries: the development and adoption of locally appropriate technologies; long-term training and technical assistance services for fish farmers; the presence of commercial hatcheries and feed industries; availability of credit; the development and connection to markets; and the presence of strong farmer organizations and stakeholder networks. Increasing emerging evidence suggests that if African aquaculture is to realise its natural potential and deliver expected social and economic benefits, governments should place greater attention on alleviating bottlenecks in the sector and promote more commercial enterprises for future growth (Brummett et al 2011; Ottinger et al 2016).

2.1.4 Aquaculture in Asia

Asia is of significant importance to global fish markets and to enhancing global food security. Asia is known to be the home of aquaculture due it's rich ecological aquaculture history dating back thousands of years as well as the region's remarkable progress in remaining ahead of the rest of the world in aquaculture production (Ruddle and Zhong, 1988; Beveridge and Little 2002; Edwards, 2009; FAO 2016). Aquaculture development in Asia has rapidly evolved over the past 50 years from small-scale production systems towards an industrial intensified model of aquaculture. This intensification of aquaculture in Asia led to significant changes in natural resource use per unit of farmed fish produced, including an increase in energy, fertilisation, formulated feeds and water pollution as well as a decrease in land and freshwater use (Tacon and Metian, 2008; FAO, 2017b). Furthermore, the evolution of aquaculture development across Asia had led to many benefits, including the enhancement of the world's capacity to consume fish as well as increased income and employment for fish farmers (Edwards, 2002; FAO, 2016). As a result of this development history, today the practice of aquaculture in Asia has little similarities to its ancient past. Recent statistics by the FAO (2014), revealed that Asia has accounted for approximately 89% of world aquaculture production of fish for human consumption over the past two decades. While aquaculture production varies greatly across countries in Asia, a dominate countries dominate in the supply of farmed fish. In 2014, Asia aquaculture production was 65.6mt (89% of the world's total aquaculture production) with the top five aquaculture producing countries being: China (45.5mt, 62%); India (4.9mt, 7%); Indonesia (4.3mt, 6%); Vietnam (4.4mt, 5%); Bangladesh (2mt;

3%) (FAO, 2014). Thus, China remains by far the world's major aquaculture producer and is of great importance in contributing to world food security (HLPE, 2014; FAO, 2016). As expected, the highest concentration of fish farmers is in Asia, estimated to be 18million in 2014 (94% of global fish farmers, 18.7m) (FAO, 2016).

Increasing emerging studies have attempted to assess the historical development of aquaculture across Asia and to understand which factors have enabled or constrained development. For example, a recent study by Hishamundu and colleagues (2009) investigated the strengths and weaknesses of the aquaculture development history in Southeast Asia and identified several lessons to learn from. The authors described the evolution of aquaculture development in Southeast Asia as being originally driven by market demand with heavy entrepreneur support towards a more progressive involvement by government in providing incentives and a supportive role for the sector. The authors went on to identify good governance in relation to enhancing research and providing an enabling investment environment as a major strength in the aquaculture development history of many countries in Southeast Asia. However, many constraints to aquaculture development in Southeast Asia were identified, including: shortage of land resulting in an increase in intensified land-based systems and a move to marine cage culture; lack of available water supply; availability and high cost of feed; limited energy supply for intensified systems; environmental degradation; limited expertise among fish farmers; as well as limited capacity and expertise among personnel responsible for technology dissemination and enforcement of government aquaculture policies. These findings are supported by a recent review of aquaculture development trends in Asia-Pacific by the FAO (2017b) which highlighted that although commendable efforts had been made in developing good governance frameworks (policies, legal and regulatory requirements, support services), progress was not consistent across all countries and a lack of expertise and financial capacity often delayed implementation. Nonetheless, the authors point out that aquaculture development in Asia is a success story. The authors point out that many Asian countries have established strong aquaculture governance structures and that policies orientated towards the promotion of international trade (incl. aquaculture certification), reductions in environmental impacts, tax rebates for importation of aquaculture products have contributed to the sustained success of aquaculture growth experienced in the region. Furthermore, a number of policy-driven developments relating to the establishment of inter-governmental agencies, NGOs and networks that provide technical and financial assistance to aquaculture development have been influential in supporting the success of aquaculture in Asia (Dey et al 2008; FAO, 2017b). For example, within China, the aquaculture sector has transformed over the last few decades and improved governance has contributed to the continued success of the sector through: increased attention granted to environmental sustainability, enhanced technical support for producers through a national extension system with expert staff; product diversity and commercial integration along supply chains (Hishamundu et al 2009; FAO, 2016). Recent future projections of global fish production up to 2030 highlight that Asia, in particular China, will continue to be the epicentre for global aquaculture production and consumption of fish products (World Bank, 2013). As the aquaculture sector in Asia continues to intensify, improved capacity to enact and effectively manage aquaculture governance structures will be critical to its continued development (Hishamundu et al 2009; FAO, 2017b).

2.1.5 Sustainability of Aquaculture

Sustainable aquaculture development requires that aquaculture be economically profitable, environmentally sound, technically feasible and socially acceptable. Today, all four factors of sustainable aquaculture development face significant challenges which make meeting rising demands for food fish in conformity with the 2030 Agenda for Sustainable Development as well as the continual provision of social and economic services immensely challenging (FAO 2016a,b). The global rapid expansion and intensification of the aquaculture industry has given rise to a number of social and environmental issues affecting the sustainability of the sector (Hall et al 2011; Klinger and Naylor 2012). Key concerns relate to the sector's high dependence on terrestrial crops and wild fish for feed as well as requirement for freshwater and land resources. Increasing contributions to the literature recognise that valid concerns over the sustainability of aquaculture must crucially be taken into account when considering aquaculture's role to the global food system (Naylor et al., 2000; van Mulekom et al., 2006; Troell et al, 2014). In terms of social impacts, an emerging body of literature reveals that inequalities and social conflicts may arise over ownership and access rights of aquaculture operations as well as distributional effects along dynamic supply chains (Toufique & Gregory, 2008; Blythe, 2013; Morgan et al 2016).

A growing body of literature identify a number of environmental impacts arising from aquaculture world-wide, including: loss or degradation of large areas of valuable coastal and inland environments (e.g. Wolanski et al., 2000; Troell et al., 2014); aquatic pollution (e.g. Coe et al, 2007); enhanced diseases and contamination on wild stocks (e.g. Bondad-Reantaso and Subasinghe, 2008; Lehane, 2013); as well as competition or depletion of wild fish stocks for feed (Bene et al 2015). For example, the rapid growth of shrimp aquaculture across Asia over the past decades has led to significant land use changes with significant amounts of mangrove forest areas lost to make way for shrimp pond culture (Joffre and Bosma, 2009; Paul and Røskaft, 2013).

Aquaculture's high dependence upon terrestrial crop and wild fish for feeds also has implications for the resilience of the global food system (Troell et al, 2014). Aquaculture feed is currently derived from a range of sources, including: crops and crop by-products, wild fisheries (predominantly small forage fish), fish processing by-products and livestock by-products (Naylor et al, 2009). Fish meal and fish oil continue to be important nutritiously rich ingredients in aqua feeds. In 2014, over 15mt of non-food fish products was reduced to fishmeal and fish oil, predominantly utilised as feed for the aquaculture industry (Tacon and Metian 2008; FAO, 2016). Fishmeal and fish oil production is mainly comprised of the anchoveta fish species and a large bulk of fishmeal and fish oil production comes from Latin America which experiences one of the lowest regional fish per capita consumption (10kg) rates compared with the global average of 20.2kg. Thus, it is acknowledged that the use of wild-fish for aquaculture feed can present implications for food security via diminishing food resources, particularly for low-income and nutritionally sensitive populations (Tacon and Metian, 2013; Beveridge et al 2013; Troell, et al 2014). However, the production of fishmeal has seen a declining trend over the past two decades due to reduced catches of anchoveta. Moreover, to offset the high prices of fishmeal and fish oil, the aquaculture industry is prioritising reducing its dependence on fishmeal for feeds and is selectively using fishmeal and fish oil during targeted growth periods of farmed species (Troell, et al 2014). As a result, the aquaculture industry is placing increasing attention on the production of aquaculture feed from alternative sources such as protein rich crops, microalgae and waste from fish processing (Klinger and Naylor 2012; Naylor et al 2009; FAO, 2016). Importantly, the demand for aquaculture feed varies by farmed species and the degree of intensification. For example, filter feeding farmed shellfish such as mussels, clams and oysters do not require feed whereas most finfish species require commercially produced feed. Moreover, intensified systems are highly resource demanding requiring high inputs of feed compared with less intensive systems that have a lower ecological footprint (Naylor et al., 2000). Today, over 50% of aquaculture production, measured in volume, was achieved through non-fed animal species, predominantly comprising silver carp, bighead carp, clams, oysters and mussels.

Importantly, the negative impacts of aquaculture are influenced by the nature and scale of production as well as other key socio-economic conditions contextualising the sector (Hall et al 2011; Klinger and Naylor 2012; Krause et al 2015). Many scholars remain sceptical regarding aquaculture's contribution to the global food system unless future growth of sector can offset the negative externalities associated the development of certain systems and species cultivated (Troell et al 2014). With growing recognition of the negative impacts of aquaculture on the environment and to society, increasing attention has been called for on improving monitoring and assessments of aquaculture development within different contexts (Krause et al 2015; Bene et al 2016; Ottinger et al 2016).

2.1.6 Threats to the future sustainable development of aquaculture

Aquaculture development further requires dealing with multiple threats, both internal and external to the sector, which impedes the future sustainable growth of the sector and aquaculture's ability to deliver social and economic services. A diverse range of biophysical, institutional and socio-economic challenges can affect the sustainability of aquaculture. Major threats include: climate change impacts , competition for critical resources (land, water), pollution, economic policies, demographic and social shifts, weak governance, among others (Cochrane et al 2009; Adger et al 2013; FAO, 2013; Charles et al 2016; Lynch et al 2016;). Many of these problems are particularly acute for small-scale and inland aquaculture in Africa, which has faced significant shortcomings in realising aquacultures expected benefits (Macusi et al 2015; Cooke et al 2016).

A recent review of fisheries and aquaculture literature by Bene and colleagues (2016) reveal that climate change is recognised to impact fisheries and aquaculture, as well as dependent communities, through changes in rainfall, temperatures, weather events, ocean acidification, among others (Feely, Doney, & Cooley, 2009; Fleming et al., 2006). The authors highlight that the impacts from climate change will in turn affect fisheries and aquaculture's role to food security and development. However, the authors pinpointed that much of the evidence to date focus exclusively on capture fisheries with limited investigation into the impacts of climate change on aquaculture and its dependent communities (Cinner et al., 2012; Perry, Ommer, et al., 2011; Allison et al., 2009; Cochrane et al 2009; Merino et al., 2012). Emerging contributions to the field reveal that climate change is a major challenge to the aquaculture industry. For example, a recent global review of the aquaculture sector by Ottinger and colleagues (2016) reveal that sea level rise, extreme weather events (floods, drought, storms) and rising temperatures could impact directly and indirectly on the productivity of aquaculture systems with implications for food security. Moreover, inland aquaculture is known to be particularly vulnerable to climate change due to shortages in the availability of freshwater resources, particularly in highly climate-sensitive areas such as SSA. A recent study by Macusi and colleagues (2015) discussed climate change impacts on freshwater ecosystems, including inland fisheries and aquaculture systems. The authors concluded that inland aquaculture systems will be particularly affected by: drought leading to high rates of pond evapotranspiration resulting in reduced water volume and quality; floods destroying aquaculture operations; and rises in water temperature affecting the ecology and behaviour of fish. The impacts of climate change on aquaculture systems will further affect the livelihoods of dependent communities, particularly already highly vulnerable communities in SSA (Connolly-Boutin and Smit, 2016).

Given that the aquaculture sector is highly diversified and contextualised by environment, social, economic and political factors; it is acknowledged that finding solutions to overcome threats to the future sustainable development of aquaculture will require context specific appropriate measures (Troell, et al 2014; Macusi et al, 2015; Ottinger et al, 2016).

2.1.7 Governance of Aquaculture

The promises of aquaculture development are well known and include increased employment opportunities, improved food security and nutrition, reduced poverty and wealth generation. However, the potential of aquaculture development to realise these benefits is subject to the effectiveness of governance (FAO, 2017a).

As recently described in the literature (FAO, 2017a), aquaculture governance is “the set of processes by which a jurisdiction manages its resources with respect to aquaculture, how its stakeholders participate in making and implementing decisions affecting the sector, how government personnel are accountable to the aquaculture community and other stakeholders, and how the respect of the rule of law is applied and enforced… Its purpose is to promote sustainable aquaculture that is economically profitable, environmentally friendly and socially equitable.” To assist with the establishment and implementation of good governance in aquaculture, two flag ship guidelines are recommended for use by stakeholders involved in aquaculture – Article 9.1.1 of the Code of Conduct for Responsible Fisheries on aquaculture development (FAO, 2015) as well as the technical guidelines for aquaculture governance and sector development (FAO, 2017a). In practical terms, these guidelines describe that aquaculture governance requires setting up and implementing policies, strategies and plans, laws and regulations, administrative and institutional arrangements as well as adherence to four principles- accountability, effectiveness and efficiency of governments, equity, and predictability of the rule of law- to lead the sustainable growth of the sector. In addition, recent contributions to the literature emphasize that given the complexity of modern aquaculture, effective governance must be people orientated and adequately address the varied multi-dimensional nature of the sector, including the socio-economic, ecological and technical contexts (Hishamundu et al 2009; Hishamunda et al 2014; HLPE, 2014; Krause et al 2015).

Failure to establish good governance of aquaculture can result in misallocation of resources, negative social and environmental impacts as well as limit sectoral growth (Smith et al., 2010;

Hishamunda et al 2014; FAO, 2014). Dominated by inland aquaculture systems in developing countries, governance of the aquaculture industry is often challenged by political conflicts and significant limitations in capacity and resources. For example, a lack of planning processes, coherent and appropriate policies as well as limited resources and capacities have been identified as major causes of the failure to meet aquaculture's natural potential in Africa to date (Hishamunda et al 2014). Moreover, a lack of gender disaggregated data in fisheries and aquaculture has resulted in gender blindness in policy. The important role of women in fisheries and aquaculture has traditionally been neglected in policy with implications for the sustainable management of these sectors and impacts to food security and economic development (Williams et al. 2012c; FAO 2014; HLPE 2014).

World-wide, there has been some progress towards addressing the promotion of a more holistic view of fisheries and aquaculture (Gopal et al, 2014; FAO, 2012b; FAO 2015). For example, the UNFAO has developed the Code of Conduct for Responsible Fisheries (CCRF) as well as the Voluntary International Guidelines on Securing Sustainable Small-Scale Fisheries (SSF) in the Context of Food Security and Poverty Eradication (SSF Guidelines). More specifically, the SSF guidelines give greater attention to the importance of gender in fisheries and aquaculture in relation to the equitable access to resources, decent work, management voice, and activities, among others. However, integration of these guidelines into national policies and mechanisms remains an important challenge (Hishamundu et al 2014). The FAO's Blue Growth Initiative further provides crucial guidance to governments in improving governance of aquaculture (FAO, 2016). Moreover, following the inaugural the Global Conference on Inland Fisheries, Freshwater, Fish and the Future, organised by FAO and Michigan State University (MSU), in January 2015, a road map called the "Rome Declaration" has been published which outlines ten steps to responsible inland fisheries to guide international governments towards improved conservation and management of valuable freshwater ecosystems and the inland fisheries and aquaculture sectors. In addition, aquaculture development is associated with most of the internationally agreed 17 Sustainable Development Goals (SDGs) which form part of the global 2030 Agenda for Sustainable Development. As emphasized by a recent study by the FAO (2017c), the sustainable development of aquaculture must involve the alignment of aquaculture governance frameworks with the SDGs which will require well designed coherent policies, supportive institutions, an effective regulatory framework as well as financial support.

The lack of policies, strategies, regulations and inclusion of stakeholders in policy development have been identified as some of the major constraints to the responsible development and growth of the aquaculture sector (FAO, 2001; Jamu and Ayinla, 2003; Krause et al 2015). For example, a recent review of aquaculture governance by Krause and colleagues (2015) identified a significant neglect of stakeholder participation within aquaculture governance processes which they termed the 'people-policy gap'. The authors outlined that the identified 'people-policy gap' in aquaculture governance has led to inequalities in the distribution of benefits from aquaculture and a mismatch between benefits and needs of affected communities. However, it remains unclear whether high level efforts towards establishing effective governance incorporate local people in the process (Brugère, 2006; Brugère et al., 2010; Hishamunda et al., 2009; Krause et al 2015). Moreover, many authors have questioned the important role of policies, laws and regulations in aquaculture development. Increasing contributions to the literature highlight that general policies that provide guidelines and relate to trade and investment (incl. access to land and water) are most critical for fostering aquaculture development (Brummett et al 2008; Belton and Little, 2011; Jamu et al 2012). For example, a review of African aquaculture governance processes by Jamu and authors (2012) revealed that policies and laws relating to investment and trade are more critical for commercial aquaculture development in Africa than elaborate sector policies. However, the authors went on to emphasize that the quality of governance in relation to the social and economic development is also important in promoting aquaculture development. This supports wider literature which highlight that the complexity of aquaculture requires a contextual and inclusive approach to governance whereby governance processes recognise the concerns and needs of affected end user groups or individuals associated with aquaculture (Coffey, 2005; Pita et al, 2010; Krause et al 2015; Bene et al 2016).

The type of aquaculture development can further influence the benefits and costs arising from aquaculture. As described by Belton and Little, (2011), there are two types of aquaculture development: 1) the interventionist approach, whereby aquaculture has been implemented with outsider support with a focus on rural food security and economic development; and 2) the immanent approach, whereby aquaculture has been implemented by the individual or community without outsider support with a focus on more commercially driven aquaculture development. The authors go on to highlight that an interventionist approach may present specific constraints that hinder the long-term sustainability of aquaculture due to factors such as a lack of financial support after the departure of donors (Hishamunda and Ridler 2006; Hishamunda et al, 2014). Given the complexity of aquaculture, policies and strategies must recognise that different scales and type of aquaculture operations have their own benefits and constraints, require different support services and investment and can contribute differently to policy goals (Belton and Little, 2008; SARNISSA, 2010; Belton and Little, 2011; Toufique and Belton, 2014; Krause et al, 2015).

2.2 Food Security

Food security is commonly defined as "a situation that exists when all people, 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" and can be an elusive concept to measure (FAO 1996; Maxwell, 1996; Barrett, 2010). In order to achieve food security it is necessary to simultaneously ensure four dimensions are fulfilled: availability (sufficient supply of food), accessibility (economic and physical access to food, incl. social factors), utilization (food is nutritious, safe, and socially acceptable) and stability (capacity to ensure other three dimensions are achieved over time- seasonally and year to year) (FAO, 1996; FAO, 2006; Barrett, 2010). Thus, food security is more than the amount of food produced and it embraces different interconnected dimensions that can vary over time in determining the food security status of an individual, household, community or country (Barrett, 2010; Connolly-Boutin and Smit, 2016). Central to the definition of food security is the requirement for nutritious food, both in terms of sufficient quantity and quality. Whilst food security is a prerequisite for nutritional security, factors such as poor sanitation, limited health care and education, among others, determine whether nutritional needs are met. At the same time, it is widely acknowledged that food security is determined by the sustainable use and provisioning of ecosystem services (Poppy et al, 2014; Cruz-Garcia et al 2016). The causes of food insecurity and nutrition insecurity are interconnected and driven by poverty; environmental stressors; inequalities; cultural, social and economic factors; among others that may be context specific and vary geographically (HLPE, 2014; FAO, 2014; Connolly-Boutin and Smit, 2016; Campbell et al 2016). Several contributing authors emphasize that the complex dynamics surrounding the relationship between food security, livelihoods and the environment requires multidisciplinary perspectives and solutions (Barrett, 2010; Poppy et al 2014; Barrett and Palm, 2016).

2.2.1 Food Security Evolution

Over the past decades, food security has been central to the global development agenda and its concept reflects an evolution in the field from being viewed as a function of food production to the broader holistic concept widely used today. The evolution of the concept of food security has been driven by environmental, social, technological, economic and political changes (FAO, 2003; Godfray et al., 2010; FAO et al., 2014; Bene et al, 2016). The concept of food security, initially defined as food availability, first appeared when global delegates convened to discuss and find solutions to global food insecurity at the UN World Food Summit of 1974 (Maxwell 1996; Baro and Deubel 2006). However, less than a decade later, the assumption that food insecurity and wide-spread famine experienced during this period was caused by food-availability decline alone was challenged (Sen, 1981; FAO, 2003; Webb et al., 2006). Emerging consensus revealed that food availability alone was not a solution to ending hunger and issues such as access to food were also determinants of food insecurity (Sen, 1981). Thus, the concept of food security was broadened to the multidimensional definition agreed at the World Food Summit in 1996 (FAO, 1996). Furthermore, a study by Maxwell (1996) reviewed the evolution of food security as a concept over the past decades and highlighted three key shifts: from global and national to household and individual scales; from a viewing food needs in silo to positioning food security as the success of livelihood security; and from objective to subjective measures and understandings of food security. Over the past decades, the pillar of food availability has made the most progress leading to record increases in food supplies world-wide (FAO et al., 2014; Godfray et al., 2010). In contrast, it has been reported that the pillar of food access has made the least improvement over the last two decades, especially in sub-Saharan Africa (FAO, 2014; Cruz-Garcia et al 2016). Increasing contributions to the literature recognise that utilisation, access and stability are the major global food security challenges but are the least understood dimensions of food security and have often been neglected in policy and implementation (FAO, 2014; Cruz-Garcia et al 2016; Fiorella et al 2014; Joffre et al 2017). Emerging consensus calls for the consideration of broader determinants in future food security research (Barrett, 2010; Grafton et al., 2015).

At the same time, the understanding of the important inter-linkages between all four pillars of food security and the environment has gained momentum over the past decades (Pinstrup-Andersen and Pandya-Lorch, 1998; HLPE, 2014; Campbell et al 2016; Cruz-Garcia et al 2016). Ample body of literature highlights that food insecurity is directly and indirectly linked with ecosystem service degradation, scarcity of natural resources, climate change, among others. The concept of ecosystem services, which originates in the 1970s and gained rapid popularity following the Millennium Ecosystem Assessment (2005), has grown very recently in food security discourse (Millennium Ecosystem Assessment, 2005; Poppy et al., 2014; Godfray et al., 2010). For example, a recent study by Cruz-Garcia and colleagues (2016) carried out a review of over 280 studies concerning ecosystem services and food security with a major focus on case studies of farming communities in Africa, Asia and Latin America revealing general trends and significant gaps in the interface of ecosystem services and food security research. The authors revealed that although the first paper addressing food security and ecosystem services issues originated in the 1989, it was not until the early 2000s that case studies investigating linkages between the two fields emerged. Based on the analysis of the literature, the authors further revealed significant shortcomings in food security and ecosystem service research, including: a major bias on food availability in relation to crop production with food access, utilisation and stability under-investigated; limited geographical case studies; and a disregard for trade-offs, gender and cultural services (Cruz-Garcia et al 2016). At the same time, increasing contributions to the literature draw attention to the major implications of climate change for food security and livelihoods (Thompson and Scoones 2009; Connolly-Boutin and Smit, 2016; FAO, 2016; Karunasagar and Karunasagar 2016). For example, a recent review of the literature concerning climate change and food security by Campbell and colleagues (2016) revealed that despite uncertainty and limitations in data, it is increasingly acknowledged that the climate impacts on food security will be serious and will affect all dimensions of food security as well as the whole global food system. The authors go on to highlight that much of the literature at the interface of food security and climate change is dominated by studies on crop yields with limited attention paid to broader production systems (e.g. fisheries, livestock) and food security dimensions other than production (Campbell et al 2016). Given the multi-faceted nature of food security, several authors make the important point that the key challenge is to achieve food security in a climate-resilience manner and whilst ensuring social and environmental sustainability (Poppy et al 2014; Troell et al 2014; Connolly-Boutin and Smit, 2016; FAO, 2016).

2.2.2 Global Food Security Status

The year 2015 marked progress towards reducing food and nutritional insecurity in accordance with the Millennium Development Goal Targets which aimed to halve the proportion of the population below the minimum level of dietary energy consumption and the prevalence of underweight in under five year old children. Nonetheless, it is clear that the world continues to face major challenges to achieving food security with 805 million people world-wide estimated to be suffering from food insecurity in 2014-16; the vast majority living in developing countries (FAO, 2014; FAO, IFAD and WFP, 2015; FSIN 2017). In addition, recent estimates reveal that world-wide over a third of children aged under 5 years (3.6 million children) are malnourished and an estimated 2 billion people suffer from micronutrient deficiencies (FAO, 2009a; Lam et al. 2013). Furthermore, approximately 100 million people in 2016 were reported to be facing crisis level food insecurity with immediate forecasts predicting a worsening of food security and the risk of famine in certain hotspots, particularly areas that have experienced conflict and drought (FSIN 2017). Progress towards improved food security continues to be uneven across countries and regions. Although the proportion of undernourished people in developing countries dropped from 23% in 1990-92 to approximately 13% in 2014-16, there are marked differences in progress towards improved food security across regions with a high prevalence of under nutrition remaining in Southern Asia and sub-Saharan Africa (FAO, IFAD and WFP. 2015). For example, the highest prevalence of undernourishment for any region occurred in SSA which has an estimated 220 million people experiencing food insecurity in 2014-16 (FAO, IFAD and WFP. 2015). The progress made in food security over the past decades was achieved through the productivity gains of the Green Revolution in the 1970s and 80s which led to improved agricultural seed varieties, increased fertiliser and intensification of agricultural production systems world-wide (Evenson and Gollin, 2003). As a result, it is estimated that the world's current agriculture production output is sufficient to meet global demand for food and is estimated to continue growing faster than the global population. However, giving the alarming rates of food insecurity world-wide today, it is recognised that food production alone is not the solution for improved food security and the achievement of utilisation, access and stability dimensions remain a significant challenge (Barrett, 2010).

2.2.3 Food Security in Malawi

In most recent years the global food security situation has worsened, particularly in SSA which has the highest regional prevalence of undernourishment and where the number of undernourished has increased by 44million since the 1990s (FAO, IFAD, WFP, 2017). Similar to other parts of SSA, Malawi is experiencing a food security crisis exacerbated in recent years by the effects of a pro-longed El Nino-induced drought and increased floods.

Malawi is ranked 105 out of 113 countries on the Global Food Security Index (GFSI) and has a high prevalence of malnutrition with 21% (36million) people reported to be undernourished in 2014-15 (FAO, IFAD, WFP, 2015). Rural small holder farmers play a critical role in contributing to the country's food basket with production focusing on maize, the nation's main food staple (Ndekha et al. 2000; Arimond and Ruel 2004; Bezner Kerr et al. 2010; Audsley et al., 2010; NSO, 2012). Key drivers associated with food insecurity in Malawi include: shortage of arable land and employment opportunities (Russell et al 2008), high food prices during the lean season (Audsley et al., 2010); high vulnerability to the effects of erratic weather conditions (natural flooding and drought events as well as the effects of El-Nino) (Sahley et al. 2005; Schmidhuber & Tubiello 2007); widespread poverty, a high prevalence of HIV (11% of the population in 2010, Malawi National AIDS Commission, 2015) and other socio-economic factors (e.g. limited access to assets, education, markets, etc.).

Since the 1990s, options for combating the food insecurity crisis in Malawi have focused on increasing agricultural production as well as more recently household cash-based programs

(Devereux, 2007; Audsley et al., 2010). Aquaculture development is increasingly seen as one option to combat the livelihood and food insecurity situation in Malawi by increasing productivity of the existing rural resource base, diversifying livelihoods and producing nutritionally rich food (Russell et al 2008).

2.2.4 Complexities of Food Security

Food security is highly complex and results from interactions of multiple social, environmental, economic and political stressors and drivers which vary by context (Swift 1989; Misselhorn 2005; FAO, 2014; Connolly-Boutin and Smit, 2016). The understanding of food security has progressed into recognising that food security is part of a broader livelihood strategy that determines access to food and the ability to adapt to stressors (Maxwell and Smith 1992; Scoones 1998; Chambers and Conway 1991; Connolly-Boutin and Smit, 2016). However, understanding the interconnected pathways between livelihood strategies and food security is complicated. Increasing contributions to the field reveal that engagement in food-based livelihoods do not necessary result in improved food security and nutrition (Oakley and Momsen 2005 ; Masset et al 2012; Pingali 2012; Fiorella et al 2014). At the same time, all food production systems are dependent on natural resources (e.g. fertile soil, aquatic life, land, water) and result in differing environmental and social impacts (Troell, et al 2014). For example, a recent study by Barrett and Palm (2016) documents the benefits and unintended consequences of the Green Revolution to global food security. The author points out that although it was reported that the Green Revolution increased global food availability and saved some lands from agricultural expansion, negative impacts resulted from poor policies, including: pollution affecting human and environmental health (Pingali and Roger, 1995; Galloway et al., 2003) and the destruction of valuable habitats (forests, woodlands, grasslands) leading to decreases in biodiversity, climate forcing and impacts to local livelihoods (Pingali, 2012). Major social and economic transitions as well as environmental change have shaped, and will continue to shape, global food systems (Connolly-Boutin and Smit, 2016). Recent predictions reveal that the global population will reach an estimated 10 billion people by the middle of the century leading to a rising demand for food predicted to require a 70% increase in food production (FAO, 2009). At the same time, recent predicted increases in global income and urbanisation will affect food diets, leading to a rising demand in high-quality foods and increased consumption of animal protein (FAO, 2009). Global food systems are further influenced by environmental stressors, such as climate variability (El Nino-Southern Oscillation (ENSO) events); extreme weather events (droughts, floods); natural hazards; land use changes; among others; with implications for the sustainable production of foods. Increasing contributions to the literature reveal that the impacts of climate variability. All types of animal protein production systems - agricultural lands, freshwater systems and marine-based systems - are projected to be impacted by climate related changes, including drought, floods, temperature increases; among others. (Parry et al, 2007; Thornton et al., 2009; Thornton, 2010; Macusi et al 2015). Emerging studies reveal that climate change is already impacting the production and quality of crops, livestock and fisheries (Campbell et al 2016; Barrett and Palm, 2016; Ebhuoma and Simatele 2017). The complex dynamics surrounding food security present significant challenges to reducing food insecurity in the 21st century in a climate-change-resilient and nutritional sensitive manner, while achieving social and environmental sustainability (Poppy et al 2014; Fiorella et al 2014; Barrett and Palm 2016; Thilsted, et al 2016).

2.3 The role of Fisheries and Aquaculture to Food Security and Nutrition

Fisheries and aquaculture play a critical role in supporting livelihoods and contributing to improved food security and nutrition of hundreds of millions of people, particularly rural populations in developing countries (Kawarazuka and Bene 2011; Beveridge et al 2013; HLPE, 2014, Bene et al 2015; Bene et al 2016; Thilsted et al 2016; Little and Bunting 2016). The role of fisheries and aquaculture in contributing to improved food security and nutrition is increasingly being recognised word-wide (HLPE, 2014, Bene et al 2015, Bene et al 2016). Recent contributions to the literature provide the strongest evidence based case to date in emphasising the contribution of fish to all four pillars of food security- availability, accessibility, sustainability and nutrition (HLPE, 2014; Bene et al 2015; Thilsted et al 2016). The link between fish and food security and nutrition is recognised to comprise a myriad of pathways, both direct and indirect, which can impact on varying scales from households to global levels (HLPE, 2014). Fisheries and aquaculture can play a pivotal role in contributing to food security and nutrition - both directly, via providing a supply of animal protein, essential fatty acids and micronutrients as well as indirectly, through the generation of income used to purchase food as well as the supply of animal feeds (Beveridge et al 2013; Hall et al 2011; HLPE 2014; McClanahan et al 2015; Bene et al, 2015; Bene et al 2016; Jennings et al 2017).

Availability

Global production of capture fisheries and aquaculture amounted to 167.2million tonnes in 2014 with a record proportion of 87% (146mt) of total fish supply utilised for direct human consumption and the remaining predominantly destined for fish and animal feed, which contributes indirectly to food supply (FAO, 2016). Moreover, global per capita consumption of fish reached a new record high of 20kg/capita/year in 2014 due to the rise of aquaculture contributing more than half of all food fish consumed. The demand for food fish has risen in both developed and developing countries and is expected to keep rising at more than 2.5% per year (Peterson and Fronc, 2007; Garcia and Rosenberg, 2010). Almost half of the fish food consumed today is in the form of live, fresh or chilled fish (46%, 67mt) with the remaining consumed in various processed forms, including dried, salted, smoked, frozen.

Accessibility

Fisheries and aquaculture provide a critical source of livelihoods and income, contributing indirectly to improved access to food for consumption (HLPE, 2014; Bene et al 2015). World-wide, recent estimates reveal that fisheries and aquaculture provide full-time and part-time employment for approximately 60 million people engaged in the primary sector of production (FAO, 2016). A vast majority of these fisher folk are engaged in small-scale fisheries and aquaculture and live in developing countries. Moreover, according to Allison, Delaporte and Hellebrandt de Silva (2013), between 660 and 820 million people (fisher folk and families) depend on fisheries and aquaculture related activities for income and livelihoods.

Utilisation

The significant rise in fish consumption has enriched the diets of people world-wide via increasing the diversity and nutritional richness of food. Fish is a highly nutritious source of food, containing important amino acids, essential micronutrients and a rich source of protein (Roos et al 2007; Allison 2011; Kawarazuka and Bene 2010; Beveridge et al. 2013; Bene et al 2015; Thilsted et al, 2016). Fish is recognised to be a significant source of animal protein relative to other protein sources such as cattle and poultry (Thilsted et al 2016). Today, it is estimated that fish accounts for about 17 percent of the global population's intake of animal protein and 6.7 percent of all protein consumed. Moreover, the share of fish in per capita intake of animal protein is estimated to reach more than 50% in some countries (Kawarazuka and Béné 2011; HLPE 2014; Naylor et al 2016). Geographical differences in the contribution of fish to per capita intake of animal protein have implications for food security and nutrition. Differences in fish consumption trends exist as a result of a number of factors, including: access to markets, differences in cultures and diet habits as well as the availability and cost of fish (HLPE 2014). In developed countries, levels of fish consumption are highly driven by demand with strong dependence on imports as a result of decreasing domestic supply of fish. In contrast, levels of fish consumption in developing countries are driven by supply and are dependent on local, seasonal availability of fish (FAO, 2014). Although fish consumption is expected to continue to rise in all regions world-wide over the next decade, it is reported that low-income families will continue to have low intakes of fish due to access constraints (FAO, 2016; Thilsted et al 2016). Many contributions to the literature further point out that fish is an important source of amino acids and micronutrients. The lipid content of fish is unique, comprising long-chain omega-3 fatty acids, (Long-chain poly-unsaturated fatty acids, LC-PUFAs) (Thilsted et al 2016). In addition, fish is rich in essential micronutrients – vitamins A, B, D and minerals such as selenium (Roos et al. 2003; 2007).

The contribution of fish to improved human health is well-documented in the literature. Provided it's nutritionally rich composition is well-kept, fish can contribute to improved human health in multiple ways (Thilsted, et al 2016). Increasing contributions to the field reveal that fish consumption is associated with reduced mortality (e.g. Rimm and Mozaffarian, 2006; Zhao et al, 2015) and weight loss (Smith et al., 2015). High levels of micronutrients such as iodine as well as Vitamin B12 in fish can lead to improved growth and brain function (Thilsted, et al 2016). High levels of minerals such as selenium in fish can also strengthen antioxidant defence systems and prevent cardiovascular disease (Mozaffarian, 2009). Moreover, intake of omega-3 fatty acids can prevent an array of diseases (such as coronary heart disease), reduce the risk of premature birth during pregnancy and improve child development (Thilsted et al. 1997; Larsen et al. 2011). The consumption of fish is also known to improve the utilisation of micronutrients from other plant-based foods in diets (Michaelsen et al., 2009). Importantly, the nutritional compositional of fish varies by species and the utilisation of nutrients is affected by the form of preservation and what part of the fish is consumed. For example, high concentrations of micronutrients are found within the bones, heads and viscera parts of a fish and thus consuming these parts will enhance intake of micronutrients (Bogard et al., 2015b). In addition, small fish (such as sardines, anchovy, sea bass, and tilapia) contain high levels of minerals and can obtain high concentrations of omega-3 fatty acids (such as sardines and anchovy). Thus, the consumption of small fish, when eaten whole, can lead to enhanced micronutrient and fatty acid intakes (Bogard et al., 2015b; Naylor et al 2016; Thilsted et al 2016). In terms of preservation type, ground dried small fish are known to provide high concentrations of micronutrients and a suitable meal for young children (Thilsted, et al 2016). Fish can thus provide a potential vital contribution to the alleviation of malnutrition and health of billions of people in developing countries, particularly highly vulnerable populations such as women and children (HLPE, 2014).

Stability

Stability refers to the secure access to enough food at all times and the achievement of the pillars-availability, access and utilisation.

2.3.1 Aquaculture's Position in the Global Food System

Aquaculture can make an important contribution to global and local food security and nutrition needs (HLPE, 2014; Bene et al 2015). Further, aquaculture can alleviate the pressure on already over utilised capture fisheries and provide an alternative livelihood strategy for alleviating pressures on threatened biodiversity (FAO, 2016). Today, the supply of food fish is now dominated by the production of aquaculture, in particular small-scale inland systems in developing countries (FAO, 2016). Aquaculture continues to be the fastest growing segment of the global food system and is projected to contribute over two-thirds of global food fish supply by 2030 (World Bank, 2013; Troell et al 2014). It is increasing recognised that aquaculture will be of high importance in the future food security and nutritional security of the global population due to three central arguments. Firstly, in terms of global protein supply, recent estimates reveal that fish is the dominant contributor to the supply of protein per capita compared with pig, poultry and beef (Troell, et al 2014). Giving the dominant and increasing share of aquaculture to the supply of global food fish, aquaculture is viewed as providing a crucial source of nutritious food to the global food system (Troell et al 2014; Ottinger et al 2016). Secondly, farmed fish is more efficient in converting feed into protein in comparison with most terrestrial livestock systems (Hasan and Halwart 2009; Hall et al 2011). Thirdly, aquaculture has a lower carbon footprint per kilogram of output compared with most terrestrial livestock systems (Hall et al 2011).

Today, aquaculture contributes directly to food security via supplying an estimated total world production of 73.8mt of farmed fish, most of which is destined for human consumption (FAO, 2016). Moreover, the sector contributes indirectly to food security and nutrition via providing a source of income to an estimated 18milllion people employed in the primary production of aquaculture world-wide as well as supporting livelihoods of millions more people involved in dynamic aquaculture value chains (Williams et al., 2005; Bene 2006; Allison 2011; Kassam, 2013; Bene et al 2015). Overall, the rise and present diversity of aquaculture world-wide has potential to add resilience to the global food system and provide a vital source of affordable protein and livelihoods for millions of people, particularly poor populations in developing countries (Beveridge et al., 2013; Troell et al 2014; Thilsted et al 2016). However, as described aquaculture's rapid expansion has also given rise to negative environmental and social impacts and many scholars remain sceptical regarding aquaculture's contribution to the global food system unless the sector can minimise its dependency on other food systems (Merino et al 2012; Troell et al 2014; Bene et al 2015).

2.3.2 Empirical Evidence of the Role of Aquaculture to Food Security

Worldwide, it is increasingly recognised that fisheries and aquaculture have important complementary roles in providing an important source of nutritious food, income and livelihoods among fisher folk and consumers (Kawarazuka & Be´ne´2011; Beveridge et al 2013; Troell et al 2014; HLPE, 2014; Bene et al 2015; Little and Bunting 2016; Thilsted, et al 2016). However, emerging contributions to the literature highlight that significant gaps in knowledge exist that rigorously investigate the links between fisheries and aquaculture to food security and nutrition (Bene et al 2015; Bene et al 2016). For example, a recent scoping review of evidence by Bene and colleagues (2016) identified the following six key gaps in relation to understanding the role of capture fisheries and aquaculture to food security: 1) key dimensions of fisheries and aquaculture, such as socio-economic analyses, are often not accounted for in national statistics; 2) an understanding of gender relations in fisheries and aquaculture is limited; 3) poverty and food security are not clearly conceptualised in the fisheries literature; 4) there is limited knowledge of the causal relationship between aquaculture development and food security; 5) questions remain concerning the causal relationship between fish and nutritional benefits, including a limited understanding about the role of fish in the diets of the poor; and finally, 6) there are limited studies investigating the local-level impacts of global drivers on food security in the context of capture fisheries. The authors went on to conclude that more local specific case studies are required to address these gaps and that such studies should be granted greater attention in policy discourses. Supported by wider studies (Darling, 2014; Firorella et al 2014), the authors emphasized that case study research can be highly beneficial in capturing the complex relational interplay between fish and food security which if designed effectively, can enable comparisons across cases (Bene et al 2016).

Although an increasing body of literature attempts to assess the role of fish to food security, the majority focus on capture fisheries and are limited geographically in scope with few studies exploring the role of small-scale aquaculture on household food security (Kawarazuka & Be´ne´, 2011; Darling et al 2014; Bene et al 2016). From this literature, it is clear that fishing-based livelihoods can play a complex role in household food security (Allison and Horemons, 2006). In some contexts, inland and marine capture fisheries based livelihoods were proven to improve fish consumption of adopting households compared with non-fishing households ((e.g. in marine fishing communities in Kenya (Darling et al, 2014) and inland fishing communities in Niger (Gomna and Rana, 2007)). However, in other cases, fishing-based livelihoods do not necessarily increase fish consumption and wider socio-economic factors may instead influence food security ((e.g. in inland fishing communities in Kenya (Fiorella et al, 2014) and in Bangladesh (Rahman, et al 2013)).

While these studies attempt to quantify the relational interplay between capture fisheries and food security, the majority (excl. Darling, 2014) adopted a narrow perspective of food security or only tenuously assessed the relational links due to absent of a counter factual.

Understanding the role of aquaculture to food security and nutrition is of upmost importance to the future sustainable management of the sector and it is surprising this remains poorly studied (Bene et al 2015; Bene et al 2016). Acknowledging the rapid rise and evolution of aquaculture, many increasingly important questions remain concerning the complexity of aquaculture's role to food security across scales and contexts. The complex and multidimensional nature of aquaculture and food security has presented methodological and policy uptake challenges when considering the role of aquaculture to food security and nutrition. Moreover, the informal nature of dominant small-scale aquaculture activities (often part time, seasonal) as well as the often dispersed and remote location of small-scale inland operators has led to further methodological challenges. A few studies have investigated the impacts of aquaculture on human nutrition and health (e.g. in Malawi, (Aiga et al 2009)), poverty (e.g. in the Philippines (Irz et al 2007)) and fish access and preferences among general consumers (e.g. in Egypt (El Mahdi et al 2015)). However, few studies have investigated the contribution of small-scale aquaculture on household food security and nutrition (Belton and Little 2011; Bene et al 2016).

Only recently has a small body of literature emerged that broadly assesses the contribution of aquaculture to household food security and nutrition. Growing evidence reveals that aquaculture can contribute directly and indirectly to food security via increasing food consumption and income of adopting households, for example in India (Kumar and Dey, 2006); Bangladesh (Islam, 2007; Jahan et al 2010; Belton et al 2014; Haque and Dey 2016); and in Malawi (Dey et al 2007, 2010). For example, a study by Belton and colleagues (2014) used mixed social methods to assess the impact of aquaculture development within six communities in Bangladesh to poverty and food security. Based on a 3-day recall period of certain food items, the study found that fish farming households consumed more food items on average than non-fish farming households. Similarly, in other parts of Bangladesh, the more recent study by Haque and Dey, (2016) carried out a before and after impact assessment of aquaculture development across six floodplains sites and revealed that aquaculture increased the income and fish consumption of adopting households.

In Malawi, Dey and colleagues (2007) investigated the socio-economic impacts of IAA systems via carrying out a survey of integrated aquaculture-agriculture (IAA)-adopting and non-adopting farmers in early 2004. The authors revealed that the introduction of IAA led to an overall increase in fresh fish and other protein food consumption as well as higher farm productivity and income per hectare by adopting households. (Dey et al 2007; 2010). However, the survey methods were significantly limited in the assessment of food security – a 1-month recall period was deployed with a short list of only protein food groups (beans, meat, dried fish, fresh fish and chicken) rendering the assessment of household diet diversity incomplete and food consumption poorly captured.

In other emerging studies, the impact of aquaculture does not necessarily contribute positively to household food security, for example in Bangladesh (Thompson et al 2002) and in Ghana (Kassam, 2013). For example, the recent study by Kassam (2013) provides a more complete picture of the role of aquaculture to household poverty alleviation and food security in Ghana. Guided by the SLA, the author captures multiple dimensions of food security through diet diversity, the Food Consumption Score (FCS), food adequacy questions and coping behaviours and reveals little difference between fish farming and non-fish farming household in relation to household food security status. In addition, a study by Thomson and colleagues (2002) exploring the role of fish to food security in Bangladesh observed no difference in fish consumption between fish farming and non-fish farming households. As highlighted by Naylor et al (2016), farmed fish are often considered as a “cash crop” instead of a “food crop” and thus its impact to food consumption by adopting households can vary. Although these studies largely confirm that small-scale aquaculture plays a complex role in household livelihood strategies, often contributing positively to adopting households, they adopt a narrow perspective of food security – predominantly addressing food consumption - and measure only the consumption frequency of a few food groups (e.g. mainly fish consumption) limiting assessments of diet diversity and quality. A further study by Villasante and authors (2015) evaluated the provisional services of aquaculture in Mozambique and Namibia through semi-structured questionnaires with fish farmers. The authors measured food security using a subjective value of whether fish consumption had increased/decreased since being involved in aquaculture, source of food and meals per day, concluding that aquaculture had increased access to food for fish farming households. However, this study was limited in its analysis by targeting only fish farming households (with no counterfactual) and focusing on a narrow element of food security. Another study by Ahmed (2009) adopted the sustainable livelihoods approach (SLA) framework to qualitatively assess the impact of aquaculture on fish farming and non-fish farming households in Bangladesh. Although the study revealed that fish farming contributed to improved income, food consumption and well-being, it was limited in its scope to assess food security and focused more generally on livelihood outcomes.

Overall, a review of the literature reveals that conflicting results and significant gaps still persist in the understanding of the complex relationship between aquaculture and food security (Bene et al, 2016). A large proportion of the reported studies were carried out in Asia with limited studies carried out in SSA where the need for aquaculture is greatest (Bene et al 2016; FAO, 2016). In addition, all the dimensions of food security have not been adequately addressed in the context of aquaculture. Similarly, the dimensions of gender within aquaculture and its influence on food security outcomes have been largely neglected from studies. Moreover, conditions favouring adoption of aquaculture do not occur uniformly over geographic space or time (Kam et al 2008). High risks are associated with small-scale aquaculture, particularly in rural dry land communities in SSA, where social and environmental shocks and pressures can result in challenges to the retention and expansion of aquaculture (Tran et al 2013; Campbell et al 2016; FAO 2016). The complex interactions between aquaculture and food security requires an in-depth-examination and a careful analysis that captures the relative contribution of aquaculture to food security at different scales of production, farming contexts and socio-ecological settings (Troell et al 2014; Bene et al 2016; Joffre et al 2017).

Chapter 3: Malawi Case Study

3.1 Overview - Malawi Country Context

Malawi is a small landlocked sub-Saharan African country with a total land area of more than 118,000 square kilometres (as shown in Figure 3.1.). It is bordered by Zambia to the west, United Republic of Tanzania to the northeast, and Mozambique to southeast and southwest. Twenty percent (24,405 square kilometres) of Malawi's total area is covered by water (lakes, rivers), resulting in considerable aquatic resources including Africa's third largest Great Lake- Lake Malawi. Malawi has a population of over 19 million (rising by 3.3% per annum) and is one of the world's least-developed countries, with around 84% of the population living in rural areas (CIA, 2017). The population is distributed predominantly in the Southern Region (est. 45%) compared with the northern (60%) and central regions (49%). Almost half of the population is poor with distinct differences between those living in poverty in urban (17%) and rural areas (57%) (NSO-Malawi 2012; NSO-ICF 2017). Rural populations are highly dependent on agriculture as a main source of employment (NSO-ICF 2017). The southern rural population is further challenged by health issues, for example HIV prevalence in the South (12.8%) is higher than in the North (5.1%) and Central (5.6%) parts of Malawi (NSO-ICF 2017).

The environment plays a critical role in supporting social and economic development at both the household and national levels (Yaron et al, 2011). A recent economic analysis of Malawi's natural resources estimated for the first time the value of the country's natural resources to national GDP, including fisheries (4%), forestry (6.1%) and nature-based tourism (2.7%). However, evidence demonstrates that these resources, including agriculture, are degrading at alarming rates as a result of population growth, unsustainable practices and weak natural resource governance (Yaron et al, 2011). Rain-fed agriculture is the foundation of the national economy, employing 85% of its workforce and contributing more than 35% to the country's gross domestic product (GDP) (ODI, 2011). According to the CIA (2017), the country's GDP was estimated at US$5.4 billion in 2016 (rising by 2.3% per annum). The majority of the sector consists of smallholder farmers with the dominant cultivation of maize. Malawi ranked 170th out of 188 countries included in the United Nation Development Programme's (UNDP's) Human Development Index for 2016 (UNDP, 2016). Since independence in 1964, Malawi has been through three regimes and governed by five different heads of states. Each governing party has faced challenges in maintaining economic stability, part due to prolonged decentralisation phases. The country consists of 28 districts and 8 Agricultural Development Divisions (ADDs).

Agriculture extension officers are located within each district (27, excluding the Likoma District situated within Mozambican waters in Lake Malawi) to help provide technical advice and support the sector. Since 2007, fisheries extension officers have been established in these districts as a result of the Department of Fisheries moving from the Ministry of Mines, Natural Resources and Environment (MoMN&E) to the Ministry of Agriculture and Food Security. However, the effectiveness of extension workers is limited as a result of poor capacity with at present only one officer is in post, tasked with covering an entire district. The Malawi people are of Bantu origin and comprise of many different ethnic groups, predominantly including the Chew (34.7%), Lomwe (19.1%), and Yao (13.4%) (CIA, 2017). The Chichewa (Chewa) people form the largest part of the population group and are largely in the central and southern parts of Malawi. The most common languages are Chichewa and English (official language) (CIA, 2017).

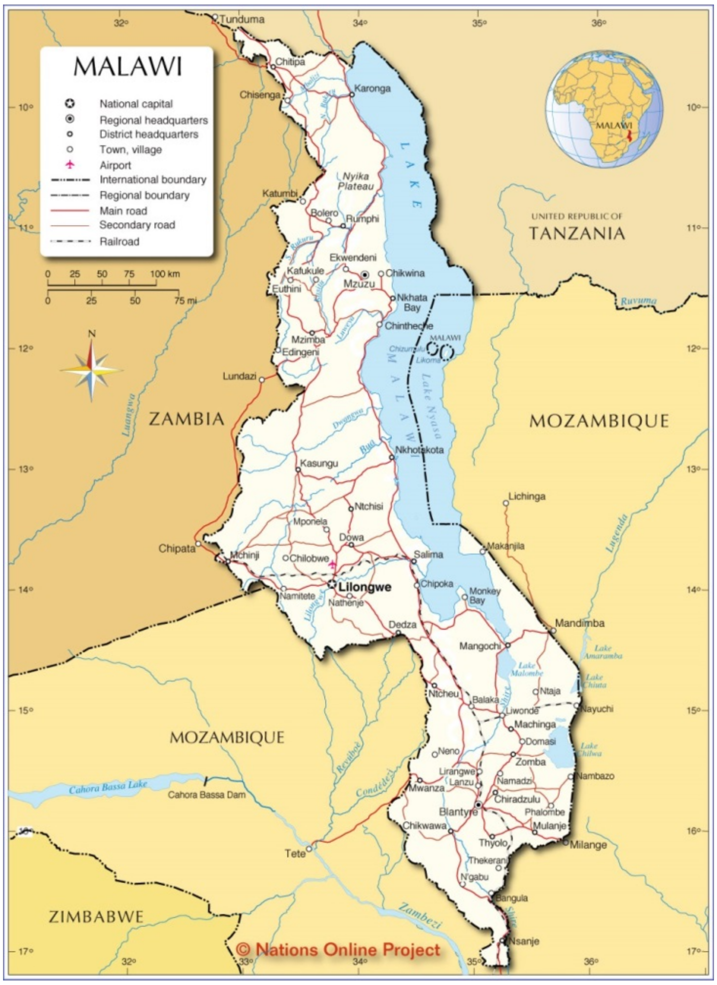

Figure 3.1. Political Map of Malawi. Source (accessed Sept 2014):
ttp://www.nationsonline.org/oneworld/map/malawi_map.htm

3.2 Overview of the Fisheries Sector in Malawi

3.2.1 Importance of fish for food and nutritional security in Malawi

The fisheries sector in Malawi is an important contributor to the social and economic performance of the country (Mwale, 2009; Phiri et al 2013). Recent estimates reveal that fisheries resources crucially support the livelihoods of more than 1.6 million Malawians via providing a source of employment (60,000 fishers and 6,000 fish farmers) and food (5.6kg per apparent per capita supply of food fish) (GoM 2012). In addition, recent analysis by (Yaron et al, 2011) reveals that the fisheries sector contributed at least 4% to national GDP in 2011. Poor reporting and a lack of accurate assessments in the aquaculture sector suggest that the benefits arising from the fisheries sector could be underestimated.

Over two decades ago, fish used to be the most affordable source of animal protein in Malawi resulting in fish paying a prominent role in Malawian diets (contributing 70% of animal protein consumption) (Russell et al 2008). However, since the early 1990s, annual apparent per capita consumption of fish in Malawi has declined significantly by more than 40% from 9.4kg to 5.4kg per annum in 2008 (Yaron et al, 2011). A decline in per capita fish consumption has been reported across much of sub- Saharan Africa, presenting serious implications to food and nutritional security in the region. Trends in per capita fish consumption in the region are expected to worsen in the future with a predicted decline from present day 6.8kg to 5.6kg by 2030 (World Bank, 2030). It has been suggested that the significant decline of annual per capita fish consumption in Malawi has been attributed to two factors: 1) population growth (60% increase from 7.9 million to 12.7 million during 1990-2012; and 2) a 20% decline in capture fisheries during this same period (GoM, 2012). The current annual per capita consumption of fish in Malawi (5.4kg) is significantly lower than the World Health Organisation (WHO) recommended guidelines of an average per capita annual consumption of 13kg to 15kg (GoM, 2009). The country is now faced with increased pressure to meet national fish demand and reverse declining trends in fish consumption in what was once an accessible source of protein for many Malawians.

In terms of aquaculture, the output of main cultured species, dominated by tilapia species and the African Catfish, was recently valued at US$ 1.4 million in 2008. The sector has increasingly contributed to the total fish supply in the country over the past twenty years (GoM, 2012). Much of the fish produced by the sector as a whole is consumed by fish farmers and within their local rural areas (Andrew et al, 2003). As a result, growing consensus in the literature acknowledge the important role of fish in providing a crucial source of daily nutritional requirements for the majority of poor rural populations (Dey et al 2010; Nagoli et al. 2009; Phiri et al 2013). In response to the increasing demand for fish consumption, the Government of Malawi has embarked on what scholars identify as an 'ambitious' initiative (Mwale, 2009) to scale up aquaculture across the country (GoM, 2006). A recent report by the USAID (2013) highlights that given the limited availability of arable land in Malawi, the key solution to improving livelihoods in rural areas is to maximise productivity from current resources. The aquaculture sub-sector is increasing being viewed as a valuable option for improving rural livelihoods, meeting fish demand and contributing to economic growth. Sector development plans are now orientating growth towards more medium to large market based aquaculture operations (GoM 2012).

3.2.2 The Fisheries Sector

In Malawi, the fisheries sector is classified into three sub-sectors: capture fishery, aquaculture and aquarium trade (Phiri et al 2013). The Department of Fisheries, positioned within the Ministry of Agriculture and Food Security, is responsible for management of the fisheries sector in Malawi. Limited knowledge exists with regards to the aquarium trade. For the purposed of this thesis, a brief overview of the fisheries sub-sector will be provided, followed by a detailed description of the aquaculture sub-sector. The capture fisheries sector is categorised into three scales of operation: small-scale commercial, semi-industrial and industrial enterprises. Fishing activities predominantly are carried out in Lake Malawi, Lake Chilwa and the Shire River (GoM, 2012). Capture fisheries production is dominated by 18 species with other species including chambo (Tilapia rendalli, Oreochromis karongae and Oreochromis shiranus), a species considered to be the most important popular and high valued species among Malawians (GoM-UNDP-2012). The capture fisheries sub-sector has shown little growth over the past two decades with most recent estimates indicating a stagnation in metric tonnes of catch at 65,000-71,000 (2007-2008) (MPEI, 2011). The recent National Fisheries Policy II (GoM- UNDP, 2012) acknowledges that weak cooperation in fisheries management and financial constraints have led to problems in the sector. Unsustainable fishing practices have also been estimated to cost a significant loss of $28 million (about MK4.6 billion) per year of potential fisheries resources to the Government of Malawi (MPEI, 2011). Table 3.1 draws on the most up to date studies to provides a summary of the comparative characteristics and management features of the capture fisheries and aquaculture sectors in Malawi.

Table 3-1 Comparative characteristics and management features of capture fisheries and aquaculture in Malawi (Modified from NEPAD, 2011, GoM, 2012).

Malawi Sector	**Capture Fisheries**	**Aquaculture**
Production trends (2009)	70,000tn/yr.	2,500- 3,000 tn/yr
Scale	Predominantly small-scale artisanal in nature (90% of production) as well as semi-commercial and commercial operations in Lake Malawi.	Predominantly small-scale artisanal in nature as well as two large scale commercial operators.
Location	Lake Malawi, Lake Chilwa, Lake Malombe, Lake Chiuta and the Lower Shire River system.	There is an estimated 8,000 small-scale ponds distributed nationwide as well as two large commercial operators near Southern Lake Malawi and in Blantyre.
Employment along supply chain (2009)	60,000 fishers, and over 500,000 people are indirectly involved in fish processing, fish marketing, boat building and engine repair.	6,000- 9,000 fish farmers.
Systems/ Gears	Small-scale: gill nets, seine nets (beach or open water types), traps and hand lines; commercial operators: purse seines and trawl nets.	Small-scale: pond culture set within agriculture farms (typically 1-3 ponds covering 0.1-1ha, pond size is 100-500m² or 10m by 22m); commercial operations: cages, ponds and recirculation systems.
Main Species Cultivated	Tilapiine cichlids, the Chambo (*Oreochromis spp*), Haplochromine cichlids, particularly the Kambuzi, Utaka and Mbaba, Mcheni (*Ramphochromis spp*), Usipa (*Engraulicypris sardella*), Mlamba (*Clarias* species) and Matemba (*Barbus* species).	Tilapias, Orechomis shiranus, O. karongae and Tilapia rendalli; the Africa catfish, Clarias gariepinus and the common carp, Cyprinus capio.

3.3 The Aquaculture Sub-Sector in Malawi

3.3.1 Development History

Aquaculture was first introduced to Malawi back in 1906 (formally known as colonial Nyasaland) via the cultivation of rainbow trout (Onchorhynchus mykiss). However, it was not until after independence in 1964, that momentum to promote aquaculture nation-wide emerged. The aquaculture sector was kick-started in the early 1970s as a result of heavy public, private and donor investment based on its perceived potential to alleviate poverty and enhance food and nutritional security. This trend is similar to that in other regions where small-scale aquaculture has been promoted as part of development interventions based on this narrative (Belton, 2010). Key champions of the promotion of aquaculture in Malawi included: the World Fish Centre, Concern Universal, UNDP, Oxfam and the United Nations Children's Fund (UNICEF). Since the late 1980s, the World Fish Centre in collaboration with the Government of Malawi and the University of Malawi led an ambitious food security initiative. Funded by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), the programme aimed to promote the adoption of the form of aquaculture known as integrated agriculture aquaculture (IAA) (Russell et al 2008). This form of small-scale aquaculture is widely acknowledged in the literature as a profitable and environmental sustainable form of fish farming (Brummett and Noble, 1995; Bunting, 2013; Hishamunda et al, 2014). As a result of the relative ease of adoption, small-scale aquaculture has dominated the sector to date.

Aquaculture potential across Malawi was first estimated by Brooks (1992). Using a pioneering sophisticated GIS model at the time, the authors analysed bio-physical parameters contingent with good sustainable growth of aquaculture to quantify and map suitable land for aquaculture production across the country. Although key social parameters such as market infrastructure, population growth, and transport infrastructure were excluded from the analysis, Brooks (1992) provided the first indication of aquaculture's potential in the country estimated to be an area of 1.8million hectares (approx. 10–25% of total land area). Cited by various policies and donor led projects over the past two decades, the study provided a land-mark report for strategic expansion of aquaculture production in the country (GoM, 2006; Mwale, 2009). However, no known literature exists examining spatial planning dimensions of the sector and a lack of cooperation among donors, public and private investors has meant that the sector has evolved with little coordination. Site selection, zoning and other forms of spatial planning has proven successful in building aquaculture sectors sustainably in many parts of the world. More recently, Mwale, 2009 updated the work by Brooks (1992) to provide a map of aquaculture operations in Malawi as of 2003-2005. Although the study by Mwale (2009) incorporated key infrastructure information of the sector (incl. feed, seed stations), its analysis was limited without the use of sophisticated tools such as GIS, a method commonly used in planning for management and expansion of aquaculture sectors world-wide. More recently, Kam et al (2008) carried out a biophysical and socio-economic analysis of the potential for land suitability of aquaculture production in Southern Malawi. The authors concluded that an estimated 35km2 of land is suitable for aquaculture development in Southern Malawi. While key factors such as access to markets and water availability where included within the model, the study was limited to the southern region and failed to provide an inventory of the current status of the sector, key information which would have fully guided the future planning of the sector. Weaknesses in national aquaculture policies, resulting in a lack of monitoring, reporting and planning of the sector, has been suggested to have constrained the sector from realising its expected benefits to date (Mwale, 2009). In 2010, Malawi was identified as one of the top 10 priority countries in Africa for regional investment and support in aquaculture growth (Jamu, et al 2012). Special attention has been granted to Malawi in light of its estimated potential of aquaculture production (10-25% of suitable land) and the significant economic and development benefits achieved in neighbouring countries (Jamu, et al 2012).

3.3.2 Production systems and Characteristics

In Malawi, the aquaculture sector has mainly focused on establishing pond, cage and tank based enterprises. A recent study by NEPAD (2011) identifies two main types of active aquaculture systems in Malawi (as synonymous with classifications provided by SARNISSA, 2010): 1) Semi-extensive, small-scale aquaculture- mostly small pond based systems integrated with agricultural activities e.g. IAA; and 2) Industrial, medium to large scale aquaculture- cage culture and recirculation commercial orientated systems. Until recently, small-scale aquaculture was the primary focus throughout the aquaculture development history of the sector in Malawi. Large scale enterprises consist of two companies. Maldeco consists of a large fish production and distribution enterprise. Established in the proximity of Lake Malawi, the company's activities consist of the production of fingerlings (hatchery station), chambo (cage culture), and fish feed (feed mill) as well as post-harvest, distribution and marketing ventures. It is the largest and long running commercial aquaculture enterprise in Malawi. However, increasing evidence has prompted heightened concern over the profitability and sustainability of the company (Russell, 2008; NEPAD, 2011). Rift Valley Fisheries is formally known as Chambo Fisheries and consists of a highly intensive recirculation aquaculture system. Located in the urban vicinity of Blantyre, this commercial enterprise consists of a host of pioneering technology in the region, including: a genetic improvement program for the indigenous Tilapia shiranus; large on-going and nursery raceway systems for an untried species; and a novel feed production system involving the production of duckweed. Both commercial enterprises have received large investments by industry and growing support from the government (GoM, 2012). Small-scale operations typically included integrated aquaculture agriculture ponds systems, with 1-3 ponds measuring up to 1ha. Ponds were constructed across the country in suitable areas (Russell, 2008). Ponds are typically owned by individual farmers however, over the past decade farmer organisations and cooperatives have emerged with the collective ownership in some districts of more than 10 ponds. Termed 'cluster farmers', these aquaculture operations also consist of ponds for cultivation and for own fingerling production. The cultivation of indigenous species in Malawi began in the mid-1950s with the farming of Oreochromis shiranus and Tilapia rendalli. Farming of these species increased nation-wide as a direct result of large breeding and feed distribution programmes set up by the government with the establishment of the Domasi Experimental Fish Farm in 1957. Today, the most commonly cited species cultivated in Malawi include: three tilapia species — *Tilapia rendalli* (chilunguni), *Oreochromis shiranus* (makumba), *O. karongae* (chambo) — and the catfish *Clarias gariepinus* (mlamba) (Russel et al 2008; GoM-UNDP, 2014). A summary of the key characteristics of these four species is provided in Appendix L. According to Malawi Gold Standard guidelines (Jamu et al. 2006), a typical aquaculture production calendar in Malawi should comprise two cycles- mid-Dec to mid-March; and April to August – which avoids the period of water scarcity (September to November). However, it has been reported that most fish farmers in Malawi only carry out one production cycle during the rainy season which coincides with the lean period of food production causing many fish farmers to carry out regular partial and premature harvests (Russell et al 2008) (see figure 3.2). As highlighted, inland aquaculture is the most predominant form of aquaculture production world-wide. Typically, many of the freshwater fish species cultured are obligate planktivores and feed exclusively on algae or phytoplanktivorous zooplankton naturally found in water termed "green water" or in addition to aqua feed (Schroeder et al. 1990; Pekar and Olah 1992). This green water in aquaculture inland systems is usually developed following fertilisation from farm and household waste and can improve the survival and growth rate of larvae (Neori, 2011). However, use of green water in aquaculture systems in Malawi has not been recorded and public information about the use of fertilisation among fish farmers is limited. Historically it has been reported that whilst some farmers who owned livestock made some use of manure to enhance pond productivity, others needed convincing as they did not want to have a murky brown colour in their ponds (Harrison

1991; Hecht 1999; Hecht and Maluwa 2003). The most recent review of the aquaculture sector in Malawi carried out by Russel et al (2008) further revealed that most fish farmers do not carry out fertilisation of their ponds and use low quality feed such as maize bran (madeya). In addition, Russel and authors (2008) reported that most fish farmers do not manage water exchange within their ponds with ponds typically being fed by an inlet channel with no outlet (Hecht and Maluwa 2003).

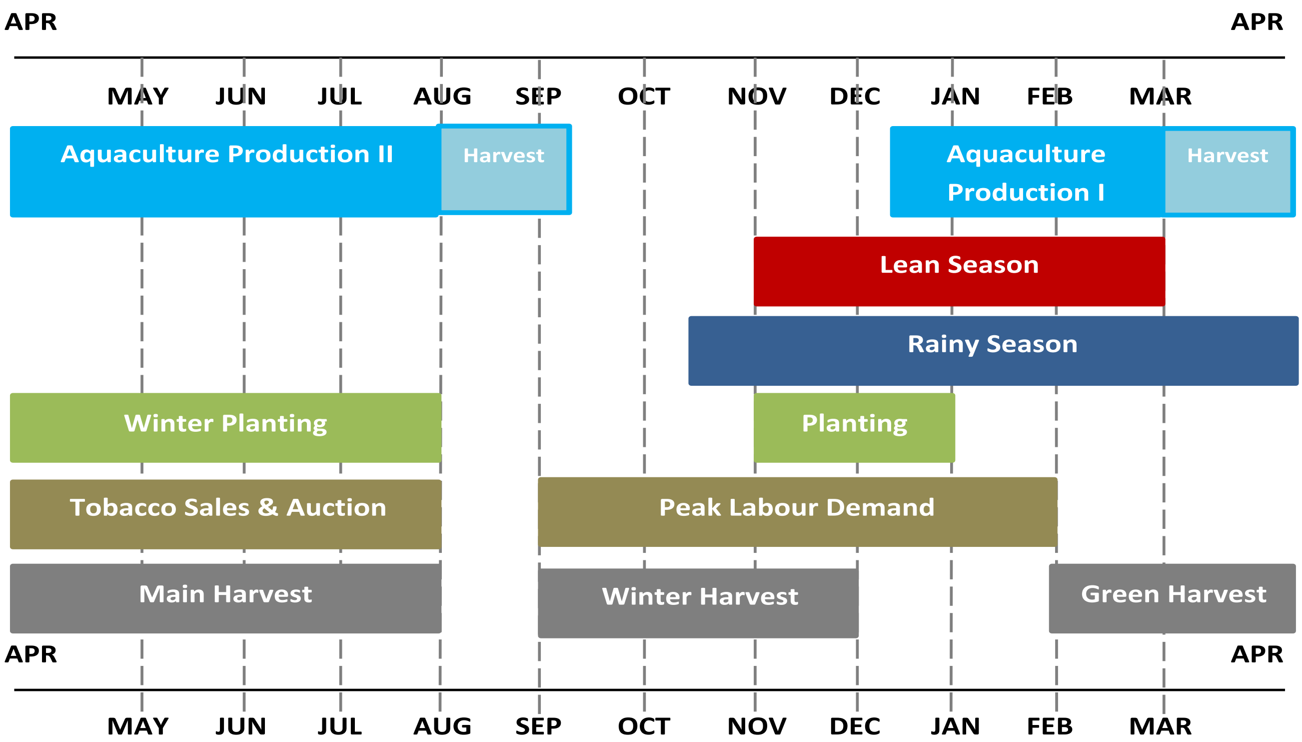

Figure 3-1 A typical seasonal livelihood and fish farming production cycle calendar in Malawi (adapted from FEWSNET 2017; Russel et al 2008).

3.3.3 Trends in Aquaculture Development

Aquaculture production in Malawi has remained very low until the mid-2000s where significant policy changes and regional awareness prompted new investment and a new orientation in the development of the sector. Overall, relative to regional growth, the sector has grown rapidly over the past 30 decades from 200tn in the late 1980s to 3,000tn in 2012. Much of this growth has been a direct result of increased adoption of small-scale aquaculture nation-wide. However, over the past decade the sector is undertaking a transition towards more commercially orientated production. Serious limitations in monitoring, reporting and accurate data in inland fisheries have been reported world-wide (FAO, 2014). Dominated by production in developing countries, located in often inaccessible areas and traditionally neglected in national agricultural discourse, inland fisheries face unique challenges for accurate reporting and assessments in the sector. Such challenges have prevailed in Malawi, exacerbated by weak governance, uncoordinated planning and a lack of capacity in extension officers (Mwale, 2009).

Recent estimates by the Government of Malawi reveal an estimated 10,000 smallholder fish ponds across the country, owned by a total of 6,000 farmers (GoM, 2012). In addition, best estimates reveal aquaculture production predominantly consists of 93% of the three tilapia species, 5% catfish and 2% exotic species such as common, carp and trout (Russell, 2008). These species are largely farmed in polyculture systems and increasing reports reveals constraints with the growth of species (Andrew et al. 2003; NEPAD, 2011; GoM-UNDP, 2014).

3.3.4 Challenges in the Sector

While growing consensus in the literature points to growth in the aquaculture sector over the past thirty years, the sub-sector still remains low accounting for 2% of total fish production in Malawi (MPEI, 2011). This is synonymous with regional growth estimates in the sector revealing bottlenecks in the development of aquaculture across much of Africa (FAO, 2014). Both small-scale and large scale aquaculture enterprises have faced challenges to sustainable growth in Malawi.

Small-scale aquaculture development in Malawi has faced a number of major challenges including: restrictions to the type of species cultivated, excluding exotic species and movement of native species within certain catchments; poor access to land and water, variations in climate affecting the availability of water and seasonal production of certain species; poor pond management due to lack high quality technical assistance and information; lack of quality seed and feed inputs, the high cost of feed ingredients, ; and fish poaching (Mwale, 2009, NEPAD, 2011). Large scale aquaculture has faced a number of challenges including, high theft rates, technology limitations in producing floatable feed, high cost of feed and high mortalities in fingerling (NEPAD; 2011).

Moreover, a number of governance issues have also traditionally limited aquaculture development in Malawi (Banda et al 2009; Hishamunda, et al 2009). The nationwide process of decentralisation, which began in the late 1990s, was committed to decentralizing many activities to newly established district assemblies through the adoption of the National Decentralization Policy and Local Government Act (1998). As part of the decentralisation process, in 2007 the DoF was repositioned from the Ministry of Mines, Natural Resources and Environment (MoMN&E) to within the Ministry of Agricultural and Food Security where it still remains today. Many scholars identify this strategic repositioning of the lead authority of aquaculture as a pivotal milestone in promoting the sector within government (Mwale, 2009). Globally, this repositioning has been identified as a common and necessary step by governments (Hishamunda et al 2014) to better manage and reconcile the complex array of legislations and policies that relate to aquaculture. However, a review by Seymour (2004) criticises the performance of decentralisation in Malawi and highlights that delays in implementing decentralisation nation-wide resulted in failures in achieving strategic goals.

Increasing aquaculture governance issues have been reported in Malawi, including: a lack of implementation of key policies (Banda, 2009); limited capacity by the Government to delivery adequate extension services (Mwale, 2009); a lack of clarity in regulatory processes (licensing, property rights) (Mwale, 2009); a lack of transparency of roles in the decision-making process (Mwale, 2009); and a lack of support services and investment in commercial aquaculture research (Hishamunda and Ridler, 2006). For example, Mwale (2009) highlighted that a lack of investment has meant that the sector is reliant on only two hatcheries, resulting in physical constraints in accessing good quality seed and feed by dispersed rural fish farmers. A regional review of aquaculture development in Sub Saharan Africa by Coche et al (1994) also reveals limitations with the sustainability of donor led operations which they highlight to be a result of short-term investment in support services for fish farmers and short-sighted goals. Government led breeding programs have improved strains of native species suitable for aquaculture development; however, early evaluations of the aquaculture sector in Malawi revealed perceived constraints with slow growth of species by fish farmers (Andrew et al, 2003). It has been suggested that poor husbandry management and construction of ponds may be determinants for the apparent slow growth in some species (Dey, et al, 2010).

While increasing literature acknowledge constraints faced by the sector, mixed opinions exist regarding the degree to which Malawi has met it's expected potential in terms of aquaculture growth.. A regional review of aquaculture by Jamu et al (2012) describes Malawi's aquaculture sector as a regional success as a result of Malawi adopting an interventionist approach to the aquaculture sector. This is supported by increasing empirical evidence which reveals the positive impact of aquaculture to local livelihoods (Russel, et al, 2008; Dey, et al 2010). However, the recent review of the sector by NEPAD (2011) highlights that Malawi's aquaculture sector has only partially met its expected benefits. This is supported by a study by Valeta (2011) which describes the evolution of the aquaculture sector in Malawi and concludes that the sector has failed to reach its potential growth compared with investments made by government and non-government organisations. A lack of accurate and up to date statistics of aquaculture in Malawi adds heightened uncertainty to this debate. Although both small-scale and large scale enterprises have faced many challenges to date (NEPAD, 2011), many scholars emphasize that constraints can be overcome with good governance and investment in commercial aquaculture and support services (Mwale, 2009).

3.4 Governance of Aquaculture in Malawi

A critical factor of successful aquaculture is good governance (FAO 2012; Hishamunda et al 2014). The multi-purpose nature of aquaculture systems (social, financial and ecological) presents unique and common problems to the management and sustainable development of the industry (Hishamunda et al 2014). There is growing consensus that good governance is critical to developing an "enabling environment" for sustainable aquaculture production and the promotion of wider sector pro-poor strategies (Hishamunda and Ridler 2006; Russell et al 2008; Hishamunda et al 2014).

The aquaculture governance system in Malawi has been described by Jamu et al (2012) as adopting an "evolutionary approach model". In the light of Malawi being identified as one of the top aquaculture producing countries and a country of strategic investment importance across Africa (Jamu et al 2012), the role of governance in developing a sustainable industry in Malawi is increasingly important. Two recent publications of trends in key drivers of change for the aquaculture sector will have implications for the design, implementation and evolution of governance frameworks, regionally and within Malawi. Firstly, a recent study by the World Bank (2013) reveals a decline in fish per capita consumption (current 6.8kg/p to 5.6kg in 2030) in Sub-Saharan Africa (SSA); expected higher dependency on imported fish to meet domestic demand and an increase in population growth. Although some scholars are cautious over the report's results, there is general agreement that the study provides insights about the future direction of the aquaculture and fisheries sector in Africa. Secondly, the catchment level approach project in Malawi carried out by Tran et al (2013) reveals that in the near future (2020-2050) water availability is expected to decline, particularly in the dry season, as a result of climate variability. Deciding how best to manage aquaculture growth sustainably in these circumstances will require the Government of Malawi to manage a well-coordinated policy and institutional environment that can effectively reduce waste of the sector, improve market access, reconcile increasing conflicts by resource users and increase production at scale. Furthermore, Russell et al (2008) highlights that the wide range of resource users and the diverse ways in which they incorporate aquaculture into their livelihoods presents a further challenge to the effective transparency of policies implemented in Malawi.

3.4.1 Roles. Governments and Others

Over the past ten years, the decision making process and implementation of aquaculture management in Malawi has undergone what scholars describe as a rapid transformation and paradigm shift in direction and structure (Russell et al 2008; Jamu et al 2012). Recent studies analysing the development of aquaculture governance in Malawi identify the process of decentralisation (Seymour, 2004), the adoption of the donor driven interventionist approach to governance (Jamu et al. 2012) and support from regional networks (Russell et al 2008; Banda et al, 2009) as contributing factors to this period of transformation. The timing of this shift has parallels with trends in aquaculture governance development across Africa (Jamu, et al 2012) as well as globally (Hishamunda et al 2014), through the adoption of a more holistic set of guiding principles increasingly implemented and promoted in general fisheries and aquaculture discourses (Song et al 2013). As a result, governance of the aquaculture sector in Malawi is now served by management structure comprising both at the top level and at local jurisdictions (Banda et al, 2009; Hishamunda et al 2014).

The study by Jamu et al (2012) reveals that since the introduction of aquaculture in Africa, governments have followed two distinct approaches, as originally described by Belton and Little (2011), in developing governance frameworks: the interventionist approach and the immanent approach to aquaculture governance. They acknowledge that Malawi has followed the former approach since the introduction of small-scale aquaculture operations in the early 1970s which was driven by donor funding and donor policy formulation support (Hishamunda and Ridler 2006; Russell et al, 2008; Jamu, et al 2012). As described by Brummett and Jamu (2011), a core principle to implementing donor led aquaculture operations in Malawi was the adoption of the Farmer–Scientist Research Partnership (FSRP) which developed a participatory process to engage fish farmers, researchers and extension officers in the scaling out of integrated aquaculture agriculture operations across Malawi. While Jamu et al (2012) illustrate that this interventionist approach has jump started aquaculture production, infrastructure and governance strategies in Malawi; they acknowledge that this approach must be met with strong strategic and implementation plans to sustain growth in the industry (Jamu et al, 2012). This historical context has shaped the institutional and policy framework of aquaculture governance as well as the role of government that prevails in the sector today (See figure 3.3).

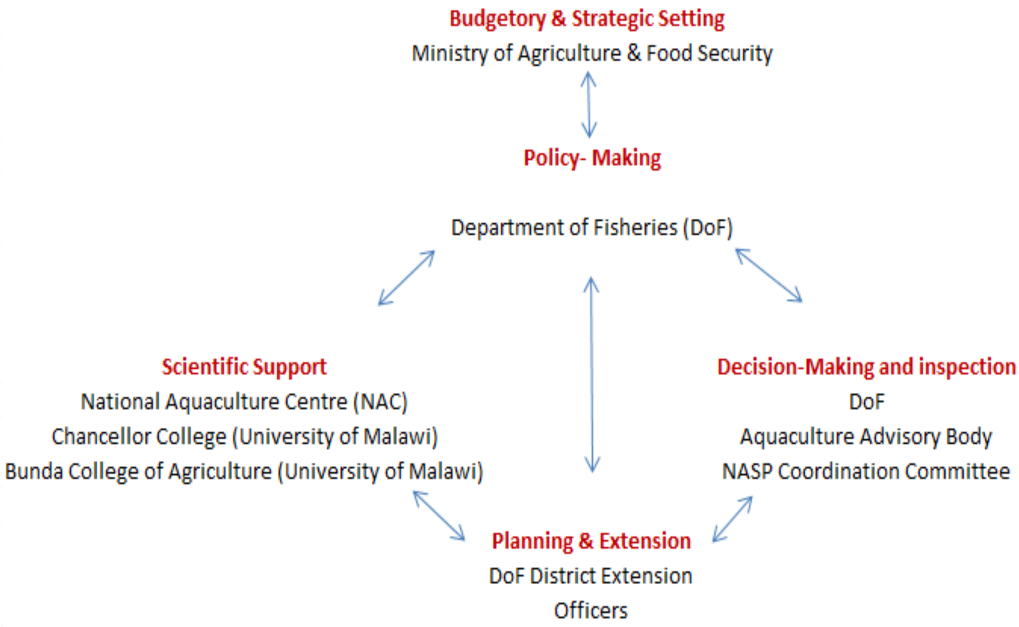

Figure 3-2 Roles of institutions governing aquaculture at the national level in Malawi as of 2014 (Adapted from Hishamunda et al, 2014).

The DoF is the lead authority for aquaculture management with a central role to coordinate, develop and implement regulatory requirements for the industry. Over the course of the past decade, the DoF has made what scholars identify as progress in delivering its responsibilities and shaping the future course of the sector (Russell et al 2008; Mwale, 2009). Key deliverables in creating an enabling environment for growth included the creation of hatcheries, fingerling production centres, satellite extension stations and three research stations (Mwale, 2009). These were created to facilitate institutional changes, training and delivery services; improve supply side conditions; and support the development of adaptive technology (i.e. fish breeding, disease control). Russell et al (20008) point out that the re-positioning of the DoF to the Ministry of Agriculture and Food Security in 2007 was a significant strategic move designed to raise the visibility of aquaculture horizontally and vertically within government and within wider budget priorities. A further key responsibility of government is to the ensure aquaculture governance is sufficiently coordinated and integrated horizontally across relevant departments in government and vertically across actors at all levels. Traditionally and as experienced elsewhere in Africa, aquaculture in Malawi has been largely marginalised from development discourse such as within the Malawi Growth and Development Strategy (Heck, 2007) despite the growing recognition of its role in creating pathways to improved food and nutritional security. Finally, the DoF is responsible for the delivery of diverse regional and international agreements and the development of key partnerships which promote good practice and raise awareness of the aquaculture sector within Malawi. Over the past ten years, it can be suggested that the DoF has taken an active approach towards developing close regional partnerships, evident by the government's participation in three significant initiatives: 1) the New Partnership for Africa's Development (NEPAD) Fish for All Summit in 2005; resulting in the endorsement of the NEPAD Action Plan for the Development of African Fisheries and Aquaculture; 2) the implementation of the FAO Special Programme for Aquaculture Development in Africa (SPADA) in 2007; and 3) the first continent wide network for the exchange of information on aquaculture 'Sustainable Aquaculture Research Networks in sub-Saharan Africa (SARNISSA)' (SARNISSA 2010). Numerous studies have highlighted that the government's involvement in these regional partnerships has resulted in strengthening of policies and subsequent increase in aquaculture production since 2005 (Russell, et al 2008; Mwale, 2009; Jamu et al, 2012).

3.4.2 Roles. Stakeholders

Globally it can be seen that the role of stakeholders is increasingly becoming an important part in the management of aquaculture (FAO, 2012; Hishamunda et al 2014). In Malawi, it has been suggested by Mwale (2009) that the process of decentralisation and the adoption of a participatory and top-down model to aquaculture governance are attempting to widen the role of stakeholders within the decision making process of aquaculture management. Many studies have shown that the decentralised process has resulted in a change in the roles and structure of public administration as well as encouraged an increasing array of actors directly involved in aquaculture (those engaged in farming fish, post-harvest activities, seed and feed production, traders, NGOs, external donors) (Hecht and Maluwa 2003; Andrew et al. 2003; Russell et al 2008). This change in improving the system of governance is widely supported by key international and regional guidelines endorsed by Malawi. For example, the FAO Code for Conduct in Fisheries and the EC funded SARNISSA project both call for greater transparency with public participation in decision making processes and implementation plans (SARNISSA, 2010; FAO, 2012). Public participation is widely acknowledged in the literature as a necessary factor in developing good governance (Coffey, 2005). As described by Pita et al (2010), the concept of participation concerns the involvement of stakeholders in policy-making and implementation. Numerous studies have shown that public participation in the management of aquaculture can deliver multiple benefits, including: establishing trust between government and fish farmers (Pita et al, 2010); resolving conflicts amongst end users (Tran et al 2013); facilitating education of technical knowledge (Brummett and

Jamu, 2011); and improving the legitimacy, acceptance and compliance of policies and regulations (Jentoft and McCay 1995; Pita et al, 2010).

A study by Andrew et al, (2003) provided the first attempt in trying to assess the relationship between the quality of governance services and the benefits derived from aquaculture interventions. The study carried out a nation-wide survey over a decade ago from communities in areas identified as suitable for aquaculture according to Brooks (1992). While the study revealed critical insights into the impact of extension delivery to the adoption of IAA based on fish farmer's perceptions, it provided little evidence in unpacking the impact of such services to the poor not directly involved in fish farmers. Furthermore, the study provided little evidence about the fish farmers' knowledge of key policies and regulation as well as the impact of governance systems on improving access and utilisation of fish within the communities.

3.4.3 Strategies, Policies and Legislative Landscape

An integral part of successful aquaculture is the development of strong and integrated policies and implementation plans to achieve set objectives and maintain a sustainable sector (Jamu et al, 2012; Hishamunda et al 2014). Growing consensus in the literature points to four core attributes necessary to contribute to strong targeted aquaculture policies: 1) the degree of policy mainstreaming within wider development and environment sectors; 2) the ability to adopt a market led approach; 3) appropriate acknowledgement of land and water rights; and 4) recognition of the role of aquaculture to food security. Jamu et al (2012) explain that the degree to which these factors are met within policies and strategies determines the effectiveness aquaculture interventions and future growth. Over the past two decades, progress has been made in establishing policies and strategies to guide aquaculture development in Malawi. It is widely acknowledged that this transition in Malawi's aquaculture development history was the result of two significant regional events: 1) the FAO led workshops between 1987-2004 which guided policy direction towards commercial goals; and 2) the NEPAD Fish for All Summit held in Abuja 2005 which resulted in the endorsement of the NEPAD Action Plan for the Development of African Fisheries and Aquaculture. It is recognised by Mwale (2009) that these initiatives marked a positive step in the development of various aquaculture strategies and policies in Malawi such as the development of the Presidential Initiative on Aquaculture Development in Malawi (PIAD) which was established in 2006. Adapted from the USAID (2013) agricultural policy map, figure 3.4 provides a timeline of the history of aquaculture policy and strategy development in Malawi over the past fifteen years. Management of aquaculture at the national and local government level has largely been guided by the following six key national laws, policies and strategies:

1. The Fisheries Conservation and Management Act 1997;
2. The 2001 National Fisheries and Aquaculture Policy (NFAP);
3. The National Aquaculture Strategic Plan (NASP) 2005-2015;
4. The Malawi Gold Standard Aquaculture 2005;
5. The introduction of the Presidential Initiative on Aquaculture Development in Malawi (PIAD) in 2006; and
6. The revised second edition of the National Fisheries Policy II 2012-2017.

Recent reviews of aquaculture governance in Malawi conclude that Malawi has made significant progress in developing a strong integrated governance framework to sustainably manage the sector but that bottlenecks exist to sustainable growth that must be overcome (Mwale, 2009; Jamu et al, 2012). While both studies reveal a positive trend in aquaculture governance history in Malawi, they do not include an assessment of the latest phase of development, including the revised National Fisheries Policy II 2012-2017.

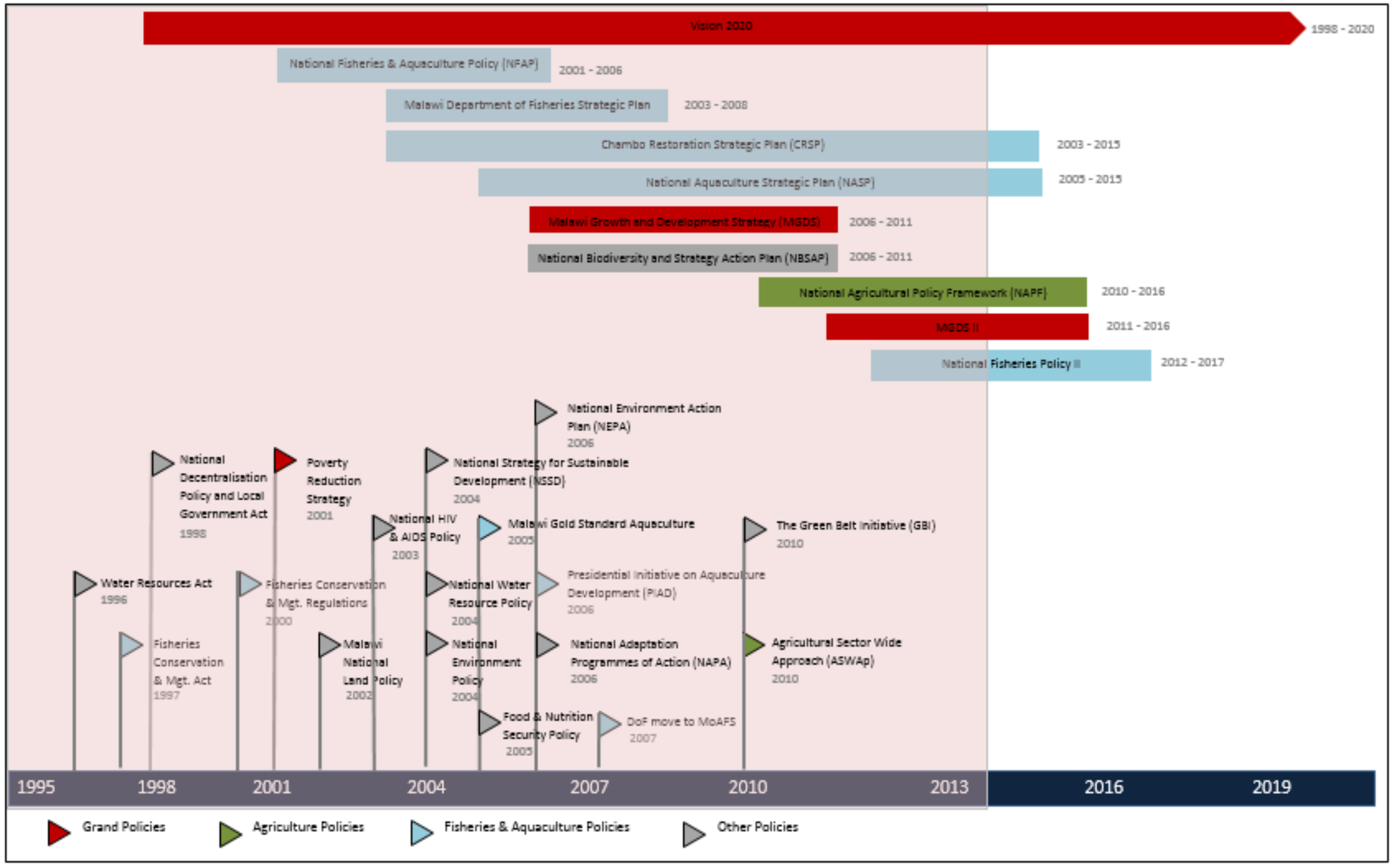

Figure 3-3 A timeline of the history of national aquaculture (and related sector) policies, strategies and laws in Malawi 1995-2020 (derived from literature review see reference list).

3.4.4 Instruments. Demand side/supply side

It is widely reported in the literature that policy instruments can provide a vital role in managing supply and demand side conditions for the sustainable growth of aquaculture (Hishamunda, et al 2012). A review by Russell et al (2008) provides what appears to be the most recent analysis of the full value chain conditions of the aquaculture sector in Malawi. While they highlight progress has been made by the Government of Malawi in building an enabling economic and social environment for the sector, they highlight constraints in measures aimed at improving access to credit, developing feed and seed industries and providing adequate extension services (inputs and services). A summary of key findings from the literature in relation the supply side conditions of aquaculture development in Malawi is provided below.

Supply side policy instruments:

Fingerling (seed) production-

Over the past decade, the Government of Malawi has made progress in developing the fingerling industry via a) the development of DoF hatcheries (notably, at the NAC and Kasinthula); and 2) the encouragement of two large privately owned hatcheries (Russell et al 2008). While Hecht and Maluwa (2003) highlight that these hatcheries have improved the production and availability of fingerlings all year round, the sparse geographic distribution of fish farmers have resulted in access constraints and limitations in attracting private investments. Growing literature has called into the question the quality and distribution of fingerling distribution from the DoF hatcheries. Andrew et al. (2003) reported that the insufficient availability of fingerling was a significant reason for pond abandonment by a quarter of ex-fish farmers surveyed. Furthermore, Hecht and Maluwa (2003) highlighted that fingerlings from the NAC were typically from mixed-sex production and resulted in subsequent slow growth rates of species. To help facilitate the use of quality seed by farmers, both the DoF and donor organisations have implemented education programs or extension support to encourage farmers to adopt best practice techniques. Recommended techniques include: hand sexing of species to improve the growth rate of species (Hecht and Maluwa 2003) and the use of alternative high protein-rich seed such as soybean. While this participatory on farm approach has helped improved farmer knowledge, cultural and socio-economic constraints exist prohibiting the sustained adoption of such methods (Russell et al, 2008).

Feed production-

The availability and cost of feed, such as fertilisers and other farm inputs, have been reported to be a significant economic challenge for fish farmers in Malawi (Andrew et al, 2003). It has been reported by Russell et al (2008) that the majority of all fish farmers use the government led recommended feed- maize bran (*madeya*)- to supplement growth of cultivated species. However, the quality, availability, access and use of this feed have increasingly been called into question in the literature. Hect (1999) highlighted the low protein content of madeya and concluded with recommendations for targeted extension services to promote the use other more nutritious farm feed by-products such as pawpaw leaves. The availability of madeya has also been identified as a major constraint to farmers. Russell et al (2008) highlights that the peak fish production season (December to March) coincides with the crop production season resulting in competing demands for farm by-products and subsequent reductions in the availability of feed inputs for fish growth. A study carried out over two decades ago by Harrison (1991) also revealed limitations in fish farmer's knowledge of best practice techniques as well as misconceptions regarding the benefits of using manure as feed. An older study by Msiska (1987) also revealed the effects of cultural perceptions with regards to the use of manure as feed for fish growth. Since these reports were published, little evidence exists in the literature regarding fish farmer's perceptions of the effectiveness and use of feed and seed within their aquaculture operations.

Access to credit-

Governments have introduced various measures to improve access to capital by fish farmers in order to kick and maintain production (Hishamunda et al, 2014). In Malawi, the development of the IAA systems requires significant capital upfront for pond construction and appropriate purchase of inputs (seed and feed) as well as continual access to credit to recover on-going maintenance costs. In general, it has been suggested by Belton and Little (2011) that the donor led interventionist approach, which has been adopted within Malawi, has resulted in a lack of financial support to farmers after the donor has exit a project. Furthermore, the study by Andrew et al (2003) highlighted that poorer fish farmers in Malawi lacked sufficient access to capital and labour necessary to meet on-going operational costs of their fish farms. The Government of Malawi attempted to improve access to credit via the introduction of the Malawi Gold Standard Programme in 2005. The programme provided a loan scheme whereby fish farmers who adopted a successful business plan were rewarded with access to credit. Similar financial schemes have been widely reported to be successful in other countries (Hishamunda et al, 2014). For example in Madagascar, government officials evaluate business plans as a move to kick start commercial activity via facilitation of access to credit from banks. In Malawi however, Russell et al (2008) highlighted that the Gold Standard Programme has had limited success and was in fact suspended by the banks after one year of implementation as a result of non-compliance by fish farmers who used the loads for non-fish farming activities. Mwale (2009) also concur that a lack of extension services support contributed to the failure of the uptake of the scheme in Malawi.

Demand side policy instruments:

Globally, many governments have adopted various measures such as marketing approaches to improve the demand side of aquaculture (Hishamunda et al, 2014). In Malawi however, this relatively new sector is faced with the unique challenge of promoting this non-indigenous form of cultivation to sparsely distributed, demographically diverse communities across the country. Little evidence exists in the literature with regards to understanding the demand side of farmed fish within the country. Key issues identified in the wider literature and which could to be addressed in Malawi include: consumer attitudes towards farmed fish (Pita et al, 2010); understanding the relationship between wild and farmed fish with respect to domestic consumption of fish (Allison, 2011); and analysing the effectiveness of government communication in the promotion of fish farming (Mwale, 2009). In consideration of the above supply and demand side conditions, three studies have attempted to use GIS to map the potential for aquaculture production in Malawi based on ecological, economic and social parameters (Brooks 1992; Kam et al 2008; Mwale, 2009). Brooks (1992) provided the first analysis of the potential areas and inventory of aquaculture development as of the early 1990s which was subsequently updated by Mwale, 2009 to reflect changes in commercial aquaculture production. While both studies attempt to provide a nation-wide map of aquaculture development, they fail to reveal the extent of existing aquaculture production per district as a result of lack of baseline data at the time. The third most recent study by Kam et al, 2008 builds upon Brooks (1992) study to provide an up to date comprehensive analysis of the potential areas for aquaculture in Southern Malawi. However, this analysis fails to include an inventory of current statistics of aquaculture production in the region. Based on this review, it can be suggested that a gap in knowledge exists to holistically provide an understanding of the current picture of the aquaculture sector (number/distribution of ponds, feed and seed industry, potential remaining available land) which is known to prove influential for strategic planning purposes (Hishamunda, et al. 2014). Given the vital role IAA has in the diversification of rural livelihoods (Dey et al, 2007), there is growing consensus that the proposed expansion of aquaculture in Malawi (UNPEI, 2012) will require the government and wider stakeholders to provide crucial investment and support services to the growing sparsely distributed fish farmers across the country (Russell et al. 2008).

3.4.5 Communications

Good governance of aquaculture requires transparency in the decision-making process and implementation of policies. Globally, differences in governance structure and implementation reflect the challenge by governments of how to improve transparency and involve stakeholder within the decision making process ((Mikalsen and Jentoft 2008; Jamu, et al, 2012; Hishamunda et al, 2014). In Malawi, the government has made progress in strengthening its governance framework over the past decade through the adoption of a participatory approach and the creation of various communication tools to assist with its implementation. To facilitate communication and extension support to fish farmers, the Government of Malawi supported the establishment of an extension service radio program - Usodzi wa Lero- which provides a weekly source of fisheries information. While this mode of communication has helped improve on farm production (Andrew et al, 2003), on farm technical support and local information exchange networks have been identified as the dominant mode of communication by fish farmers (Russell et al 2008). However, growing evidence points to weaknesses in communication by extension services staff as a result of lack of capacity, budget and the spare distribution of fish farmers across the country.

3.4.6 Conclusions

As the industry expands, building an understanding of fish farmer’s attitudes and perceptions about the effectiveness of governance will increasingly become important, particularly in light of increased conflicts among resource users (Tran et al, 2013) and expansion in new areas. Mwale (2009) highlights that good communication by government and stakeholders involved directly in aquaculture will become vital in elucidating benefits, reconciling conflicts and building trust in the sustainable management of the industry. The sector is now on a new development track, orientated towards commercial, market based enterprises. The chapter concludes that current literature is inadequate to provide a full understanding of the impact of aquaculture, in its differing forms, to food and nutritional security in Malawi. Given the recent significant growth in the sector and policy transition, the aquaculture sector in Malawi provides an especially interesting and relevant study, with the potential to yield lessons applicable to the region.

Chapter 4: Theoretical Background and Methodology

This chapter first presents the reader with an over of the conceptual frameworks used to guide the assessment of the role of aquaculture to food security. The chapter then goes on to provide an overview of the research approach, site location as well as detailed concerning the research methods employed within this thesis.

4.1 Conceptualising the role between aquaculture and food security

4.1.1 A Sectoral Approach

Over the past decade, increasing literature has attempted to outline the pathways and conditions through which fish can contribute to improved food and nutritional security (Edwards, 2000; Stevensen and Irz, 2009; Allison, 2011). The recent report by HPLE (2014) describes a myriad of direct and indirect pathways through which the aquaculture and capture fisheries sectors impact food security and nutrition. Each pathway is described as functioning at different scales and differences exist between aquaculture and capture fisheries (See figure 4.1 below). The conceptual framework presented by HLPE (2014) describes the role of fish, both indirectly and directly, in contributing to the four pillars of food security: 1) the production of fish for use by human consumption, animal feed and non-fish animal food (food availability), 2) the generation of income activities (access), 3) source of high protein and micro-nutrients (utilisation); and 4) sustained improved food security and nutrition as a result of 1-3 (stability). However, the conceptual diagram has failed to address a number of valid elements contextualising the role of aquaculture to food security, including: the multiple shocks and pressures internal and external to the sector that may negatively impact the sustainability and long-term production of aquaculture as well as shape the flows of direct and indirect benefits; the ability of certain aquaculture systems to indirectly increase production of other crops or animals used for food consumption (e.g. the reuse of water from pond culture for crop irrigation or the reuse of waste from integrated multi-trophic aquaculture (IMTA) system to support growth of other marine species such as shellfish); and a neglect of the complex social, economic and political factors contextualising both production and outcomes of aquaculture. Nonetheless, the conceptual diagram presented by the HLPE (2014) provides a useful guide in an attempt to consider the complex dimensions and linkages between the aquaculture sector and food security and nutrition.

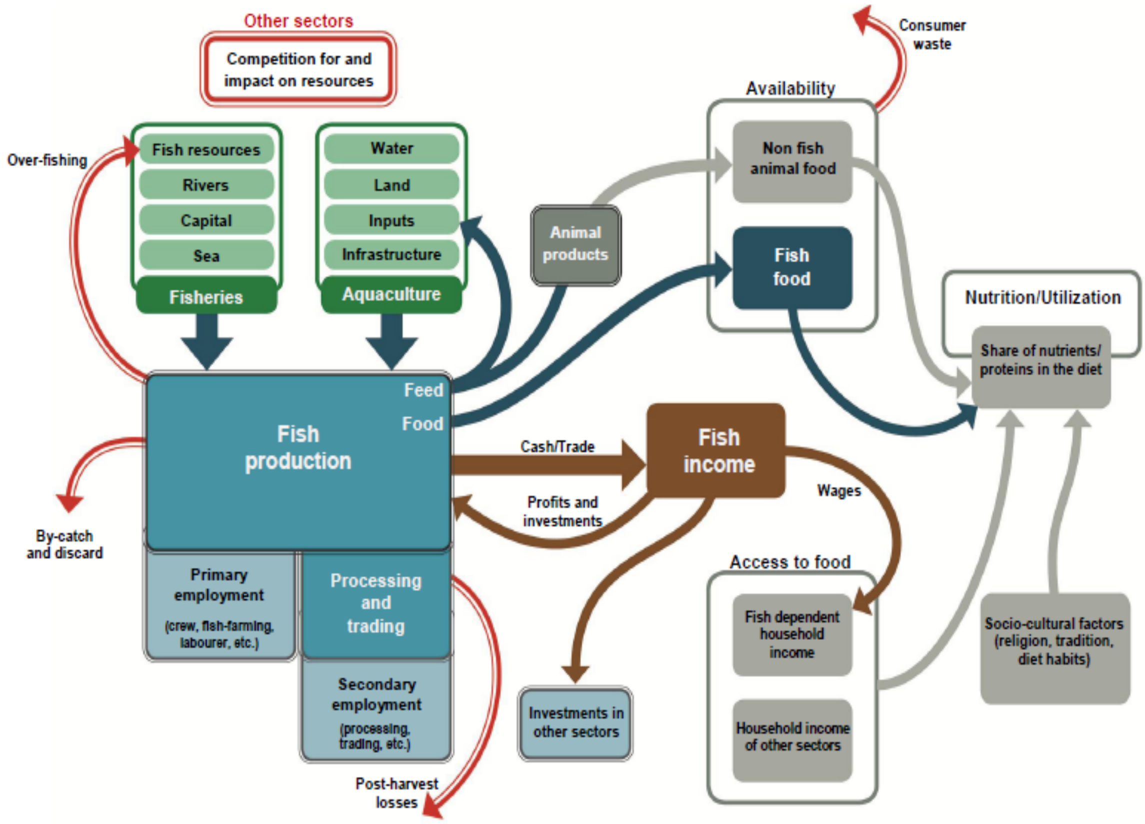

Figure 4-1 A conceptual relationship between fish and food and nutritional security (HLPE, 2014).

4.1.2 The Sustainable Livelihoods Analysis Approach

The Sustainable Livelihoods Analysis (SLA) approach is a framework that aims to holistically conceptualise the diverse ways that people make a living (DFID, 2000; Scoones 2009). As described by Chambers and Conway (1991, p. 6), a livelihood ''comprises the capabilities, assets and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term.'' Developed in the mid-1980s (DFID 2000), the SLA has been widely tested and adapted in various contexts and topics with the aim to improve rural development policy and practice (Edwards et al.,2002;

Scoones, 2009). The SLA framework helps in thinking holistically about the complexities of livelihoods through capturing of the processes and contextual factors that affect livelihoods (DFID, 2000). The SLA encompasses five dimensions: 1) vulnerability context- trends, shocks, seasonality, and other factors that affect livelihood sustainability; 2) livelihoods assets- the availability of a portfolio of five forms of capital assets: human, natural, social, financial, and physical; 3) transforming structures and processes- institutions and organisations that influence access to assets; 4) livelihood strategies- activities and choices made in pursuit of livelihoods; 5) livelihood outcomes- include changes in human well-being, income, health, and food security (DFID, 2000). At its centre, the framework considers access to five main resources that people use in varying combinations in pursuit of appropriate livelihood strategies (Scoones 1998): human capital relates to the skills, knowledge and ability to work; social capital relates to social relationships of trust, reciprocity and exchange that can be used for support; natural capital relates to natural resources such as water, land, fisheries, etc.; physical capital relates to basic infrastructure that support people such as electricity supply, water and sanitation systems; and finally, financial capital relates to access and stocks of savings. In differing contexts, access to these forms of capital is shaped by the vulnerability context and the transforming structures and processes and ultimately determines the choice of livelihood strategies and achievement of livelihood outcomes (DFID, 2000). Livelihood outcomes include enhanced income, improved food security, reduced vulnerability, increased well-being and the sustainable use of natural resources (Scoones 1998; Edwards et al, 2002). A livelihood is sustainable if people are able to reduce their vulnerability, have access to assets; maintain activities that are not detrimental to the natural resource base and improve their standard of living (Allison and Ellis, 2001; Allison and Horemans, 2006; Paul and Vogl, 2013).

The SLA is prominent in a growing number of fields, including: poverty reduction (Barrett and Swallow 2004), natural resource management (William 2003; Schreckenburg et al 2010), food security (Maxwell et al., 1999; Maxwell et al., 2003; Burchi and Muro 2016). More recently, the application of the SLA and its concepts has gained traction in the fisheries literature with the aim to investigate the role of small-scale fisheries in rural economies and inform policy to enhance their contribution to sustainable livelihoods (Allison and Ellis, 2001; Neiland and Bene, 2004; Allison and Horemans, 2006; Masud, et al 2014). A review of the fisheries literature by Bene and colleagues (2016) further reveal that increasing contributions to the field have assessed the vulnerability of the impact of climate change on fisheries and aquaculture livelihoods (e.g., Allison et al., 2009; Cinner et al., 2012; Perry, Ommer, et al., 2011; Blythe et al 2015). Moreover, a review of the literature concerning the impact of climate change on livelihoods in SSA by Boutin and Smit (2016) reveal that the SLA has been used to address a range of development issues within the sub-region, including power and gender relations (Mandel 2004; Oberhauser and Pratt 2004); diversified livelihood strategies living (Abdulai and CroleRees 2001; Manvell 2006), climate change adaptation (Jones et al. 2010; Osbahr et al. 2010), influence of policies on household poverty; effects of global environmental change on the poor (Hahn et al. 2009); and food security (Sutherland et al. 1999; Codjoe and Owusu 2011). However, the application of the SLA within the context of aquaculture and with a focus on food security remains significantly limited world-wide. Only a few studies have applied the SLA in the context of aquaculture via assessing its contribution broadly to local livelihoods (in Bangladesh (Ahmed, 2009; Paul and Vogl, 2013)) and poverty alleviation (in Ghana (Kassam, 2013)).

While there are many reported strengths of using the SLA framework to understand the complexities of rural livelihoods in both fisheries and food security analysis; the framework has some reported weaknesses. Reported shortcomings of the SLA framework include: overemphasis on the five capitals and its focus on the micro-level with under-emphasis of wider factors such as markets; neglect of power dynamics; its focus on the household level means that intra-household differences in livelihoods and inequalities in the distribution of food may be overlooked (Allison and Horemans, 2006; Burchi and Muro, 2016). Some of the reported weaknesses of the SLA framework apply only if certain elements are highlighted more than others subject to the aims of a study. Nonetheless, the SLA framework remains a very useful tool for addressing the complexities of livelihoods and the multidimensional nature of food security (Allison and Horemans, 2006; Burchi and Muro, 2016).

From the limited studies to date, the SLA framework has proven to be useful in allowing a more thorough analysis of the complex processes and contextual factors shaping fish farming livelihoods (e.g. Paul and Vogl, 2013) and food security (e.g. Hesselberg and Yaro; 2006). As highlighted by Burchi and Muro (2016), the SLA framework offers a number of advantages in the analysis of food security in comparison to alternative concepts (e.g. basic needs approach, entitlement approach), due to two key features: its ability to provide an in-depth understanding of contextual factors; and its ability to provide a long-term view of livelihoods. The authors go on to emphasize that these two features of the SLA framework specifically enable the capturing of three important elements to the assessment of food security which is not possible using other approaches: vulnerability, stability and coping strategies (Burchi and Muro, 2016). Furthermore, the extensive implementation of the SLA framework in fishing communities across 25 West African countries by Allison and Horemans, (2006) revealed that fisher folk adopt multiple livelihood strategies that are shaped by dynamic and multiple contextual factors. The authors concluded that the SLA framework was extremely useful in understanding the complexities surrounding small-scale fisheries and prioritising ways to reduce the poverty and vulnerability of fisher folk whilst ensuring the sustainable management of fisheries resources.

Within the context of small-scale aquaculture, the SLA framework can provide a comprehensive and holistic way of understanding the complex contextual factors framing fish farming as a livelihood as well as the multidimensional nature of food security and nutrition. For example, the SLA can allow for a deeper understanding of the access to crucial resources such as water, land, skills and knowledge of fish husbandry necessary for fish farming. Aquaculture is also vulnerable to shocks and seasonal patterns which can have major impacts on capital assets and access to these assets, consequently impacting on outcomes obtained from fish farming. The framework helps in thinking about multiple forcing factors such as culture, biophysical or social stressors, the role of organisations that shape access to these resource and influence people's decisions and activities associated with livelihood strategies. Finally, the SLA can further provide a holistic lens in understanding the factors that determine the achievement of improved food security and influence its sustainability. This thesis draws on the SLA framework (figure 4.2) with a focus on the livelihood outcome of improved food security in accordance with its four dimensions- availability, access, utilisation, stability. The SLA framework is used as a holistic outline and analytical guide to understand the complex interconnected dimensions and processes that should be considered in an effort to assess the role of small-scale aquaculture to food security.

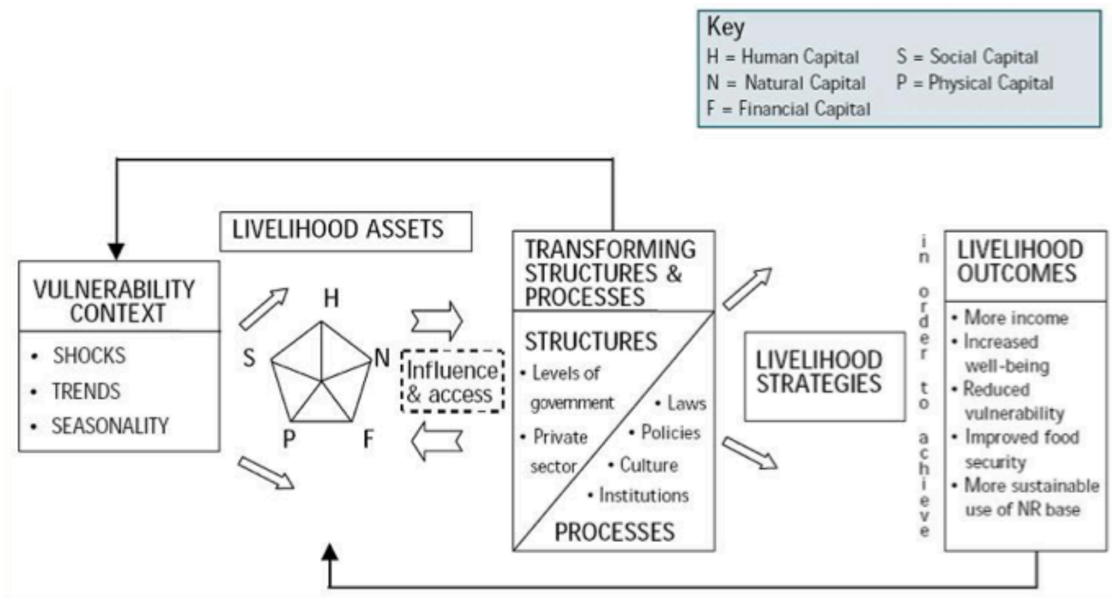

Figure 4-2 Research Conceptual Framework- the Sustainable Livelihoods Framework (DFID, 2000).

4.1.3 Gender and the SLA

Several recent comprehensive reviews have detailed the importance of gender to our understanding of fisheries and aquaculture social systems (e.g. provision of food and nutritional security and livelihood support) (Weeratunge et al. 2010; Williams 2010; Harper et al. 2013; HLPE, 2014), as well as to ecological understanding (Keiber et al 2014). Increasing evidence in the literature reveals that gender can influence food and nutritional security, both directly and indirectly, in a multitude of ways. A recent review by HLPE (2014) highlights that along with inter-sectoral issues, gender can influence the different mechanisms that determine access to fish and nutrition both within the general population (as consumers) as well as population groups directly involved along supply chains (as producers, processors and traders) (HLPE, 2014). The author's detail that women can play a dominant role in prioritising food for household members (Quisumbing et al., 1995; Porter, 2012) and thus their involvement in the fisheries sector may influence intra-household consumption of fish as food. In addition, fish as food is significantly important for gestating women in proving crucial protein and micro-nutrients for improved foetal development and health of children (FAO/WHO, 2011). Female literacy is therefore an important factor in raising awareness of the importance of fish as food, particularly in vulnerable poor communities. Within communities directly involved in fisheries supply chains, gender plays an important role in access to fish as food or fish as income. Women can also play a dominant role in prioritising food for household members (Quisumbing et al. 1995; Porter 2012) and can provide local knowledge on management of aquaculture (Weeratunge et al. 2010; Harper et al. 2013; Kleiber et al. 2014). Women are known to be essential contributors to the sector, participating in all segments of fisheries and aquaculture supply chains (e.g. fish farming, processors, traders and retailors, etc.) (Allison and Ellis 2001; FAO 2006; FAO; 2012). The gender division of labour in the fisheries and aquaculture small-scale sectors varies by country and is subject to culture, biological diversity, environmental change and economic conditions (Kieber et al 2014). For example, the role of women in post-harvesting activities may be driven by a livelihood strategy to provide crucial economic and general support within the family in contrast to carrying out higher risk and income sharing larbour activities such as fishing (Reedy-Maschner 2009; Kieber et al 2014). Unfortunately, as emphasized by Kolding et al (2014), one of the most conspicuous features of small-scale fisheries and aquaculture is the general lack of data leading to serious constraints in management decisions and an undervalued sector. As a result, little attention has been granted to the importance of gender in both inland and marine fisheries and a gap in holistically understanding crucial social and ecological aspects of these systems have emerged.

Although a gender perspective comprises the understanding of both men and women, the role of women in fisheries and aquaculture has traditionally been less visible creating a bias in management decisions. Data on the participation of women in fisheries and aquaculture is extremely limited and of poor quality, rendering an understanding of the roles between genders in fisheries and aquaculture incomplete (Geheb et al. 2008; FAO/IFAD/WB, 2009; Harper et al 2013; Monfort, 2015). As a result of limited gender disaggregated data in the sector, little policy attention has traditionally been given to the gender dimension in the fisheries sector leading to neglect of women's sectoral needs. For example, Williams et al (2012) highlighted that many global fisheries policy instruments such as the Code of Conduct for Responsible Fisheries have neglected the role of gender precluding its attention in national level policies. Many policy instruments such as access to credit are also not sensitive to gender trends of the fisheries sector. For example, in the women dominated post-harvesting sectors, the majority of cold storage facilities are managed by men resulting in women only having access to low-paid sorting/drying fish jobs. Few fisheries policy instruments have promoted women's access to markets, improved working conditions or have taken a sensitive approach to reduce negative consequences arising from internal sectoral policies. Since the early 1990s, there has been a growing representation of gender approaches to fisheries in both literature and policy discourses. This has been driven by the need to include gender as a key variable in the expanded socio-ecological view of the fisheries sector (Weeratunge et al. 2010; Williams 2010; Harper et al. 2013). Much of this growing literature however remains descriptive on the gender division of labour and limited to traditional social science methodologies and supply chain analyses. Clear data gaps are emerging with respect to understanding the role of women in the sector and implications for ecological, food and nutritional security understanding (Weerantunge 2009; Harper et al. 2013; HLPE, 2014).

In the context of livelihoods, increasing evidence highlights that men and women, particularly in Africa, adopt significantly different roles in the construction of sustainable livelihoods (Gladwin 2000; Simtowe 2010). Thus, there is an increasing need to deepen our understanding of the role of gender in aquaculture and the underlying factors that define sustainable livelihoods.

4.2 Methodology

4.2.1 Interdisciplinary Research Approach

The highly placed based nature of aquaculture requires an understanding of local contextualising factors (social, economic, political and ecological) in order to assess its impact and the distribution of benefits to affected populations. At the same time, increasing contributions to the field emphasize that the multidimensional nature of food security compels interdisciplinary approaches to capture the subjective and relational dimensions of food secure livelihoods within the context of multiple stressors (Maxwell, 1996; Poppy et al, 2014; Connolly-Boutin and Smit, 2016; Campbell et al., 2016). Although a range of qualitative and quantitative methods have been applied in the fisheries and aquaculture literature, more flexible and creative tools have been called for to a) capture the complexity of context specific factors (Harper et al 2013; Kleiber et al 2014; Morgan et al, 2016); b) produce policy relevant results (Wiber et al 2004); and c) to integrate the views and realities of fishers within the management process (Krause et al 2015). This thesis represents the most complete attempt to date in assessing the role of aquaculture to food security through the adoption of an interdisciplinary, mixed methods and case study approach.

Given the limited knowledge of the role of aquaculture to food security and nutrition, a call for more case study research has emerged to address the significant gaps in this field (Bene et al 2016). A case study approach has been extensively used in the context of fisheries and conservation research and has proven to be an effective research strategy in assessing complex socio-ecological systems (Flyvbjerg 2006; Schreckenberg et al 2010) and the role of capture fisheries to food security (Darling et al 2014). A case study approach can prove beneficial in providing a holistic and deeper understanding of complexities (Flyvbjerg 2006; Noor, 2008) and was identified as the most suitable approach to capture the complex and multi-dimensional nature of the role of aquaculture to food security (Ahmed 2009; Poppy et al 2014; Bene et al 2016). A mixed methods inter-disciplinary approach, using a combination of qualitative and quantitative methods was used to achieve the aims of this thesis. A mixed methods approach involves integrating qualitative and quantitative approaches and is increasingly been recognised to produce new forms of knowledge providing benefits beyond the use of a single method alone (Tashakkori & Teddlie, 2003; Stange et al 2006). When assessing the contribution of aquaculture to food security, a mixed methods approach provides a better means to capture different voices, the local everyday realities of sustainable livelihoods as well as provide more detailed, nuanced, understandings of the aquaculture sector and how it impacts local food security. A mixed methods approach can thus provide a crucial solution to overcome the significant research gaps reported in the pre-ceding literature review, especially in accentuating the voices of women and in capturing the social dimension of aquaculture that have been traditionally overlooked (Krause et al 2015; Kleiber et al 2016). Increasing contributions to the literature identify a number of benefits to the employment of a mixed methods approach which include (Bryman, 2006):

- Increased validity of data: mixed methods allow the collection of data from a range of techniques and different perspectives;
- Completeness: gaps occurring in one data collected may be complete by another method;
- Instrument model: a mixed method approach can include the sequential use of methods allowing qualitative tools to inform quantitative survey design;
- Triangulation: integration of methods enhances confidence in research data, enables findings from one method to be challenged or integrated with another and enhances validity of findings.
- Complexity: a mixed methods interdisciplinary approach can help address complexity inherent in natural resource systems like aquaculture (Ahmed, 2009; Paul and Vogl, 2013). This approach can bring unique perspectives, challenges existing theories, and provides a holistic approach to explore relationships within complex social-ecological contexts.

The purpose of this form of research is that the combination of qualitative and quantitative methods can provide a deeper understanding of the conditions and processes that shape aquaculture's role to food security than what either research field approach would alone. Although this method is quite labour intensive and requires multiple stages of data collection, it serves to provide a more holistic and rigorous perspective to addressing this thesis' complex research aims.

4.2.2 Study Location and Case Study Sites

Research was carried in the southern region of Malawi in the district of Zomba (see figure 4.3). The district comprises a total land area of 2,580 km² and recent estimates reveal a population of 600,000 in rural areas and 100,000 in the urban city of Zomba (NSO-GoM 2008). The district's economy is dominated by agriculture and comprises one of Malawi's most important sources of capture fisheries- Lake Chilwa - situated within the Lake Chilwa Basin, and which contributes the main source of fish in the district. The Southern rural areas of Malawi, including the rural population of Zomba, have a disproportionate share of the poor (e.g. Zomba rural 70%, urban 30%). The main ethnic groups in the district are Mang'anja/Nyanja, Yao and Lomwe. Religion is dominated by Christianity (78%) and Islam (20%). Chichewa is the most common native language spoken. The local government system is led by the Zomba District Assembly and supported by the establishment of Traditional Authorities (TA) and leaders of respective communities, with 1,571 villages under its mandate (GoM, 2009). The District is framed by Lake Chilwa to the east, the Shire valley to the west, Liwonde Forest Reserve in the North and Namadzi River marks the southern border of the District. The Lake Chilwa Basin provides the most significant source of water for the district. The major rivers in Zomba District are the Shire, Likangala, Thondwe, Domasi, Mulunguzi, Naisi, Namadzi, Phalombe Lintipe and Likwenu. Malawi has a sub-tropical climate with three seasons: the warm-wet season stretches from November to April, during which 95% of the annual precipitation takes place; a cool, dry winter season is evident from May to August; a hot, dry season lasts from September to October. Temperatures range from as low as 10°C to as high as 30°C.

This district has been chosen to explore the aims of this thesis for the following reasons:

- The district has one of the highest densities of fish farmers and fish ponds in the country and is estimated to have high potential for aquaculture growth in the future (Kam, et al 2008);
- Heavy donor interest: the District has been targeted for aquaculture development since the 1970s by various organisations; and
- Social conditions: Communities within the District are facing increasing pressures in producing and accessing food in light of recent economic and production shocks.

In light of these conditions listed above, the district provides a good case study to explore the impact of aquaculture on food and nutritional security.

Selection of Fish Farming Communities

Two case study fish farming communities- Makawa and Malundu - were purposively selected to explore the aims of this thesis (Teddlie and Yu, 2007). The two study sites are shown in Figure 4.3 and a summary detailing social and fish farming characteristics of the two villages is presented in table 4.1 below. The fish farming community of Makawa is located in the Traditional Authority of Kuntumanje in close proximity to Lake Chilwa. This fish farming community has adopted the immanent approach to aquaculture development whereby two fish ponds were constructed on demand by the community in 2012 and are owned and managed by a village committee. The Malundu fish farming community is located in the Traditional Authority of Mlumbe in the Chingale Area. This fish farming community has been subject to the 'interventionist' approach to aquaculture development whereby a series of fish ponds were developed with direct assistance from external organisations. In Malundu, a cluster of over 40 fish ponds were constructed since 2001 with support from various external agencies however, approximately 15 remained active when this study was carried out. The two case study fish farming communities were purposively selected based on the following criterion: actively engaged in small-scale aquaculture; located within the district of Zomba; size of village; accessibility.

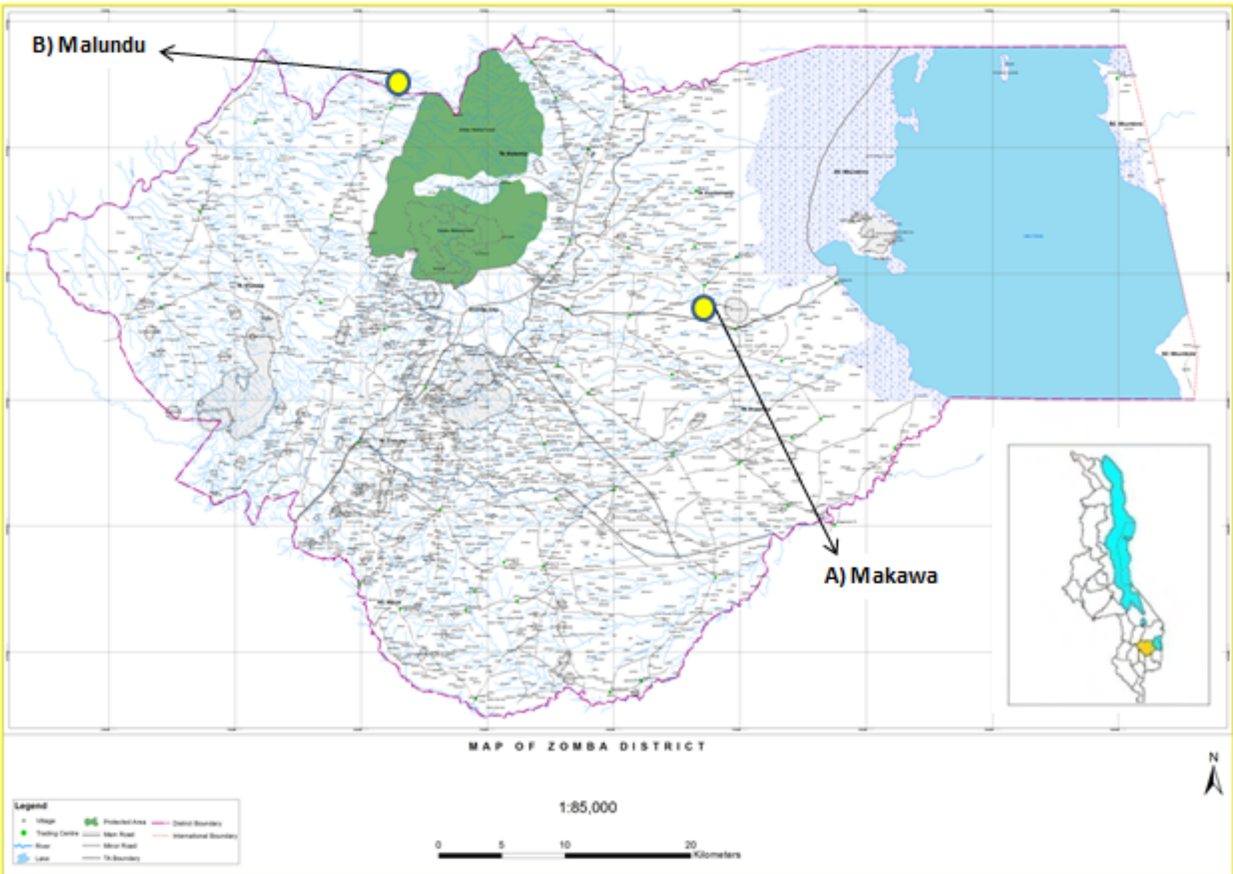

Figure 4-3 Map of Case Study Sites within the Zomba District, Southern Malawi: a) Makawa; b) Malundu (obtained from the NSO, July 2014).

Table 4-1 Summary of social and fish farming characteristics of both case study sites Makawa and Malundu.

Characteristic	**Makawa Village**	**Malundu Village**
Location	Located in the Zomba district, on the east side of the Zomba plateau in the Traditional Authority of Kuntumanje.	Located in the Zomba district, on the west side of the Zomba plateau in the Traditional Authority of Mlumbe.
No of Ponds and Year of Construction	2 earthen ponds constructed in 2012.	40+ earthen ponds constructed since 2001, 15 remaining active as of 2015.
Characteristics of Ponds	No formal use of integrated aquaculture agriculture. Fingerlings sourced from the government's National Aquaculture Centre.	Some use of integrated aquaculture agriculture via reuse of water for crop irrigation. Fingerlings sourced from the government's National Aquaculture Centre. Theft deterrence previously set up by historic fish farming committee.
Aquaculture Development Approach	Imminent approach- aquaculture introduced by community.	Interventionist approach- aquaculture introduced by a number of external organisations.
Livelihoods	Rural subsistence livelihoods, predominantly agricultural based.	Rural subsistence livelihoods, predominantly agricultural based.
No Households	63	74
No of Fish Farming Households	32	30
Fish Farming Pond Ownership	Owned and managed by the village committee.	Owned by individuals. Historically ponds used to be owned and managed by a fish farming committee.

4.3 Research methods

This final section explains the data and methods used in the research in accordance with the three objectives of this thesis. A brief summary of each method employed is provided along with details of overall research analysis. Further details about the methods, including data collection protocols, is provided within each of the results chapters (see chapters, 5, 6 and 7 of this thesis). Secondary and primary data collection methods were carried out in a phased approach to achieve the objectives of this PhD. Data were collected in two phased stages from 2014 to 2015 as described below and illustrated in figure 4.4. Secondary data collection involved the compilation of a range of information relating to the aquaculture sector in Malawi, including national and district level statistics about the characteristics of the aquaculture sector as of 2014 (number of fish ponds, size of ponds, species cultivated, number of fish farmers, construction year); national level aquaculture production trends since 2000; spatial information regarding the location of fish ponds down to village level. Secondary data was sourced from key informants in the field as well as online from peer reviewed journals, grey literature and government websites. A combination of the following participatory, qualitative and quantitative methods was used for primary data collection. Table 4.2 presents a summary the methods used to address each of the research objectives within this thesis.

Table 4-2 Summary of research objectives against research methods applied within this thesis.

Research Objective & Questions	**Research Method**
Research Objective 1: To assess the drivers, barriers and future prospects of the aquaculture sector in Malawi through the perceptions of key stakeholders.	Qualitative Key Informant Interviews.
Research Objective 2: To identify gender roles as well as the constraints and benefits associated with aquaculture through the perceptions of women and men fish farmers.	Participatory Photovoice process.
Research Objective 3: To assess and quantify the direct and indirect association of aquaculture to household food security through the comparison of fish farming vs non-fish farming households.	Quantitative household surveys.

4.3.1 The Increasing Need for Creative Social Methods in Fisheries and Aquaculture Research

Emerging contributions to the literature call for an approach to research that considers the social and cultural aspects of inland fisheries and aquaculture as well as captures the perspectives of different end users in order to improve the valuation and management of sectors (Youn et al 2014, 2016; Simmance et al 2016). A recent review by Kleiber et al. (2014) highlights that biases in research have led to significant gaps in gender-relevant data in small-scale fisheries and conclude that more creative methods are required to deepen our understanding of gender in fisheries and aquaculture. Moreover, greater attention to gender dynamics and in particular the roles of women in inland fisheries and aquaculture have been called for to improve an understanding of the needs and experiences of people driving the sector (Kleiber et al. 2014). However, the often informal and unrecognised nature of women's participation in small-scale aquaculture, coupled with the typical marginalisation, vulnerability and high illiteracy rates of small-scale fishing communities in developing countries, present further methodological challenges to the assessment of the social dimension of fisheries and aquaculture (Allison and Ellis 2001; Nayak et al 2014; Thorpe et al. 2015; Morgan et al 2016).

Recognition for the value of applying mixed social methods to the understanding of fishing and fish-farming based livelihoods is increasing emerging in the literature (Youn et al 2016; Ahmed, 2009; Schreckenberg et al 2010). Qualitative methods in particular have been called for in aquaculture to provide more locally context research, include fishers and their perceptions, and produce policy relavent outcomes (Harper et al 2013; Kleiber et al 2014; Wiber et al 2004; Jacobsen et al 2011; Krause et al 2015). The use of participatory approaches in research have arisen to provide a more in-depth analysis of the views of local people that could otherwise not be achieved through standard social methods such as quantitative surveys (Chambers 1992; Pretty et al. 1995; Schreckenberg et al. 2010; Bennett 2016; Barlcay et al 2016; Morgan et al 2016; Simmance et al 2016). The application of participatory approaches, during the past two decades, has increased in literature associated with the management of natural resources. The drive to include a more participatory approach to fisheries research has largely arisen from a number of perspectives, including the move towards interactive governance and participation in fisheries management, as well as the importance of collaborative learning in small-scale fisheries (Wiber et al. 2009; Jacobsen et al 2011; Kolding et al. 2014; FAO 2015). In fisheries literature, a range of participatory methodologies have been implemented which have been classified into four models as described by Hoefnagel et al. (2006): 1) Deference Model- requiring the role of fishers as research assistants, e.g. Ticheler et al. (1998); 2) Experience-Based Knowledge (EBK) Model- emphasizes fishers' observations as a supplement to research-based knowledge, e.g. Wilson et al. (2006); 3) Competing Constructions Model- understanding differences in stakeholder objectives leading to biases in presenting knowledge, e.g. Finlayson. (1994); and, 4) Community Science Model- promotes collaborative fisheries science through incorporation of models 1-3 with effective communication. Hoefnagel et al. (2006) suggests that the ideal method to participatory fisheries research is the Community Science Model of Interaction, which provides a more collaborative and holistic approach to the development of research by scientists and fishers.

4.3.2 Methods to Address Objective 1 - Qualitative Methods

A qualitative approach using the method of Key Informant Interviews (KIIs) was used for the achievement of research objective 1 of this thesis because it was identified as the most suitable method to provide objectivity and depth to understanding the aquaculture sector in Malawi (Baily, 1994). A key informant, as described by Theis and Grady (1991), is anyone who has special knowledge of a particular topic. Some authors remain sceptical of the benefits obtained from qualitative techniques such as key informant interviews and point out that such approaches are statistically insufficient, can be highly biased and not generalizable (Luloff, 199). However, increasing evidence shows that qualitative techniques such as key informant interviews serve great promise in providing in-depth information about a particular topic that cannot be gathered from other methods. There are reported numerous advantages in using key informant interviews in research which include: the generation of rich and localised information, the ability to provide in-depth perspectives in a short time period, the ability to build local collaborative support for future research and a flexible method to implement face-to-face or remotely with expert participants, among others (Creswell 1998; Cinner and McClanahan, 2006). Moreover, the examination of key informant perspectives can generate localised, culturally appropriate information used to provide an up-to-date understanding on complex issues such as factors affecting aquaculture development (Chambers, 1995; Baily, 1994; Creswell, 1998; DFID 2000). Within this study, key informant interviews were chosen as a suitable method in order to provide rich information about stakeholder perspectives on the drivers, challenges and future prospects associated with the aquaculture sector in Malawi. Furthermore, this method was chosen to be carried in the first phase of primary data collection activities in order to support the design of subsequent research methods and the direction of research within this study (see chapter 7). Further details concerning the employment of Key Informant Interviews within this thesis, including data collection protocols, are presented in Chapter 5 of this thesis.

4.3.3 Methods to Address Objective 2 - Participatory Methods

One innovative Community-Based Participatory Research method (CBPR) that has been increasingly reported in the literature as having the potential to offer considerable promise for use with marginalized, often neglected, illiterate populations is the Photovoice process (hereafter referred to as Photovoice) (Castledon et al 2008; Hurworth, 2003; Bisung et al 2015).

The core principles of CBPR include community representation and empowerment, co-learning, long-term partnerships and sustainable outcomes (Israel et al, 1998; Castledon et al 2008; Horowitz et al 2009; D'Alonzo, 2010). CBPR stresses the importance of the co-production of knowledge between community members and professionals involved in the research process and is often viewed on a continuum based on the nature of community engagement (Castledon et al 2008; Horowitz et al 2009; D'Alonzo, 2010; Balazs et al 2013). In line with the principles of CBPR, Wang (2005) identifies three goals for Photovoice (1) to assist individuals with recording and reflecting on select community issues; (2) to encourage group dialogue on these issues; and (3) to influence policy-makers. Importantly, increasing literature recognises the variability in CBPR and that some principles of community engagement and influence are considered to be long-term goals (Castledon et al 2008; Balasz et al 2013).

A modified Photovoice methodology was adopted within this study in order to provide an in-depth understanding of the role of gender in small-scale aquaculture. The use of this method within the context of small-scale fisheries provides a timely endeavour in advancing methodological approaches in fisheries research and in capturing rich perspectives of previously overlooked complex social-ecological aspects of the sector. A modified Photovoice process was developed within this study in order to effectively meet the aims of this thesis, address concerns inherent in fisheries participatory research and overcome limitations identified in previous Photovoice studies. Further details of the Photovoice assessment carried out within this thesis can be found in the published paper by Simmance et al 2016. Furthermore, an evaluation of applying the Photovoice modified method in the context of small-scale aquaculture is detailed in Chapter 6 of this report.

The originators, Wang and Burris (1997 p. 369) describe Photovoice as a process by which ''people can identify, represent and enhance their community through a specific photographic technique.'' At its centre, Photovoice seeks to make community needs more visible and to empower illiterate participants to advocate for changes at the individual, community and policy level (Wang and Burris 1997). Photovoice uses the means of photography to capture community issues and interests through a research process directed towards equal sharing of research decisions and empowerment of participants. A comprehentive review of the use of Photvoice in natural resource studies by Simmance et al (2016) revealed growing recognition that Photovoice provides a powerful tool in addressing complex social-ecological issues, in capturing rich perspectives of marginalized populations in diverse settings, as well as in producing policy relevant insights to community issues (Bosak 2008; Baldwin and Chandler 2010; Beh 2011; Tanjasiri et al 2011; Berbes-Blazquez 2012; Bennett and Deardon 2013; Bisung et al 2015;Crabtree and Braun, 2015; Kong et al 2015). From this evaluation and building on work by Palibrodo et al (2009), a summary of the advantages and limitations of applying the Photovoice method was drawn (see Table 1). The use of Photovoice in fisheries and aquaculture research has only been applied to a small number of studies, and no reported studies within the context of small-scale, inland fisheries or aquaculture (Simmance et al 2016).

Modified Photovoice Methodology for Fisheries and Aquaculture Research

Participatory research tools must be adaptable to a community's particular circumstances and context. It is not surprising, therefore, to find that during the previous decade, Photovoice has evolved into a more flexible participatory methodology from Wang and Burris's (1997) original static description. Although many successful modifications of the Photovoice method exist, as described by Simmance et al (2016), an improved eight step Photovoice process was developed to address: 1) inherent challenges in participatory small-scale fisheries research; and 2) limitations reported with applying Photovoice; see below steps and Appendix D:

1. Community connection and consultation- building trust;
2. Planning- funding, logistics, ethics;
3. Recruitment and group training session- participant identification, introduction, camera distribution & instructions;
4. Photography assignment and camera collection - periodic check-in on participants, camera collection, and development;
5. Discussion of photographs through individual interviews- development of narratives through critical reflection on images;
6. Data analysis- coding of main topics and themes;
7. Group discussion- verification of key messages, identification of dissemination activities, and evaluation of the Photovoice experience; and
8. Dissemination- communication of outcomes to targeted audiences.

Changes were made to the recruitment, training session, and interview format, length of study, photography assignment, and evaluation stages. The changes address limitations outlined in Table 4.2. Through the lens of Photography, the method serves to portray context specific ´real life´ imagery of community issues through the unique perspectives of participants over and above what other traditional methods can capture (Kong et al 2015, Bennett and Deardon 2013). In addition, the Photovoice process allows marginalized peoples to become empowered and better able to advocate for change at the individual, community and policy levels (Wang et al 1998). This study describes a modified and flexible Photovoice method applicable to understanding rich context specific social and ecological information in the context of aquaculture. As described in Simmance et al (2016), this improved Photovoice method, applicable to small-scale fisheries, contributes to the growing methodological literature in fishery research and provides a timely endeavour to advancing wider social-ecological understandings of small-scale and inland sectors.

Photovoice Ethical Considerations

Due to the use of photography and community participation, the Photovoice method comprises a number of ethical challenges (Wang and Redwood-Jones, 2001). The capturing of visual images is a political and intrusive activity which can lead to unintentional outcomes (Riley and Manias, 2003; Teti et al 2012). Participatory research also requires the ethical distribution of costs and benefits associated with participant participation (Catalani and Minkler, 2010). Although increasing number of Photovoice studies discuss general ethical and participation issues (Castledon et al 2008; Catalani and Minkler, 2010), there tends to be little in-depth discussions about how ethical challenges are overcome in practice, particularly in the emerging application of Photovoice in environmental studies. Within this study, special attention was given to ethical challenges around Photovoice, including issues around anonymity and confidentiality. The following five activities were carried out to mitigate ethical implications within the eight step Photovoice process implemented within this study. Firstly, at the start of the Photovoice process, a consent form was obtained from all participants which provided permission to use images and transcripts recorded for wider research purposes as well as confirmed if participants wished to endorse anonymity. Translators were also asked to sign a confidentiality agreement and were comprehensively trained about the Photovoice process. Secondly, a two-day training session was carried out with all participants at the start of the Photovoice process to ensure participants understood the ethical implications of capturing visual images and in producing research using photography (please see Appendix E). Participants were asked to gain verbal permission from any individuals captured in photographs. Thirdly, at the start of the Photovoice process a meeting was held with the Chief and wider community members within each of the two villages to inform them about the Photovoice process, including a rationale for the selection of participants, what the photographic exercise entailed, and the intended use of the recorded images and transcripts. Fourthly, an inexpensive and easy to use camera was selected for use during this study to minimise the risk of theft and social conflicts on participants. Fifth, a final group discussion was organised with participants to seek verification of transcripts and permission to share photographs captured. Participants were also asked for their feedback on the Photovoice process. Further reflection on the outcomes and limitations of the Photovoice process implemented within this study can be found in Chapter 6, section 6.5.2. Together, these mitigation actions ensured that this study received ethical approval as detailed in section 4.4 of this chapter.

4.3.4 Methods to Address Objective 3 - Quantitative Methods

Quantitative Household Surveys: Household questionnaires have increasingly been used in the context of fisheries and aquaculture to gather quantitative information about diverse social and ecological dimensions of these sectors (Geheb et al, 2008; Darling, 2014). Within this study, the use of questionnaires as a traditional social science method was adopted to quantify the role of aquaculture to food and nutritional security among fishers and non-fishers households from the two case study sites. A household survey was designed with mostly closed questions, giving opinion, ranking the statements and multiple choice options where applicable. A limited number of open-ended questions were included, for example if participants needed to specify options outside those given in the question. Households were sampled according to participation in fish farming. The questionnaire comprised three sections and included a range of socio-economic variables in accordance with the SLA conceptual framework, four pillars of food security and characteristics of fish farming. Regression modelling will be applied. The specific technique will be selected after initial exploration of the data using simple descriptive summaries. Findings from the quantitative household survey will be used for triangulation with other methods adopted within this study. Further details can be found in chapter 6 of this report.

Table 4-3 Summary of advantages and limitations associated with the Photovoice methodology (Adapted from Palibrodo et al. 2009).

Actor (s)	Advantages	Limitations
Participants	- Develop skills in reflecting on and understanding community functioning. - Accessibility and ease of use of cameras, particularly for vulnerable people (e.g. elderly, illiterate, women). - Have improved self-esteem from skill building, competently taking photographs and participation. - Participate in decision-making and problem solving skills, collaboration, and consensus through group process. - The opportunity for participant views to be integrated into decision-making processes.	- The time commitment may be taxing for some individuals, particularly if the project continues over several weeks. - The novelty of cameras by inexperienced participants may result in the capturing of non-related project photographs. - The participants might have trouble presenting complex or abstract ideas through their photographs. - The close examination of an issue of concern can cause negative feelings. - The dissemination of outputs to policy makers requires time and careful planning.
Researcher/ Facilitator	- The active participation of community members as co-researchers provides a level of expertise and knowing that would otherwise not be accessible. - Photovoice creates a flexible power-sharing form of research that differs from traditional research methods. - ‘A picture is worth a thousand words’… Photovoice provides richer, varied, and unpredictable data over and above traditional research methods. - Photovoice emphasizes empowerment and offers a non-oppressive way of engaging marginalized individuals and groups to gather their own research information.	- Time and budget can be a concern. - The loss of, or damage to, cameras is a possible risk. - Photovoice adopts a ‘snapshot’ approach and can lead to omission of community issues or interests. - A wide range of researcher skills is necessary to complete the Photovoice process. For some researchers, community work may be a new and unfamiliar experience.
Community	- The opportunity for community growth and improvement, based on the activities of participants. - When community members gain an increased understanding and awareness of community strengths and struggles, they are better equipped to get involved and work towards change.	- The actual outcomes of the Photovoice activities may not be as significant as expected by community members. - Influencing policy change requires long-term time frames for effective monitoring and evaluation.

4.3.5 Research Methods Limitations

Although mixed methods research designs are gaining momentum due to several research benefits as listed above, O'Byrne (2007) emphasizes that it is important to critically reflect on inherent limitations within methods. Common limitations identified with the mixing of qualitative and quantitative research methods include: increase time and resources required to carried out multiple data procedures; an enhanced and more comprehensive understanding is required to manage the heightened complexity of qualitative and quantitative methods; clearer presentation of research outcomes is required. Critical reflections of the limitations arising from the use of different social methods employed within this study are further provided in the respective chapters below: chapter 5, section 5.5.4; chapter 6, table 4.2. above and section 6.5.2; chapter 7, section 7.5.6. Furthermore, an overview of the limitations of this thesis is provided in chapter 8, section 8.6.

4.3.6 Triangulation of Methods and Tools

A triangulation approach has been adopted within this thesis and draws upon a combination of mixed method presented above to explore the complex pathways by which aquaculture can contribute to improved food security. The use of multiple sources of data to address a case study has been advocated as a means to increase the validity of a project. For example, findings from the quantitative household surveys may be triangulated with findings from the Photovoice process to provide a deeper explanation for conclusions drawn in relation to benefits and challenges faced by fish farmers. Caution will be taken when triangulating results to ensure inconsistencies are resolved and conclusions accurately reflect what is happening on the ground.

4.3.7 Phases of the Study & Data Collection Activities

The study is carried out over a series of five phases as illustrated in figure 3.3. Phases 1-4 have been completed, including all data collection activities which commenced in August 2015. A brief summary of the phased approach to field data collection is provided below. Field data collection activities were completed in two stages as follows:

- Data Collection Phase I: the aim of the first phase of field data collection was to: a) carry out key informant interviews with a range of aquaculture experts; b) to obtain relevant secondary data concerning the aquaculture sector; and c) to explore possible case study fish farming sites and the feasibility of the second phase of data collection activities. This phase was successfully completed in July, 2014.

- Data Collection Phase II: this final phase of field data collection was carried out over a 3 month period from May- August, 2015. The aim of this final phase was to: a) implement the Photovoice methodology; b) carry out quantitative household surveys; and c) obtain any further relevant secondary data.

4.3.8 Ethics statement

This study sought ethical approval from the University of Southampton's Research Ethics Committee (reference 14727, see Appendix O of this thesis) as well as the Malawian National Committee for Science and Technology (NCST). In addition, permission to conduct research within the two case study communities was obtained from the Zomba District Local Authority and village leaders. All participants provided either verbal (recorded via use of a Dictaphone) or written informed consent to participate in this study.

Chapter 5: Stakeholder Perspectives: the Drivers, Barriers and Future Prospects of the Aquaculture Sector in Malawi.

5.1 Introduction

This chapter looks at the case of Malawi where recent trends, like elsewhere in SSA, reveal an urgent demand to meet the country's fish food deficit and a growing awareness for the potential of aquaculture in meeting development goals. The history of aquaculture development in Malawi has been described as following an evolutionary interventionist approach whereby heavy donor funding of small-scale aquaculture kick started the industry in the 1970s, followed by a peak in production from the mid-2000s due to changes in policy and the advent of commercial operations (Russel et al 2008; Jamu et al 2012; Hishamunda et al 2014; Hishamunda et al 2014). In 2010, Malawi was identified as one of the top 10 priority countries in Africa for regional investment and support in aquaculture growth (Jamu, et al 2012). Special attention has been granted to Malawi in the light of its estimated potential of aquaculture production (10-25% of suitable land) and the significant economic and development benefits achieved in neighbouring countries (Jamu, et al 2012). However, both small-scale and large-scale aquaculture enterprises in Malawi have faced impediments to growth and sustainability. A recent review of aquaculture development in Malawi by NEPAD (2011) revealed that small-scale aquaculture has faced a number of challenges including: restrictions in species cultivated; variations in climate affecting the availability of water of ponds and seasonal production of certain species; poor pond management due to lack of extension support; a lack of quality seed and feed, resulting in high input costs; and fish poaching. These findings support previous work which identified multiple challenges affecting small-scale fish farmers in Malawi (Andrew et al, 2003; Dey et al, 2010; GoM, 2012). Challenges to more intensive aquaculture operations (Madelco vs the Rift Valley Farm) identified include: high theft rates; technology limitations in producing floatable feed; high cost of feed and high mortalities in fingerling.

The debate regarding whether aquaculture has met its expected potential to date is on-going. While many recognise the value of small-scale aquaculture in providing positive social and economic services to local communities (Dey, et al 2010), others have pinpointed that the promotion of small-scale aquaculture has failed to expand aquaculture production to the level required to meet national fish demand (NEPAD, 2011; Valeta 2011). A lack of accurate and up to date statistics of aquaculture in Malawi adds heightened uncertainty to the debate. Most of the above studies unfortunately fail to investigate issues related to the drivers, challenges and future needs of the aquaculture sector. Moreover, knowledge of the dynamics driving change in the sector during the most recent phase of development from the mid-2000s to date is largely unknown. There is a further lack of knowledge about how the contextual driving and hindering factors of aquaculture are perceived among stakeholders within the sector. Such information is highly valuable in order to understand how societies (stakeholders) respond to changes and to improve future management and planning of the sector. Moreover, increasing contributions to the literature emphasize that the incorporation of perspectives from stakeholders in the management of aquaculture can bring multiple benefits, including: more localised and enriched understandings of the sector (Krause et al 2015); resolution of conflicts amongst end users (Tran et al 2013); facilitating of education and technical knowledge (Brummett and Jamu, 2011); and improved legitimacy, acceptance and compliance of policies and regulations (Jentoft and McCay 1995; Pita et al, 2010). The current limited empirical evidence is inadequate to provide in depth understanding of the current aquaculture sector in Malawi. Therefore, for a better understanding of the aquaculture sector in Malawi, there is a need for current opportunities and barriers to be examined. This chapter tries to fill this knowledge gap by expanding upon understanding of inhibiting and driving factors of aquaculture development in Malawi through examining knowledge and opinion of key stakeholders within the industry. Specifically, the purpose of this chapter was to investigate the status of the aquaculture sector in Malawi, its constraints for production and future prospects in a new era of development.

5.2 Chapter Aims

This chapter aims to investigate the following research objectives and questions:

Research Objective: To assess the drivers, barriers and future prospects of the aquaculture sector in Malawi through the perceptions of key stakeholders.

Research question 1: What are the perceptions of key stakeholders on the status and drivers for aquaculture development in Malawi?

Research question 2: What are the perceptions of key stakeholders on the challenges experienced in the aquaculture sector?

Research question 3: What are the perceptions of key stakeholders on the future prospects and needs of the aquaculture sector?

Contribution: This chapter aims to fill an important gap in the literature via providing a better understanding of the aquaculture sector in Malawi to help inform the future sustainable management of the sector and its contribution to food security.

5.3 Research Method and Data Collection

As detailed in chapter 4 of this thesis, Key Informant Interviews (KIIs) were chosen as the most suitable method to achieve the objectives of this chapter. This section provides further details concerning the employed data collection protocols and analysis of data obtained.

5.3.1 Data Collection

The purpose of the interviews was to gain an insight into the perspectives of key stakeholders towards the aquaculture sector in Malawi. Within this chapter, participants were recruited using a combination of purposive and snowball sampling (Neuman 2000; Hergenrather et al 2009; Bradshaw and Straford 2010). Semi-structured interviews were carried out with purposively selected key informants who were likely to have specialised knowledge concerning the development of aquaculture within Malawi and thus be able to provide accurate and varied information about the sector. A snowball sampling technique was also used whereby key informants interviewed identified other experts to participate in the study. The sample size was therefore determined by the data obtained, and involved sampling to redundancy. A total of 17 respondents from five categories of stakeholders were interviewed during Jun-September, 2014; 1) government agencies (n=4); 2) academia (n=3), 3) international intergovernmental organisations (n=5); 4) Non-Governmental Organisations (NGOs)/ Charities (N=4); private sector (n=1). There were no specific exclusionary criteria for participants of this study. A list of all participants and details about the respective organisations can be found in Appendix A.

A semi-structured interview schedule was employed for data collection in this chapter (see appendix B). Edwards and Holland (2013) define a typical semi-structured interview as comprising a list of questions or a series of topics as an interview guide with the purpose of generating information through a flexible exchange of dialogue with the interviewee as well as some structure for comparison across interviewees. The semi-structured interview schedule was comprised of 14 open-ended and non-directive questions that focused on three main issues concerning the aquaculture sector in Malawi: status and drivers of aquaculture development; challenges to aquaculture development; governance and policy effectiveness in managing the sustainable growth of the sector. Questions were developed and cross-checked by experts to ensure correct wording and appropriateness of questions to reflect the context of aquaculture development in Malawi. All key informants were sent a standard email explaining the objectives of the study and inviting them to a personal interview. A consent form, the interview schedule and abstract providing more information about the study, were attached to the invitation (see Appendix B). The interviews were carried out either face–to–face during a field visit to Malawi in July, 2014 (n=14), or by Skype (n=3). Overall, the average length of interviews was 1 hour. Each interview began with a general question about the informant's role and work in their respective organisation, followed by more specific questions and probing where necessary to facilitate deeper conservation. All interviewees signed a consent form prior to interview, which detailed the rights as participants in this research and acquired interviewee permission to record the interview. All interviews were audio-recorded via use of a Dictaphone and transcribed verbatim.

5.3.2 Analysis

All transcripts were entered into NVivo 10 to facilitate data analysis. In our analysis of the data, we used a combined technique of inductive and deductive thematic analysis. A thematic analysis, as described by Braun and Clarke (2006), was carried out through a recursive process of identifying, analysing and reporting themes within the data. There are many advantages of carrying out a thematic analysis, including: ability to summarise key features of a large data set, highlight similarities and differences across a data set, generate useful policy relevant qualitative information (Braun and Clarke 2006). The exact form and product of thematic analysis varies. Within this study, the thematic analysis adopted is the realist method which involved the reporting of experiences and perspectives of participants to reflect reality. As described by Braun and Clarke (2006), a theme captures 'something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set'. Themes were identified through a combined technique of inductive and deductive coding. A "good code" is one that captures the qualitative richness of the phenomenon (Boyatzis, 1998, p. 1). Codes were modified and refined through several iterations before analysis proceeded to identify emerging themes from the data. Three overarching themes were identified that were perceived to capture the common issues discussed in the data and pertinent to the aquaculture sector in Malawi. The final analysis sheet included the identification of three broad themes and corresponding subthemes and relevant quotes were identified that best exemplified each category to support the presentation of results.

Key informant interviews are widely reported to be susceptible to error, bias and misinterpretation (Baily, 1994). During the purposive selection of key informants, caution was taken to ensure that representative of key informants included a diverse range of actors currently involved in the aquaculture sector. Furthermore, at the end of every interview, notes were taken concerning the quality of the interview carried out. This information was used to support the interpretation of results and assess the reliability and quality of data outputs.

5.4 Results

Data analysis of stakeholders' interviews identified three overarching themes: 1) drivers of aquaculture development; 2) challenges to aquaculture development; and 3) future prospects and needs of the sector. They are discussed below, along with exemplar quotations. Participant coding is used throughout presentation of quotations to protect the identity of the speaker.

5.4.1 Drivers of Change in the Aquaculture Sector

Thematic analysis of stakeholders' responses revealed stakeholder perspectives on the development history of aquaculture in Malawi. This theme included a general description of the development history of aquaculture in Malawi and identification of drivers of change.

Interviewees outlined that aquaculture has had a long development history in Malawi and has followed a “start-stop” trajectory in terms of production trends. Interviewed stakeholders described that since the introduction of aquaculture in the 1950s until 2000, small-scale subsistence aquaculture became widely adopted across Malawi as a result of numerous donor and government led projects. However, many interviewees (n=9) expressed disappointment that growth in production was slow and stagnated at around 200 tonnes per year during this period. Furthermore, interviewees outlined a significant change in aquaculture production from 2005, revealing an increase in production from 800tns in 2005 to an estimated 3000-4000tns today. Finally, interviewees were divided on whether the aquaculture sector in Malawi could deliver its expected goal of meeting fish supply demand in the country. Whilst some interviewees (n=8) appeared hopeful that the growing trend in aquaculture production is contributing to food security, some interviewees (n=4) believed that production levels remained insignificant and were not growing at the desired rate to meet the urgent and high fish demand in the country.

Interviewed stakeholders outlined that aquaculture is a very important sector in Malawi due to multiple attributes, including: providing food and nutritional security, income generation, supporting the conservation of fisheries, supporting local livelihoods and providing good utilisation of marginal lands. Interviewees also shared that traditionally fish plays a major role in the diets of Malawians but the dire state of declining or stagnant capture fisheries has created a critical deficit of fish supply in the country as well as a high price for fish. There was a consensus that aquaculture provides a critical role to food and nutritional security in Malawi. Interviewees described that aquaculture contributes to all pillars of food security: providing a direct and regular source of affordable fish for consumption, especially in times of shocks and during the agricultural lean period; providing a source of income to support livelihoods and purchasing power; and providing a nutritious source of protein such as high value chambo species. Interviewees outlined that Malawi faces a major problem with malnutrition and pinpointed that farmed fish can provide a critical source of affordable protein, particularly for vulnerable groups of society such as women, children and people with HIV/AIDS. A few interviewed stakeholders (n=3) further described how aquaculture provides a better utilisation of marginal lands in terms of production of protein compared with other food types and also wider services such as the re-use of pond water for crop irrigation and the promotion of integration with livestock farming.

Interviewees highlighted that the sector had undergone rapid changes over the past decade due to a number of intrinsic drivers of growth. Interviewed stakeholders attributed the apparent jump in aquaculture production since 2005 to shifts in production systems and scales of operation, policy as well as attitudes of the fish farmers. A few interviewees (n=5) described how small-scale fish farmers traditionally acted like "fish keepers" over the past few decades whereby they carried out no or limited harvesting and re-stocking of fish in ponds which impeded growth across the sector. The two points below demonstrate the viewpoint of interviewees:

"In Malawi fish farming was introduced some time back I think in the 50s but people took fish farming as basically keeping them in their ponds and they can harvest when they want to or fish out a few when they want to but they were not looking at that as a means of farming business so it hasn't actually developed much because of that kind of attitude and also the government policy was looking at fish farming at small-scale level but now we are changing our approach" (Government Agency).

"In Africa and Latin America it is a bit different because there is no fish farming tradition where in Asia there is a very strong fish farming or connected fish farming tradition. So in Africa and Latin

America we have to develop better the way of growing fish not only for direct food and but also as a little business and perhaps this is a different approach compared to what was taking in the past… so in Africa and Latin America we are making an effort to assist countries to assist aquaculture as a small businesses so they can really not only feed on the fish but they can trade and use aquaculture production as a livelihood and way for development" (International Intergovernmental Organisation).

However, interviewees went on to outline that a shift in the approach to aquaculture from the mid-2000s emerged, which interviewees suggested was attributed to a move towards upgrading subsistence small-scale aquaculture to a commercial level, encouraging fish farmers to treat aquaculture like a business as well as the emergence of intensive aquaculture systems (cage culture and recirculation systems). One of the interviewees summarised the situation by saying:

"*I know people challenge that we have put a lot of efforts in aquaculture in terms of projects, this and that but probably not much is happening but I would say that what I have seen since 2005 to date, I have seen that there is quite a lot of potential if you bring a number of commercial players in the arena or the system, if you graduate some of these small holder farmers to a semi-commercial level, I can see a very good level of production and I can aquaculture has big potential for Malawi" (Academia).*

Furthermore, interviewed stakeholders described significant changes in the policy landscape associated with aquaculture over the past two decades. During the mid-2000s a number of specific aquaculture initiatives emerged such as the National Aquaculture Strategic Plan (NASP) and the Presidential Initiative on Aquaculture Development (PIAD), the movement of the fisheries into the Ministry of Agriculture, and renewed national and regional support was granted to aquaculture through key regional events. Interviewees were divided as to whether these policies were effective in achieving desired growth rates in aquaculture production. For some interviewees (n=5), 2005 was identified as a turning point in national policy direction due to a positive move towards commercialisation across the sector for export markets, food security and business goals. For example, as expressed by one of the interviewees:

"So where we are coming from, aquaculture was more of at a subsistence small-scale level but we are revising the policy now to commercialise it. There have been some movements or efforts since 2005… there was a bit of a political will where we even had a presidential initiative to promote aquaculture you can read on that… that has tended to shift our mind set now to say let's look at aquaculture as a business… not constructing a pond and having it for years and years no… but have the fish sold and then restock the pond that is what we are looking at" (Government Agency).

However, a number of interviewees (n=4) expressed concerns that these initiatives did not go far enough to promote growth in the sector due to inherent gaps in policy and implementation. Finally, only a few interviewees (n=6) were aware of the latest revision of the National Fisheries Policy (2012- 2017) and believed that the revision of the National Policy and Act would support the continual growth of the sector in the coming years; quoting one interviewee:

"That's why we are revising the policy because we saw some gaps. The old policy was mainly subsistence small-scale so we said no lets go forward with commercialising aquaculture so the concept on PIAD was now premised on the fact that we should go from small-scale to large scale aquaculture so we are now realigning all our policies, all our strategies to be in tune with that … how best can we have an environment that's conducive to aquaculture development whether it is pond based or cage farming so we are moving towards that to create an enabling environment for that. The revision of the act and the revision of the policy are underway…PIAD we take it as an ongoing initiative. The way it was designed it had to attract some donor resources it hasn't been" (Government Agency).

5.4.2 Challenges to Aquaculture Development

Multiple endogenous and exogenous factors were identified by interviewees as impediments to the sustainability and growth of the aquaculture sector in Malawi. Major constraints identified included: technical (feed, seed, selective breeding), economic (access to upfront capital investment and profitability), social (access to market knowledge, conflict over resources), environmental (climatic shocks, availability of water) as well as governance (weak implementation) issues.

In relation to technical constraints, the majority of interviewees (n=14) expressed concerns with the availability and access to high quality feed and fingerlings. Many interviewees (n=5) revealed economic and physical access constraints to fingerlings resulting from too few hatchery operators in the country and a high demand for fingerlings from NGOs leading to the price of fingerlings becoming too expensive for fish farmers. Furthermore, a number of interviewees (n=4) expressed concerns with the selection of species cultivated in Malawi and pinpointed that growth and productivity trends in the few indigenous species selected for aquaculture remain worryingly low. To rectify the situation, a few of interviewees (n=5) suggested to carry out selective breeding of more local species as well as to carefully consider the selective breeding of exotic species (e.g. the tilapia *Oreochromis niloticus*). In relation to economic constraints, many interviewees (n=8) revealed that people are now finding it difficult to enter into aquaculture due to limited access to credit to fund the upfront high investment capital required. Moreover, a few interviewees (n=4) outlined that the high cost of inputs is resulting in poor husbandry techniques leading to low production and profitability issues. A lack of market knowledge, competition with wild capture fisheries and slow progress towards adopting aquaculture as a business by small holders were identified as additional impediments to the profitability of aquaculture. Interviewees also shared concerns about the social acceptability of both extensive small-holder pond culture and intensive cage culture operations in Malawi. A few interviewees (n=4) described how the introduction of cage culture in the southern part of Lake Malawi resulted in significant conflicts over access to fisheries resources and ownership of the cages leading to the stopping of operations. Furthermore, a few interviewees (n=7) revealed that a growing competition for land and water resources in Malawi was leading to heightened conflict between small-holder fish farmers and other users within rural communities. Climatic variability and shocks such as flooding and drought events were also identified as major constraints affecting the productivity and retention of aquaculture. Many interviewees(n=5) expressed concern that climate variability is causing low water levels or the complete drying up of ponds during the dry season which was suggested to increase conflict over water resources and predation of fish by monitor lizards and birds. To rectify this issue, one interviewee suggested that the construction of deeper ponds could reduce the threat of water stress. Finally yet importantly, interviewed informants discussed the aquaculture governance landscape in Malawi. Division emerged concerning the effectiveness of aquaculture policies to date. For some interviewees (n=5), the policy framework was viewed as supportive in encouraging the sustainable growth of the sector. These interviewees applauded the government's efforts over the past few decades in revising policies and providing increasing attention to aquaculture at the national level. The two quotes below demonstrate this point:

"In the time past if you were to review the policy, perhaps as back as the 1970s, you rarely saw aquaculture as the main thing… ok they promoted it and there was some initiatives but of late if you go to the aquaculture and fisheries policy there is a huge emphasis on aquaculture. So it's there and it is providing quite a good environment for aquaculture growth… So in general, policy yes is quite good, maybe not as effective, but the policy environment is quite ok" (Academia).

"I would say that government has been forthcoming to encourage aquaculture and to encourage any kind of fisheries" (Academia).

However, significant concerns were expressed over the effectiveness of policies to date and there were recurrent calls for improvements in terms of policy implementation and planning of the sector. For example, as expressed by one of the interviewees:

"Honestly I am not so convinced that they have done a lot for aquaculture… there is still a way to go to improve aquaculture strategies and planning… so no I think there is quite a way to go, especially for cage culture and to implement something like this on the Lake… there are some legislations and

policies but I think there is quite some way to go and also implementation" (International Intergovernmental Organisation).

Multiple governance constraints were identified by interviewees, including: a lack of resources to implement policies; capacity gaps in terms of numbers of staff and skills; leadership issues; a lack of funding for aquaculture; data limitations with respect to up to date reliable estimates on aquaculture production and fish trade statistics due to weaknesses in monitoring and data management; a lack of policy coherence; a lack of spatial planning; and poor quality extension services. Many interviewees (n=6) revealed that there is a significant lack of implementation of polies. The quotes below demonstrate this point:

"I should be frank, I haven't read this one but my question would be whether it has been utilised because Malawi is very good at paper work, we produce quite a lot of paper work and writing and implementation is the challenge. Now that challenge is either leadership. For example it might the Directors of the Fisheries Department in Malawi might not be pushing or even they might be pushing but other people up there are not listening to them and the government might want to prove to you that they are working. So this component it needs a bit of push from the advocacy prospective and the advocacy to be based on evidence so we easily get that in terms of evidence in Malawi and bring about the change we want to see" (Non-Governmental Organisations (NGOs)/ Charities).

"Policy framework is supportive but lack of resources to implement the policy is one of the biggest challenges of the sector" (Non-Governmental Organisations (NGOs)/ Charities).

Interviewees described 'shocking' capacity gaps within Government and consensus revealed that a lack of adequate resources impeded implementation of policies, the quality and availability of extension services as well as research within the sector. The two quotes below demonstrate the viewpoint of interviewees:

"The policy is clear about a support and focus on aquaculture. However, there is need to allocate adequate resources to the sector for extension, research, training and learning" (Non-Governmental Organisations (NGOs)/ Charities).

"The other thing is in terms of shortage of staff at all levels… I think we need more staff in fisheries, fisheries extension, and fisheries research. The master plan did state what we require more staff in the sector but not much has been filled in terms of skills as well as numbers. This is a real problem" (Government Agency).

Furthermore, one interviewee attributed capacity gaps in policy implementation to the institutional issues caused by the decentralisation process experienced across Africa:

"This is the problem in a lot of African countries… The Achilles heel of the decentralisation program… two of them are: 1) the lack of the capacity for the decentralised institutions to be able to their job and 2) the lack of adequate budget allocation. So the decentralised process in a lot of African countries has not worked as its designed to do" (International Intergovernmental Organisation).

Constraints in relation to the planning and monitoring of the sector were expressed by the majority of interviewees. Many interviewees (n=8) outlined that there is no spatial planning in the sector and that small-scale aquaculture ponds are scattered across the country often in sites that may not be suitable for aquaculture. Interviewees highlighted constraints in relation to the quality and availability of extension services. There was a consensus that extension services play a vital role in supporting the aquaculture sector in Malawi. However, a number of interviewees (n=6) emphasized that the existing capacity of extension services was insufficient and lacked technical knowledge in aquaculture. One of the interviewees summarised the situation by saying:

"We have seen that extension is another issue. We don't have technical experts in extension who can really talk to the farmers relating to fish farming… and therefore what the tendency has been with working with agriculture extension workers who do not have knowledge in fish farming therefore we are more les s like miss-placing the technicalities… therefore we are not hitting what we are supposed to hit and that is a very big bottleneck- extension… I think if you ask the district how many aquaculture extension is there, you will be surprised maybe 1 or 2 but for agriculture there is so many" (Academia).

To rectify this situation, there were recurrent calls for improved training of extension workers through the development of a curriculum incorporating knowledge about commercialisation of the sector as well as the development of a coordination mechanism to improve and support monitoring and spatial planning of the sector. Interviewees were divided on issues relating to data of aquaculture. For a few interviewees (n=3), national aquaculture production data was deemed readily available due to monthly recordings at the district level. However, an almost equal number (n=4) expressed concerns about the quality and availability of data, attributed to poor communication by NGOs as well as limited capacity for monitoring. There was also disagreement among interviewees concerning issues over selective breeding of exotic species. For a minority (n=2), current policies that prohibit the farming of exotic species (e.g. the tilapia Oreochromis niloticus) were deemed a hindrance to the growth of the sector and a call for the careful consideration of farming faster growing exotic fish species emerged. According to one interviewee:

"That one has a mixed bag. Yes we are seeing change but we still need refinements. Mostly we are talking of improved strains of fish or the fast growing fish but we need strong implementation of the policy where there should be a deliberate move to even promote the exotics in a proper way

such as restricted farms which could come in the policy itself or in the Act. It is a blanket recommendation to say no… what we need is specific farmers to be allowed to aquaculture some exotics under a close supervision. I want to also add… our borders, we might be restricting to say we don't want this… international conventions do not allow this but we are seeing that even if mechanisms are not there one- the cooperating agencies are not putting much investment into protecting the indigenous itself… there's no comprehensive program to screen from the world for fish farming and we are still farming the slow growing fishes…. and farmers now with the internet now they are sharing notes with their counterparts in other areas where they are culturing the same fish, fish of similar species, and they are growing faster and whatever so people are saying why can't we try what our colleagues are doing there… it is like a time bomb as farmers might just bring them in…. now to avoid bringing it by default why can't we do it in a proper way… that's why we are saying why can't there be a deliberate move in policy to say specific farmers can implement whatever" (Government Agency).

However, a few others (n=2) applauded the government's efforts to protect its high biodiversity of native fish species through prohibiting the farming of exotics and the use of local indigenous species. This was eloquently stated by one of the interviewed key informants:

"Well in my personal opinion of course aquaculture has a great potential in Malawi. I believe the government has been doing a big effort to really stand by the production of native species and in that sense I believe it is one of the only place where you have this incredible large fish biodiversity where the government and other stakeholders are really trying to farm the native species… which is something really unique" (International Intergovernmental Organisation).

In relation to stakeholder engagement, there were recurrent calls for the need to engage a wider range of key stakeholders in the planning and policy formulation of aquaculture. Key stakeholders identified by interviewees included: fish farmers, extension officers, researchers, government (incl. fisheries, agriculture, land, water, and economic departments/units), private sectors, NGOs. Many interviewees (n=7) highlighted a lack of policy cohesion among sectors that influence aquaculture development and called for better harmonisation and coordination of policies, particularly between fisheries, water, land and agricultural sectors. Many interviewees (n=6) expressed significant concerns over the retention and future sustainability of the aquaculture sector in Malawi. These issues were attributed to water stress, historic approaches to aquaculture and the type of aquaculture development introduced to communities (immanent vs interventionist models). For example, as expressed by one of the interviewees:

"*Water is stressed, most of the ponds are drying and some farmers have been abandoning fish farming and it has increased predation because the ponds levels are low" (Government Agency).*

Moreover, a few interviewees (n=4) highlighted that when aquaculture is introduced with heavy subsistence support from an outside organisation (interventionist approach), the retention of aquaculture post completion of the project can be low due to lack of uptake of knowledge and reliance on financial support. The two quotes below highlight the viewpoint of interviewees:

"Em we have seen over the past years the contribution again from NGOs who also promote aquaculture, although the contribution has been a mixed bag in terms of whether the people only adopt when the NGO is active but I think when the money phases out I think the people do not continue with aquaculture… this is actually based on the practice that… I mean the way they approach the whole aquaculture production by giving them a lot of incentives by subsidising too much so people only go there to get the benefits not that they want to actually go into aquaculture production" (Non-Governmental Organisations (NGOs)/ Charities).

"Again another challenge that I see is that there is a need for continual supervision by aquaculture experts on the farmers. If you see productivity in an area it is because of a project but once that project phases out the productivity does not simply continue otherwise if it were not so we would have seen that aquaculture would have been big by now in terms of participation from the local farmers. Aquaculture will begin via a project and when it phases out you also see aquaculture ponds dying out so that is another challenge. I don't think farmers have taken hold of the principles and are running with it… they have to be supported by some project or programme" (Academia).

5.4.3 Future Prospects and Needs of the Sector

Interviewees were divided regarding perspectives about the future performance of the sector. For two thirds of the interviewees (n=12), the potential for aquaculture growth and its ability to contribute to food security in Malawi was perceived as great. This was attributed to recent shifts in policy support for aquaculture as well as the high availability of suitable land in Malawi. However, nearly as many (n=10) expressed concerns about the future potential of aquaculture in Malawi due to a number of identified critical issues, including: the lack of funding and awareness of the value of the sector; challenges in overcoming shocks and pressures experienced by fish farmers; lack of understanding of the sustainable limits of the sector; as well as the need to advance commercialisation across the sector. Priority areas for research and investment in aquaculture were identified by interviewees as a means to foster future growth of the sector in Malawi. The lack of research in areas including breeding, climate change, feed, socio-economic and spatial planning was highlighted by many interviewees (n=12) as critical research gaps impeding the future growth of the sector. Whilst a few interviewees mentioned that some areas are currently being addressed, consensus emerged that many areas required further advancements in research and more funding. Research on the commercial production, assessment and quality of fingerlings from local species was identified as a high priority area for future research. The two quotes below highlight this point:

"*My own thinking is that research on breeding to me should be a high priority… research on commercial production, looking at our own local species should be a priority, research on feed should be a priority, I think those are very important research that we need to raise the profile of aquaculture production in Malawi" (Non-Governmental Organisations (NGOs)/ Charities).*

"Another area is one of the assessments of species that would do well. Of course I know this has already been done and there are species that have been grown but I think that is an area that still needs more research establishing which kind of species we should be encouraging farmers to grow" (Academia).

The need to invest in technology for transportation and year-round production of fingerlings was also identified as an important area. According to one interviewee:

"Transportation of fingerlings you need to look at technology for that for transporting fingerling long distance… even producing fingerling in cold season is an issue right now. I was happy yesterday when I got to talk to the general manager from Maldeco and at least in this year they produced one million fingerling this month in this particular cold season but it has been difficult over the past years from my view I think we are making a breakthrough but at the local level how can local fish farmers be able to produce fingerling even in the cold season so that they are supplied the whole year rather than waiting for when it is hot and so we need research in these areas" (Government Agency).

The effect of climate change on aquaculture in terms of water availability was also identified as a priority area for research. For example, as expressed by one of the interviewees:

"I think there are still a lot of areas to play around for research concerning fish farming in Malawi. The effects of climate change as well on aquaculture… this is another problem which I have not yet mentioned…. in some areas you find that the ponds easily dry up in the dry season and how do you make sure that there is adequate water for fish farming in those areas…. that is an important area" (International Intergovernmental Organisation).

Although many informants highlighted that progress in research towards developing quality feed exists, there were recurrent calls for more research on feed formulation to improve growth rates. Further research into the socio-economic aspects of aquaculture in relation to benefits obtained across supply chains as well as retention issues were also identified as research gaps. Quoting one interviewee:

"Of course the area regarding socio-economics of aquaculture is an area that we also need to talk about… are we sure that the kind of incomes that farmers get from aquaculture area sustainable. why are the aquaculture farmers die off all the time… could it be that there is not much that comes of it. That's an area that needs assessment… what are the socio-economic factors that essentially determine whether aquaculture will go forward or not" (Academia).

A couple of informants (n=2) further emphasized the need for more research to improve and monitor the strategic planning of aquaculture in Malawi in order to encourage growth in areas identified as having potential as well as to sustainably promote cage culture operations. Limited sharing of unpublished information as well as threats from disease were further identified as problematic areas warranting future research attention. The two quotes below demonstrate this point:

"The other area is the area of actually publicising the research that they have done… they have done quite a lot of research but most of that hasn't been put up in papers that you can actually pick up and read so we still say this area is a very researchable area… when some other researchers have done that some time back but the documentation is not there" (Government Agency).

"But the gaps regarding technical issues now are fish disease… we haven't done much in that area and we have seen very destructive diseases in the Zambezi and other countries… Zambezi is just very close and it is worrying that we have not prepared much in that area…. so this is one gap which I am seeing" (Government Agency).

There were recurrent calls for future investments in the sector (n=8), including critical areas such as feed, research, commercialisation of the sector, public-private partnerships, extension services and capacity building for fish farmers in order to support future growth of the aquaculture sector in Malawi. Using the words of one of the interviewed stakeholders:

"Starting at the industry or improving the industry, you need an injection or kind of investment. if we don't have investors then we will be stagnant. These investors can be within or outside… like the same issue of cage culture or intensive systems in ponds they can also venture into that… we have also seen similar farms like in Lake Harvest in Zimbabwe is a very good example and here MALDECO is a very good example. If we had several of those investors and very good support in terms of feed industry that would probably assist in improving the production of aquaculture" (Academia).

The need to invest in commercialisation across the sector via upscaling small holders to operate at the semi-commercial level was seen as a key investment area. For example, as expressed by one of the interviewees:

"First of all investments for small-scale to move them into semi-commercial… that's number one and therefore investments in capacity building for the farmers, investments in the fund availability for farmers… if we had like in countries like in Ghana they have an agriculture bank that allows credit facilities for farmers that would be good… but we don't have that in the country so we need that system, you need capacity building… we need this feed there so these areas in the country are very key" (Academia).

Feed was seen as a key area requiring substantial investment in relation to improving the quality and availability of feed to all fish farmers. Calls for substantial investment in public-private partnerships also emerged in relation to addressing critical technological constraints such as technology supply for production systems and the feed industry. The two quotes below highlight this point:

"We need a very very big investment in research and also investment in encouraging what we call Public-Private partnerships. I think coming up with the farms which are commercial in nature, producing big volumes of fish… I think that is the only way to improve production from aquaculture" (Non-Governmental Organisations (NGOs)/ Charities).

"So to me the combination of investments- public and private- to address the key technological constraints- is critical. There are some which are fundamental which require some high level applied science to address but other than that if you have conscious farmers they should be able to resolve some of the constraints" (Private Sector).

Recurrent calls for substantial investments in research, particularly in relation to improving seed production, emerged. The quotes below highlight the viewpoint of interviewees:

"We need a very very big investment in research" (Non-Governmental Organisations (NGOs)/ Charities).

"But from cooperating agencies more should also go to seed production… so more research in improving the biological performance or the fish seed should be targeted" (Government Agency).

"The research gaps which I am seeing are broadly also funding across the research is limited… currently we are funded by government, only government programs, but fish farming needs quite substantive funding" (Government Agency).

Extension services was seen an important area requiring investment in relation to supporting the skills and capacity of extension workers to carry out their roles effectively. According to one interviewee:

"Extension services are an area we need to invest quite a lot on. Extension services and support for that extension worker. For example, the mobility aspect of extension workers. Extension workers might be basically dumped at a station and does not bring the impact we want to see. These extension workers need to go out and work with the farmers as the farmers require knowledge and we need for example pilot projects where the extension worker… extension workers have targets" (Non-Governmental Organisations (NGOs)/ Charities).

Finally, a few informants (n=2) recognised the need to invest more in improving the capacity of farmers to enter into aquaculture through better access to capital, particularly for women. For example, as expressed by one of the interviewees:

"Another area… well start-up of capital that could encourage women,… women are not really taken part because of lack of capital so if that could also be encouraged to have a start-up capital" (Government Agency).

5.5 Discussion

The aim of this chapter was to advance our understanding of the drivers, barriers and future prospects of the aquaculture sector in Malawi through the perceptions of key stakeholders. Overall, stakeholders interviewed discussed a wide range of issues pertinent to the aquaculture sector in Malawi and provided rich contextual information that both supported and expanded upon existing knowledge concerning its drivers and constraints to growth as well as future prospects and needs. This section draws on relevant literature to interpret and discuss the key research findings from this chapter in accordance with the identified three overarching themes: drivers of aquaculture development; challenges to aquaculture development; and future prospects and needs of the sector.

5.5.1 Drivers for Aquaculture Development

In relation to trends and drivers of aquaculture, findings from key informant interviews revealed that the evolutionary interventionist approach adopted in Malawi has led to a slow and erratic trajectory of aquaculture growth. Whilst heavy donor support was attributed to kick-starting a good platform for growth in small-scale aquaculture, aquaculture development in Malawi was recognised as failing to achieve its full potential, including falling short in expectations to meet national demands for fish supply. These findings are synonymous with other countries in SSA and support current literature, which reveals shortcomings in African aquaculture development because of weaknesses in donor led projects and unrealistic expectations (Coche et al, 1994; Moehl et al., 2006; Brummett et al., 2008; Mwale, 2009; Little et al., 2012). However, interviewed stakeholders further revealed a turning point for aquaculture production in Malawi from 2005. Synonymous with aquaculture production estimates for the rest of Africa, accelerated growth in aquaculture production occurred from the mid-2000s in Malawi driven by a new heavy investment in order to move towards commercialisation of the sector (Moehl et al. 2006; NEPAD, 2011; Jamu et al 2012; FAO, 2006). This is further supported by other studies which highlight that significant changes in policy direction, better incorporation of aquaculture within national policies, the occurrence of major regional events prompting greater attention on aquaculture; as well as additional capacity put in place recently led to a rise in aquaculture across the continent over the past decade (Brummett et al 2008; Russell et al 2008; Jamu et al 2012; FAO, 2016). Finally and not surprisingly, all interviewed stakeholders believed that aquaculture should be encouraged in Malawi for reasons such as: to meet the increasing demand for fish; due to the high availability of natural resources suitable for aquaculture development; to contribute to improved sustainable livelihoods and food security and nutrition; as well as to alleviate pressure on wild fish resources.

5.5.2 Challenges to Aquaculture Development

The findings from the key formant interviews presented within this chapter unearthed several factors that were perceived to be impediments to the growth and sustainability of aquaculture in Malawi. Rich information was obtained from the key informant interviews supports but also expands upon recent literature by revealing that multiple persistent and new challenges affect the growth of the aquaculture sector in this latest era of development in Malawi. A recent review of the aquaculture sector in Malawi by NEPAD (2011) highlighted that small-scale aquaculture suffered from variable economic performance; site and water availability issues; limitations in the availability and quality of fingerlings as well as theft; whilst commercial operations faced significant profitability issues and theft as well. However, findings presented in this chapter reveal an increasing number of perceived constraints impeding aquaculture growth in Malawi today. Synonymous with challenges experienced in the rest of Africa (Hishamunda et al 2009; Beveridge et al. 2010; SARNISSA 2010), major constraints identified in the aquaculture sector in Malawi included: technical (feed, seed, selective breeding), economic (access to upfront capital investment and profitability), social (access to market knowledge, conflict over resources, theft), environmental (climatic shocks, availability of water) as well as a suite of governance issues (weak policy implementation, poor extension services).

The poor availability of good quality and reasonably priced fingerlings was perceived by interviewed stakeholders as negatively affecting the productivity of aquaculture. In addition, current policies prohibiting the use of exotic species in aquaculture were perceived to be a hindrance to aquaculture productivity, albeit by only a few stakeholders. These findings contribute to the on-going debate over the use of exotic species in aquaculture development across the continent with views divided over the potential to improve productivity versus concerns over impacts to indigenous wild fish species (Anash et al 2014). Furthermore, the recent report by NEPAD (2011) emphasized that local indigenous species can be farmed effectively and profitably in Malawi suggesting that other factors impede productivity. High costs of inputs as well limited access to credit were further identified as impediments to the profitability and entry into aquaculture in Malawi by stakeholders. These findings are consistent with other regional studies which highlight that access to credit is very limited across Africa and that high costs of inputs can render aquaculture not economically viable (SARNISSA, 2010). Stakeholders further highlighted that conflict over access to resources as well as theft present constraints to the long-term success of aquaculture development in Malawi. Social acceptability of aquaculture is widely recognised to play an integral part in the sustainability of aquaculture and findings presented within this chapter support existing studies that demonstrate that a range of barriers continue to prevent community acceptance of aquaculture in Malawi (NEPAD, 2011). Findings further revealed new insights into the significant threat of climate variability on the sustainability of aquaculture. Stakeholders revealed that climate shocks such as flooding and drought affect the availability of water and site conditions and highlighted that these impacts can lead to heightened conflict over resources, increased predation of fish and low productivity.

Findings from the qualitative key informant interviews in this chapter revealed mixed views concerning the effectiveness of aquaculture governance in Malawi. A recent global review of aquaculture development by Hishamunda et al (2009) revealed that unsuitable policies was a major cause of aquaculture's slow development across Africa. Through consultation with global experts, the authors revealed that aquaculture policies lacked support for commercial operations, unclear property rights and that legislation was unfavourable for business investment. Moreover, a study by Jamu and colleagues (2012) specifically reviewed aquaculture governance in Africa and concluded that policies that relate to the much larger arena of trade and investment are more important for promoting aquaculture development than specific sector policies, laws and regulations.

In relation to aquaculture governance, stakeholders highlighted progress and weaknesses in the perceived effectiveness of national governance structures associated with the aquaculture sector. Although stakeholders perceived progress had been achieved in developing national policies and supporting growth in modern commercial aquaculture systems; multiple governance issues were identified, including: the lack of policy implementation; significant capacity gaps; weak extension services in terms of officer numbers and skills; low levels of investment in the sector; data limitations concerning up-to-date and reliable statistics about the sector; a lack of policy coherence; limited spatial planning and monitoring of the sector. Furthermore, findings from this chapter revealed that interviewed stakeholders perceived donor led aquaculture systems to face a high risk of abandonment due to a lack of uptake of knowledge and access to capital once donor support is discontinued. These findings may be part explained by previous studies that reveal: aid to aquaculture across SSA was poorly managed and did not create sustainable outcomes (Brummett et al, 2008); a lack of capital and technical advice often prevails after completion of a donor led project (SARNISSA, 2010); aquaculture is often viewed as a secondary source of livelihoods resulting in a return to other profitable livelihoods when resources to manage ponds are low; low profitability can lead to abandonment (SARNISSA, 2010).

5.5.3 Future Prospects and Needs of the Sector

Findings from this chapter revealed cautious optimism among interviewees regarding the future prospect of the aquaculture in Malawi due to the reported opportunities and barriers presented above. Generally, government funding for research in relation to the aquaculture sector was perceived as limited by interviewees. Adequate funding for research to help solve gaps in knowledge and overcome constraints relating to critical areas such as selective breeding, climate change; commercial production, feed, social acceptability and spatial planning of the sector was called for. Improved communication of research outputs produced by all stakeholders involved in the aquaculture sector was seen as a further critical area of importance. Such findings were synonymous with wider studies in the region that revealed gaps in aquaculture research required to support the growth of the sector (SARNISSA, 2010). Furthermore, a lack of investment across the aquaculture sector was considered a constraint to the future growth of the sector, particularly in the following areas: feed quality and availability; research; commercialisation of the sector, including upscaling of small-scale operators; public-private partnerships; skills and capacity of extension services; and capacity building for fish farmers. As highlighted by previous studies, a strong legislation which promotes investment as well as improved access to financing for aquaculture development are crucially necessary to attract future investment in the sector (SARNISSA, 2010; Brummett et al, 2011).

5.5.4 Limitations of the use of Key Informant Interviews for assessing the aquaculture sector

A number of limitations in this study are worth mentioning. A limitation of carrying out key informant interviews is that the selection of key informants may not be representative of all experts within a given topic investigated. As such, biases may arise within the generation and interpretation of information gathered. However, within this study key informant stakeholders were carefully selected and sampled to redundancy. In addition, the adoption of a flexible approach to data gathering (face-to-face or Skype interviews) ensured all identified experts were interviewed. Overall, this approach allowed for the elicitation of perspectives from a good representation of actors engaged within the aquaculture sector in Malawi during the time period this thesis was carried out. Moreover, the coding and identification of themes within qualitative research is often completed by numerous authors to improve validity. However, given the nature of this study, the identification of codes and themes within the data was completed by one person with cross verifications from supervisors. To improve validity of data interpretation, extra time was taken to thoroughly identify recurrent themes in the data as well as appropriate quotations to support the presentation of results in order to minimise biases. Finally, the timing of this study coincided with the National General Elections in 2014 and it is believed that the revision of the National Fisheries Policy II was under review. As a result, stakeholder views concerning the National Fisheries Policy II may have been influenced by this context.

5.6 Conclusion

This chapter aimed to assess the drivers, barriers and future prospects of the aquaculture sector in Malawi through the analysis of key stakeholder perspectives. Overall, findings presented within this chapter suggest that the promotion of aquaculture in Malawi continues to be driven by the many needs: to meet increasing demands for fish, support livelihoods, improve food and nutritional security as well as alleviate pressure on wild fish resources. Although progress relating to improvements in policy formulation and efforts to enhance commercialization across the sector were observed, findings suggest that multiple challenges are perceived to impede future growth and sustainability of the sector, including: lack of available good quality and reasonably priced fish seed or fingerlings; limited access to capital; low investment across the sector; weak social acceptability; climatic shocks; weak governance relating to poor implementation and capacity gaps affecting extension services and monitoring of the sector. To encourage aquaculture expansion and growth in the country, results presented in this chapter further revealed stakeholder perspectives concerning priority areas for research and investment within the sector. Priority areas for future investment include: feed quality and availability; research; commercialisation of the sector; public-private partnerships; skills and capacity of extension services; and capacity building for fish farmers. Important areas requiring further research include: selective breeding, climate change; commercial production, feed, socio-economic and spatial planning. This chapter provides a significant and timely contribution to the field via providing insights into key stakeholder perceptions about the drivers, barriers to growth and needs of the undervalued and understudied aquaculture sector in Malawi. The following chapters 6 and 7 build upon the findings presented in this chapter by further exploring the characteristics, impact of and challenges to aquaculture development at the local level.

Chapter 6: Using Photovoice to Explore the Role of Gender in Aquaculture Development

6.1 Introduction

Understanding the role and value of small-scale fisheries and aquaculture to livelihoods and food security is a key challenge in conserving fishery resources and sustainably developing aquaculture. This is particularly true for small-scale inland fisheries and aquaculture, one of the most under-reported and under-valued fisheries sectors, and which increasingly face environmental and societal change (Kolding et al 2014; 2016). Complex social factors (incl. gender norms, cultural values, ethnicity or religious beliefs) can crucially influence who participates in fisheries and aquaculture as well as the distribution and flows of benefits arising from these sectors (Geheb et al. 2008; Kleibler et al 2015; Krause et al 2015; Harper et al 2013; Hishamunda et al., 2009; Morgan et al 2016). Both women and men play important roles in contributing to the fisheries and aquaculture sectors worldwide (Allison and Ellis 2001; FAO 2006; FAO; 2012). Characteristics of gender in fisheries and aquaculture typically comprise the division of labour, gender relations and behaviour which impact on socio-economic benefits arising from the sectors (Harper et al. 2013; Williams et al. 2012a). In relation to aquaculture, the sector is known to have fewer gender barriers than capture fisheries, resulting in more women actively participating in diverse aquaculture activities (including pre-harvest, harvest, and post-harvest activities) (Weeratunge et al 2010; Williams et al 2012b). For example, aquaculture is known to promote opportunities for women due to the homestead and less labour intensive nature of operations; e.g. in Bangladesh (Farnworth et al., 2015), in Tanzania (Luomba 2013), and in Nepal (Bhujel et al. 2008). However, in some regions gender norms have been reported to indirectly limit women's participation in aquaculture by placing constraints on their mobility, time and capacities e.g. in Bangladesh (Jahan et al. 2010; Shirajee et al. 2010); in Nigeria (Fapohunda 2005), in Cameroon (Brummett et al 2011). The role of gender can also influence the contribution of aquaculture to food security and nutrition. For example, a recent review by the High Level Panel of Experts (HLPE) on Food Security and Nutrition (2014) highlights that gender can influence the different mechanisms that determine access to fish and nutrition both within the general population (as consumers) as well as population groups directly involved along supply chains (as producers, processors and traders). Women can also play a dominant role in prioritising food for household members (Quisumbing et al. 1995; Porter 2012), including the promotion of household fish consumption through their involvement in aquaculture e.g. in Bangladesh, (Jahan et al. (2010), and in Uganda (Kasozi et al. 2014).

At the same time, the fisheries and aquaculture sectors world-wide have undergone rapid structural, economic and resource changes over the past few decades and will continue to do so in the future (WorldBank 2013; FAO 2014). Aquaculture development requires dealing with threats both internal and external to the sector, including: climate change, competition for critical resources (land, water), pollution, economic policies, demographic and social shifts, weak governance, among others (Lynch et al 2016; FAO, 2013; Charles et al 2016; Adger et al 2013). Many of these problems are particularly acute for small-scale and inland fish farmers in Africa and especially for livelihoods dependent on inland fisheries and aquaculture in the dry lands of Africa which face heightened vulnerability to climatic shocks (Cooke et al 2016; Kolding et al 2016). As a result, changes in gender patterns may arise in relation to divisions of labour (Walker and Robinson 2009), participation in certain activities (Geheb et al 2008) and access to resources (Porter and Mbezi 2010). These dynamic framing conditions contextualising fisheries and aquaculture reinforce the need for greater understanding of gender contributions to the sector and consideration of ecological, social and economic issues experienced by both women and men fish farmers (Walker and Robinson 2009; Krause et al 2015; Thorpe et al 2015). Integration of gender aspects in fisheries and aquaculture policy in an important and timely component in developing a more holistic understanding of these sectors in the light of global interest to support food security, income generation and livelihoods.

6.1.1 Gaps in Understanding the Role of Gender in Aquaculture

A gap in understanding gender patterns in fisheries and aquaculture has been widely reported in the literature (FAO 2009; FAO 2014) which limits our accurate understanding of how these sectors function (Geheb et al. 2008; Kleibler et al 2015; Harper et al 2013; Williams et al. 2012c; FAO 2014; HLPE 2014). Moreover, although a gender perspective comprises the understanding of both men and women, the role of women in fisheries and aquaculture has traditionally been overlooked and neglected in policy discourses (Williams et al. 2012c; FAO 2014; HLPE 2014). As highlighted by Williams and colleagues (2012a) “gender roles and contributions need to be understood within their context and characterized with respect to economic, social and individual assets and people’s needs”. Questions pertaining to the contribution of men and women within the aquaculture sector, differences in the distribution of socio-economic returns as well as constraints to participation, to name but a few, are poorly understood and warrant deeper assessment, particularly in the context of SSA. Characterization of gender aspects within fisheries and aquaculture presents special methodological and policy uptake challenges (Harper et al 2013; Kleiber et al 2014; Bene et al 2016; Cooke et al 2016). Although a range of qualitative and quantitative methods have been applied in fisheries and aquaculture research, more flexible and creative tools have been called for to a) capture the complexity of context specific factors, including gender (Harper et al 2013; Kleiber et al 2014; Bene et al 2016; Bennett 2016); b) produce policy relevant results (Wiber et al 2004; Bene et al 2016); and c) to integrate the views and realities of fishers and fish farmers within the management process (Jacobson et al 2011; Krause et al 2015; Bennett 2016; Youn et al, 2016). Recognition for the value of qualitative methods in fisheries research has recently emerged due to its usefulness in adding richness, depth, connectivity and participatory processes to knowledge produced (Chambers 1992; Pretty et al. 1995; Schreckenberg et al. 2010; Bennett 2016; Barlcay et al 2016; Morgan et al 2016; Simmance et al 2016). One participatory method- Photovoice- has increasingly been used in natural resource management literature as a means to capture people's perspectives and empower marginalized groups, but has had little adoption in fisheries research and no known application to the context of aquaculture within developing countries to date. Overall, this chapter aims to address these information gaps by applying a modified Photovoice method, applicable to the context of small-scale fisheries, to elicit and portray the unique perspectives and lived experiences of men and women engaged in aquaculture in Malawi through imagery and narratives.

6.2 Chapter Aims

This chapter aims to investigate the following research objectives and questions:

Research Objective: To identify gender roles as well as the constraints and benefits associated with aquaculture through the perceptions of women and men fish farmers.

Research question 1: What roles do male and female fish farmers partake in with regards to aquaculture?

Research question 2: What benefits are received by male and female fish farmers from aquaculture?

Research question 3: What challenges are experienced by male and female fish farmers with regards to their participation in aquaculture?

Contribution: This chapter aims to contribute to the methodological literature and to provide new information concerning gender characteristics in the context of small-scale aquaculture and its role to food security and nutrition in Malawi.

6.3 Research Method and Data Collection

As detailed in chapter 4 of this thesis, the Community-Based Participatory Research method Photovoice was chosen as the most suitable method to achieve the objectives of this chapter. The reported benefits of using Photovoice above and beyond that received from standard interviewing techniques (Kong et al, 2015) as well as its ability to make community needs more visible through the empowerment of participants serves great promise in applying the tool to investigate gender dimensions in diverse small-scale fisheries contexts. Furthermore, through the facilitation of social action and policy orientated outputs, the Photovoice process can address the emerging need for policy relevant data in fisheries and aquaculture research (Wiber et al 2009; Krause et al 2015). Given Photovoice' s success within the natural resource management literature, the tool was therefore deemed highly appropriate to meet the aims of this chapter as well as to contribute to the underutilised application of creative participatory methods within small-scale fisheries research. Taken into account these modifications and steps suggested by other studies (Castleden et al. 2008; Bennett and Deardon 2013), an improved eight step Photo-Voice process was developed for this study as described below in Section 4 of this thesis and presented in Simmance et al (2016). This section provides further details concerning the employed data collection protocols of Photovoice and analysis of data obtained.

6.3.1 Data Collection

A modified Photovoice process, as described in chapter 4, was implemented within two fish farming communities- Malundu and Makawa – in the southern district of Zomba, Malawi. Given the underreported nature of small-scale inland aquaculture and resulting knowledge gaps in understanding how men and especially women are involved in aquaculture, this chapter focuses on illuminating fish farming as a livelihood in Malawi. Data collection was carried out over a three-month period from mid-May to mid-August 2015 which coincided with the dry season in Malawi. This time period was deemed appropriate given the known success of studies with similar duration (Catalani and Minkler 2010; Bennett and Deardon, 2013), an appreciation of work and household demands which may influence the quality of participant engagement as well as budget considerations. Furthermore, it was hoped that prolonged emersion in the field would facilitate the development of trust and relations within the two case study communities. The data collection process followed guidelines as detailed in the field manual (Appendix E) and described below.

Research Planning & Community Connection

Firstly, prior to the commencement of field work, a lengthy period of planning was carried out with support from local collaborators and included: obtainment of ethical approval from local and in-country institutions, obtainment of field budget, purchasing of all equipment and materials, and planning of all logistical arrangements within the set data collection timeline. In addition, a research assistant was recruited to facilitate the delivery of the project in the local language Chichewa. A two-day training session was organised prior to data collection activities which included: translation of the field manual into Chichewa (appendix E), ethical considerations with implementation of Photovoice and several role plays of the Photovoice process. Secondly, sufficient time was allocated to build trusting relationships with community members through obtaining permissions from village Chiefs, regular face-to-face communication as well as transparency in reporting the aims, expectations and timeline of the research within both study locations. Furthermore, working closely with local experts at WorldFish also helped to build working relations throughout the Photovoice process and support sustained communication within both study sites.

Participant Recruitment and Training

At the third step in the process, recruitment and training of participants was conducted separately within both communities. The Photovoice process was conducted with a total 14 participants, 7 respectively from each of the two study sites. Further details regarding the rationale of sample size and participant recruitment can be found in section 5.3.1 below. Once participants had agreed to participate in the study, a group training session was held in a communal and comfortable location within each study site. The training session was conducted over a 2-3 hour period and comprised the following elements: a) research aims, timeline and benefits of participation; b) ethical considerations in research using photography; c) safety concerns; d) technical instructions regarding how to use the disposable cameras; and e) details of the camera assignment. Informed consent was obtained from all participants, verbally via use of a Dictaphone or in writing, during the training session. A Photovoice log-sheet detailing participant demographic and fish farming information was recorded at the beginning of the session (see Appendix F). The training session was led by the lead researcher and facilitated by a research translator who translated all instructions from English into the local Chichewa language. Notes were taken throughout the session to capture group dynamic information as well as key messages arising from participants. For this study, the use of low cost disposable cameras with a cap of 27 images was selected as the preferred camera instrument due to ethical, accessibility, technical and budget considerations. Given that participants were inexperienced in using cameras, special attention and time was given to train participants on how to use the disposable cameras. At the end of the training session, each participant was given a camera with a unique tag ID for data ownership control.

Photography Assignment

Fourthly, each participant was asked to carry out the photography assignment over a 1 week period, commencing with the collection of all cameras. This timeline was deemed sufficient due to the following reasons: a) to allow participants enough time to capture their experiences of fish farming whilst not impeding on other daily chores; and b) to allow adequate time for participants to recall the aims of the task. During the photography assignment, participants were asked to take pictures of what for them best represented attitudes, perceptions and practices in accordance with the following three questions: 1) What activities do you carry out in relation to fish farming? 2) What benefits do you receive from fish farming? 3) What challenges do you experience in fish farming? During the 1 week period, face-to-face check-in on participants was made on a pre agreed date to ensure that: a) the task was being carried out as planned; and b) any challenges experienced were addressed (e.g. damage or theft). In addition, one participant from each Photo-Voice group who showed good skills in using the cameras during the training session was chosen to act as a 'helper' to others during the photography assignment. After the 1 week period, the cameras were collected on a pre agreed date and the photographs developed in a local photography store.

Discussion of Photographs through Individual Interviews (Narrative Building)

Fifth, after printing the photographs, in-depth individual interviews were conducted with all participants to learn the narratives behind photographs. Interviews were carried out at a convenient date and comfortable location suggested by participants. Individual interviews ranged from 1.5-2.5 hours in length and began with participant led categorisation of photographs (according to activities, benefits, challenges), followed by the selection of important photographs and subsequent discussion of each image. Participant led selection of photographs is an important step in the Photovoice process as it facilitates rich insights into prioritised issues and aids data analysis (Berbes-Blazquez 2012; Benett and Deardon 2013). A code (participant ID and photograph number) was written on the back of each photograph to aid data recording during the participant led selection of photographs. A variety of techniques can be used to elicit responses to photographs and to build narratives associated with the images selected by participants in a Photovoice study (Palibrodo et al. 2009). Within this study, a modified version of Wang and others (1998) mnemonic SHOWED line of questioning (pg.80) was used as follows: What's in the picture? Why did you take the picture? Why did you select this picture over the others? What would they like to tell to others with this picture? Why would it be important to give this message to others? Is there any other information you were unable to capture during the exercise that you would like to share in relation to this question? These questions were repeated for each selected image within the three categories (activities, benefits, challenges). Notes were taken throughout the discussion and all interviews were recorded with permission via use of a Dictaphone to aid analysis.

Group Discussion for Verification and Evaluation

Finally, a group interview was held within both study communities. All participants, except one male participant from Malundu, completed this final group session. The aims of the final group session were to: a) share narratives and verify key messages captured during individual interviews; b) discuss outcomes of the project and dissemination activities; and c) capture group perspective on the Photovoice experience. The group interviews lasted between 2-3hours and were recorded with permission via use of a Dictaphone. A copy of all pre-selected photographs was printed for each participant and the associated captions documented to facilitate discussions. The group interview was led by the researcher and facilitated by a translator assistant. To begin with, all photographs were spread onto a large mat in the middle of the group so that each participant could share their experience and verify key messages effectively. After verification and sharing of narratives, a group discussion about desired outcomes and dissemination activities was made, followed by a final reflection on the Photovoice exercise. Discussions were guided by semi-structured questions as detailed in the field manual (see Appendix E). At the end of the group session, participants were provided with refreshments as a token for their time and were thanked for their participation in the study.

6.3.2 Sample Size & Participant Recruitment

The Photovoice process was conducted with a total 14 participants from the two study sites- 7 from Malundu village and 7 from Makawa village – between June to August, 2015. The sample size was deemed adequate to generate rich data based on recommended sample sizes by Wang and other (1999) as well as other studies which have had success with groups of this size (Hergenrather et al 2009). Participants were recruited using a combination of purposive and snowball sampling (Bradshaw and Straford 2010). Purposive sampling is a form of non-probability sampling that allows for the selection of individuals based upon a variety of criteria determined by the research study of interest. Snowball sampling is a non-probability sampling process that is used to identify research subjects through an initial contact who is used to suggest possible participants for the study. Both techniques have been used in similar studies to contribute depth and relevance to a research interest as well as to overcome obstacles in sampling concealed populations (Neuman 2000; Hergenrather et al 2009). Meetings with key informants from both study sites were held on arrival to identify relevant fish farmers within the community. From these meetings, one to two men were initially identified as key gate-keepers based on their involvement in fish farming and were used to facilitate recruitment of participants within this study. Participants were selected based on the following criterion: a) actively involved in fish farming over the past year (defined as being engaged in fish farming either full time, part time, seasonally over the past 12 months); b) resident in the village of study; c) representative of various age groups; and d) specified target gender (three males; four females within both study communities). Within each community, 4 female and 3 male participants were recruited. More females were recruited in contrast to male participants per village in order to deepen our understanding of this under-reported and neglected group in fisheries and aquaculture research (Weeratunge et al. 2010; Williams 2010; HLPE 2014).

6.3.3 Data Analysis & Management

Interview data obtained from individual and group discussions were transcribed verbatim with permission by a translator assistant whilst in the field. All Photovoice data (interview transcripts and photographs) were stored electronically whilst in the field and photographs were re-printed to CDs on return to the UK. Analysis of data followed the commonly used three staged process of participatory analysis as recommended by Wang et al (1998) detailed as follows:

1. **Selecting photographs for discussion:** Participant led selection of photographs was carried out during individual interviews which enabled participants to take ownership and define the scope of discussions.
2. **Contextualizing and storytelling:** Individual interviews were carried out to enable participants to critically reflect on images and develop associated narratives.
3. **Codifying issues, themes or theories:** Photovoice requires a framework in which different meanings can be identified from a single photo. This stage of analysis was led by the researcher and involved an iterative process of deductive and inductive coding to identify issues and themes from interview transcripts. Detailed and clear code definitions were developed and cross checking of transcripts was made to ensure accuracy and quality. Iterative coding resulted in a series of common issues from which themes and sub-themes were identified both within and across participant transcripts from the two study sites. Photographs were then linked to participant descriptions to aid interpretation (as presented in the results section). All identified themes were investigated and refined over a continuous process of cross checking to minimize errors of omission and ensure rigour throughout the analysis process.

Documented notes were also used to aid interpretation of findings. This three stage process is based on the principles of Photovoice as it promotes Freire's (1970) concept of critical consciousness through participant critical reflection and dialogue (Wang and Burris, 1994). Transcript data was analysed in a similar way to other qualitative data, via codifying, and exploring, formulating, and interpreting themes.

6.4 Results

Along with a discussion of the emerging themes identified from participant narratives, this section reports on the results from the analysis of transcriptions and presents the accompanying photographs selected by participants. This section first begins by presenting an overview of participant information, followed by presentation of the results. Participant coding is used throughout to ensure anonymity.

6.4.1 Demographic & Fish Farming Characteristics

A summary of the demographic and fish farming profiles of all 14 participants recruited from two fish farming communities can be found in table 6.1 below. Within each study site, four females and three males were selected in order to capture similarities and differences in perspectives between gender groups. The average age of all participants was 42 years and ranged between 20-75 years of age. The length of time (in years) participants had been engaged in fish farming varied between the two study sites as a result of when aquaculture was first introduced within their respected communities. The role of participants in fish farming also varied between the two study sites as a result of differences in the form of aquaculture development adopted. In Malundu, aquaculture development was introduced with outsider assistance and thereby can be classified as an interventionist approach. As a result, the majority of participants reported to be engaged in fish farming as pond owners. In contrast, fish farming in Makawa has adopted the 'immanent' approach to aquaculture development whereby a fish pond was constructed on demand by community members and without external assistance. As a result, participants from Makawa reported being involved in a wider range of roles.

6.4.2 Photographs

Of all the photographs taken (n=317), 88% were relevant for the Photovoice process (see table 6.2). This was a result of a few photographs being taken for personal keep by participants (as experienced in other studies e.g. Hergenrather et al 2009) as well as the need to discard some photographs due to poor quality, possibly due to the participant's inexperience with using the camera. Of the photographs discussed, more than half of all photographs represented the topic of activities, less than a third represented the topic of benefits, and finally, less than a fifth represented the topic of challenges (see figure 6.2).

6.4.3 Themes- Scope and Focus

A total number of 8 major sub-themes were identified through the analysis of transcripts. The sub-themes were grouped according to three broad themes: 1) activities; 2) livelihood outcomes; and 3) constraints to the sustainability of fish farmer livelihoods (see table 6.3). The results of the Photovoice process for each of the three themes and associated sub-themes are presented in depth below with use of photographs and verbatim quotes.

Table 6-1 Summary description of participants.

	Participant's Code*	Age (years)	Gender (Male/Female)	Length of involvement in fish farming (years)	Role in Fish Farming
Study Site A: Makawa	MK_P1	41	M	3	Manager
	MK_P2	42	F	2	Feeding
	MK_P3	24	F	2	Feeding and Maintaining Pond
	MK_P4	45	M	3	Technical advisor, marketing personal
	MK_P5	20	F	2	Maintaining Pond
	MK_P6	64	M	2	Supervises the feeding
	MK_P7	45	F	2	Feeding and Maintaining Pond
Study Site B: Malundu	ML_P1	43	M	12	Pond Owner
	ML_P2	75	F	14	Pond Owner
	ML_P3	56	F	4	Temporary Pond Owner (Manager)
	ML_P4	29	M	14	Maintaining Pond
	ML_P5	33	M	0.2 (3months)	Pond Owner
	ML_P6	30	F	14	Pond Owner
	ML_P7	42	F	14	Pond Owner

*Participant code is used to ensure anonymity of participants. MK= Makawa Village; ML= Malundu Village.

Table 6-2 Total number of photographs taken, discussed and selected by participants.

Study Site	Total Taken	Relevant* Taken	Discussed	Selected
A: Makawa	133	107	60	17
B: Malundu	184	174	87	25
Total:	317	281	147	42

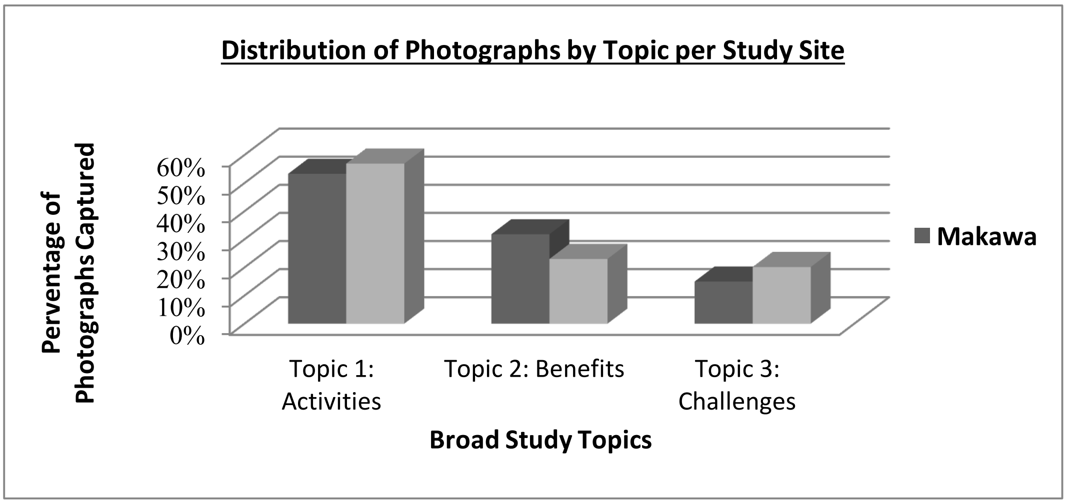

Figure 6-1 Distribution of broad topic categories captured in photographs according to 1) Activities; 2) Benefits; 3) Challenges for the two study sites.

Table 6-3 Explanation of the themes and sub-themes identified.

Theme	Sub-Themes	Definition
1. Activities	1.1. Maintenance & Pond Inputs	Feeding of fish, removing of grasses, water maintenance such as clearing of water channels as well as fertilisation activities that a participant carries out.
	1.2. Safeguarding & Pond Outputs	Guarding of fish at the pond site, harvesting of fish and water management activities that a participant carries out.
2. Livelihood Outcomes	2.1. Increased income and asset wealth	Direct and indirect financial benefits that a participant reports from fish farming such as increased income and purchasing power. Benefits may be received at the individual, household and community level.
	2.2. Improved Food and Nutritional Security	Direct and indirect food and nutritional benefits that a participant reports from fish farming such as direct self-consumption of fish, indirect selling of fish for cash for purchasing other food items and health benefits. Benefits may be received at the individual, household and community level.
	2.3. Improved Well Being	Other non-material benefits such as improved wellbeing through enjoyment, pride and satisfaction from being involved in fish farming.
3. Constraints to the sustainability of fish farmer livelihoods	3.1. Constraints to Social Sustainability	A challenge, problem or concern that a participant faces in relation to social risks such as limited access to resources, lack of skilled knowledge and social cohesion challenges that affect fish farmer livelihoods.
	3.2. Constraints to Economic Sustainability	A challenge, problem or concern that a participant faces in relation to operational and financial risks such as market constraints, availability of input resources as well as quality standards that affect fish farmer livelihoods.
	3.3. Constraints to Environmental Sustainability	A challenge, problem or concern that a participant faces in relation to environmental risks of aquaculture and on aquaculture such as biological risks (e.g. predation), severe weather risks as well as resource availability, interactions and dependencies constraints that affect fish farmer livelihoods.

6.4.4 Theme: 1) Activities

Participants used photographs to capture a range of day to day activities associated with their livelihoods as fish farmer. From the discussions, participants more frequently discussed participating in seven major roles: feeding, grass removing, water maintenance, pond fertilisation, water irrigation, fish harvesting and guarding of fish. These major activities can be categorised into two sub-themes: 1) Maintenance and pond inputs; and 2) Safeguarding and pond outputs.

Theme 1.1) Maintenance and Pond Inputs

Theme 1.1, maintenance and pond inputs, draws upon feeding of fish, removing of grasses, water maintenance and fertilisation activities which were commonly reported to be major activities comprising fish farmer livelihood strategies (see representative photographs in figure 6.2). Out of these four activities discussed, feeding was the most frequently discussed activity among the majority of participants. Although both male and female participants discussed the role of feeding, the majority of participants were female and almost all the images captured depicted women carrying out the activity. This observation therefore highlights that the feeding of fish is mostly carried out by women. The majority of participants who discussed feeding clearly expressed the importance of this activity in relation to improving the success of fish farming. Both men and women discussed the importance of feeding in their day to day involvement in fish farming, however discussions on specific aspects of feeding such as ingredient composition, timing and scheduling differed by gender. For example, when discussing a photograph of a woman feeding fish at a pond, one male participant emphasized the importance of this activity in improving the quality and production of farmed fish:

“This image is able to provide a lot of insight into what fish farmers do at the fish pond…for fish farming to be successful there is a need to feed the fish at the fish pond… proper feeding of the fish is necessary in order to harvest good fish which is good in size and weight. A fish farmer should feed their fish properly in order to be successful”. (*Participant # MK_C4)*

Further, another male participant added that the importance of feeding was attributed to the improved quality and subsequent marketability of farmed fish:

“This picture shows that when one feeds fish very well then the fish will grow up very well, they are healthy and when you go to the market everyone is attracted to buy them… others should make sure that fish are taken care of every day”. (*Participant # ML_C1)*

Similarly, female participants emphasized the importance of feeding in relation to the success of fish farming and increased production, for example:

“This is a key task in fish farming and as long as one wants to be successful in fish farming then they need to feed the fish on an everyday basis”. *(Participant # MK_C2)*

When participants described the role of feeding fish, participants more frequently discussed ingredient composition, timing and scheduling of feeding as well as the practice of feeding. It was not surprising to find that most participants identified locally available maize bran as the primary source of feed ingredient along with the occasional addition of nsima, for example:

“I want others to do the same… to take two cups of maize bran every day, one in the morning and one in the afternoon, including the use of the layer of nsima as part of the ingredients”.
Participant# ML_C6).

However, it was interesting to learn that only male participants commonly spoke of the need to use a range of other ingredients in feed, for example:

“First of all people have to take into account the advice that advisors have given them with respect to fish farming. The basic feed for fish is maize bran which is locally available and you can also feed them with other ingredients like vegetables”. (Participant# MK_C4).

Another male participant added:

“One should make sure they feed their fish properly. If one can manage they can add other things to the maize bran as these will also help the fish to grow well”. *(Participant# MK_C1).*

In contrast, one female participant stated that she used only maize bran for the feed ingredient:

“We use maize bran to feed our fish and not any other ingredients”. *(Participant# MK_C5).*

Both male and female participants commonly described the timing of feeding fish as being twice or three times a day. Interestingly, differences in timing occurred between study sites. In Makawa, participants reported feeding their fish twice a day via scheduling roles as a group, for example:

“We feed fish twice a day- in the morning and in the evening. Since it is a group fish pond then one person will go in the morning and another in the afternoon to feed the fish. *(Participant# MK_C5).*

Whereas in Malundu, participants reported feeding their fish 3 times a day, for example one male participant stated that feeding occurs “usually three times a day- morning, afternoon and late afternoon”. *(Participant #ML_C1).* Further, a female participant added:

“Fish has to be fed on a daily basis- two times a day one should use maize bran and in the middle of the day one should use the remaining layer of nsima to feed the fish. *(Participant #ML_C6).*

The majority of respondents, and as captured in accompanying photographs, reported the typical feeding method of simply broadcasting maize bran very closely over a pond’s water surface. It was interesting to learn how one female participant described a practice by which the community adopts when feeding the fish at the pond site:

“There is another reason why I captured this image which is meant to show another scenario whereby on arrival at the pond first of all we clap our hands so that the fish come to the top surface and that is when we start to spray the maize bran in the pond”. *(Participant# MK_C5).*

It was interesting to learn that female participants commonly highlighted their contentment and sense of pride with being able to partake in fish farming via the feeding of fish, for example:

“ What we are doing there is very exciting as we are feeding our fish maize bran…I am very happy to see myself being involved in fish farming especially that I and my other fellow fish farmers feed our fish in the village”. *(Participant# MK_C7).*

The second major activity commonly discussed by participants was the role of removing grass around and within fish ponds. Both male and female participants reported to carry out this activity, including with assistance from family members such as grandchildren, within both study sites. From their discussions of images, the majority of participants clearly described that the removing of grasses involved a lot of physical labour with one participant highlighting the need to involve two persons:

“As a way of taking care of fish ponds, fellow fish farmers should know that when one is slashing grasses there must be another person to collect the grass which has been slashed to ensure that the grass that has been slashed does not go into the fish pond” *(Participant# MK_C6).*

The majority of participants also emphasized the importance of carrying out the removal of grasses in order to safeguard fish, enhance the effectiveness of harvesting and to keep the pond tidy. For example, one male participant described the need to remove grasses effectively in order to ensure fish are kept in good health:

“People who have fish ponds should make sure that they properly take care of their fish ponds as much as they can. Once the grass is growing in the fish ponds they should make sure that they remove them so that the fish is no longer hindered by these grasses growing all over the fish pond.

The grasses should be removed every time they are seen to have grown to ensure the fish are well maintained" *(Participant# MK_C6).*

Similarly, one female participant emphasized the importance of removing grasses to ensure a fuller harvest of fish can be achieved:

"Apart from the fact that the fish pond has to be clean and smart it is also necessary when you come to harvest the fish because if you have grass deep down in the fish pond then when you come to harvest the net won't be able to go down. Once you remove the grass then the net will be able to go down in the pond and you will be able to catch all the fish not just the fish at the top of the pond *(Participant# ML_C7).*

It was surprising to learn that some participants from the Malundu site only reported to carry out the role of water maintenance. The majority of these participants were male indicating a possible division of labour with regards to maintaining water channels around the ponds. For example, one male participant described a man clearing water channels with the use of a hoe in order to sustain an adequate supply of water into ones fish pond:

"There is a man with a hoe in his hands which is used to clear the water channels which passes water into the fish ponds… it is a key activity which a fish farmer has to undertake to ensure their fish pond is well kept". *(Participant #ML_C5).*

The majority of participants hinted at the difficulty of securing an adequate source of water for their ponds and thus emphasized the important role of maintaining water channels in trying to overcome this challenge, for example:

"I selected this image because it shows one of the tasks that a fish farmer has to undertake and it is also partly showing one of the problems that fish farmers are facing- water availability. There was a water problem with respect to this fish pond as it was difficult for the water to reach this pond so the owner decided to find a way of ensuring that some water gets inside the fish pond so he had to clear the channels so that much water can pass into the fish pond" (*Participant# ML_C5).*

Similarly, others mentioned the importance of maintaining water channels in order to improve the production of their ponds, as this male participant mentioned:

"On the picture is a fish pond which is filled very well with water. I took that picture in order for others to take lesson that a fish pond need to have clean water and filled up to the required level. By doing that we are letting others know that fish ponds need to have clean water and be filled so that fish can grow to a good size and be tasty" *(Participant# ML_C4).*

It was surprising to note that only one female participant discussed the involvement and importance of applying manure to one's fish pond…

"It is important for others to appreciate the importance of applying manure into ones fish pond. I want others to appreciate that when no manure is applied into the fish pond then the water is not green and birds come to predate the fish so when one goes to harvest there will be only a small amount of fish…. It is not that big of a problem for me because I apply manure" *(Participant# ML_C6).*

Theme 1.2) Safeguarding and Pond Outputs.

Theme 1.2, safeguarding and pond outputs, draws upon guarding of fish at the pond site, harvesting of fish as well as the acquisition of water from the pond for irrigation activities comprising fish farmer livelihood strategies (see representative photographs in figure 5.2). While only a few participants reported the roles of water irrigation, fish harvesting and guarding, it was interesting to note that all these participants were male, indicating a gendered division of labour. Surprisingly, only one participant mentioned harvesting as well as the use of pond water for irrigation purposes, and both were reported only at the study site Malundu. One participant described several ways of harvesting fish via the use of fishing net, basket or pole and line. For example, the participant described in detail the process of using fishing nets to harvest farmed fish from the pond:

"You spread the fish net along the width of the fish pond with the help of 3 people. There are usually 3 men and you spread the net along the width of the pond. One man stands in one corner, the other in the other corner and one in the middle. The man in the middle tries to squeeze down the net and when they see they have caught a considerable amount of fish then they bring the net in and harvest the fish" *(Participant# ML_C5).*

Further, in reference to the photograph (figure 5.2d), the participant highlighted the advantage of using fishing nets as the preferred method for harvesting above other methods:

"I would recommend using fish nets to harvest fish because you can harvest a lot of fish and you can also use this method to transfer fish from one pond to another and you cannot harm the fish by using this method. Using the pole and line method you may harm the fish but by using nets you do not harm the fish" *(Participant# ML_C5).*

One participant captured the image of sugar cane (figure 5.2f) to highlight and characterise the role of water irrigation. The participant reported using water from his fish pond to irrigate crops and highlighted the importance of integrated agriculture aquaculture systems in supporting household food security:

"We should make sure that we manage the water because we use water in a number of ways- it is used for growing food and other things so we must ensure that we manage water as much as we can… I want others to take a lesson that when you use water in your fish pond you don't have to just throw the water away but instead you should think of taking the same water and using it for other agriculture practices like watering of sugar cane" *(Participant# ML_C4).*

Further, it was surprising to learn that the participant reported the practice of water irrigation as being uncommon within his community: "It is not common… many fish farmers have not realised that you can do this process" *(Participant# ML_C4).*

Guarding of fish was reported at both study sites, thus indicating the common risk of theft of fish within fish farming communities. Interestingly, the few participants that reported carrying out the guarding of fish described the role as an exclusive male activity and one that presented a challenge in the management of guarding responsibilities:

"At first we use to have a committee and that committee use to allocate 3 fishermen who would have to be on guard on a particular night and they would give turns to each other every day… that was a few years ago but now the committee has stopped" *(Participant# ML_C5).*

Another participant from Makawa commented on his photo (figure 5.2e) and emphasized the importance of guarding fish at the pond site to be successful at fish farming:

"Fish farming is very good and important but there is a need for fish farmers to consider being on guard right at the fish pond guarding their fish as a way of managing their fish…. it is showing very well that for one to realise good benefits from fish farming then one has to ensure there is security as the fish pond" *(Participant# MK_C4).*

Figure 6-2 An overview of representative photographs captured under themes 1.1. Maintenance & Pond Inputs and 1.2. Safeguarding & Pond Outputs. *From top left clockwise; a) A women broadcastig maize bran into the fish pond (Participant# MK_C3); b) a man and a women jointly removing grass from around the fish pond (Participant# MK_C1); c) a woman and her granddaugther clearing the water channels around her pond (Participant# ML_C1); d) Two men harvesting some fish from their pond using a beach seine net (Participant# ML_C5); e) two men preparing to be on guard at night at the fish pond (Participant# MK_C4); f) some sugar cane which were grown from re-using water in the fish pond (Participant# ML_C4).*

6.4.5 Theme: 2) Livelihood Outcomes

In relation to livelihood outcomes obtained from fish farming, three major themes emerged from the Photovoice process: 1) Increased income and asset wealth; and 2) Improved Food and Nutritional Security; and 3) Improved Well Being. These sub-themes draw upon the most frequently raised livelihood outcomes that were discussed by participants which include: direct fish consumption, income, asset obtainment, increased purchasing power as well as wider personal benefits. Together these livelihood outcomes reveal a variety of positive social and economic benefits obtained from aquaculture, particularly the direct and indirect pathways by which aquaculture contributes to improved food security. The results of these themes are presented below with the use of verbatim quotes to illustrate the words of the participants as well as accompanying photographs (see figures 6.3).

Theme 2.1) Increased income and asset wealth

Theme 2.1, Increased income and asset wealth, draws upon the direct financial benefits of cash income from fish farming as well as indirect benefits such as the purchasing of assets and providing a safety net for livelihoods. Half of all participants from both study sites reported income and asset benefits (see representative photographs in figure 6.3), revealing the importance of fish farming as a cash crop. Differences in relation to the beneficiaries of the reported financial benefits occurred between study sites. Within Makawa, participants commonly reported that income and asset benefits received from fish farming were distributed to the community group, as mentioned by this female participant:

"The fish is from right at the fish pond because sometimes people come to buy straight from the pond when the fish are harvested… the picture shows very well some of the benefits from fish farming…. somebody had come to buy the fish so this is the fish that some people came to buy from the group and the money now belongs to the group. The fish will be consumed by the buyers and the group obtained money from the fish" *(Participant# MK_C5).*

The majority of participants from Makawa expressed pride in supporting the most vulnerable members of their community with benefits received from fish farming. In contrast, participants from Malundu reported income and asset benefits which were distributed for individual and household gain. Distinct gender differences emerged with regards to the reporting of financial benefits. The majority of participants reporting income and asset benefits were female who more frequently mentioned various assets obtained from cash income generated through fish farming as all as the ability to support children's education. Assets reported included a bicycle, clothing and plates for personal or household use as well as school uniform for other vulnerable orphaned children within the community. For example, one female participant from Makawa commented on her photograph (figure 6..3f) and described the benefit of purchasing school uniform for orphans within the village from income obtained from fish farming:

"When we had harvested the fish for the first time we brought school uniforms from the first money we had earned from selling the fish…we benefited from fish farming as we were able to buy some pieces of clothes and were able to take them to the tailor to make school uniforms for orphans in the village. In this case the young boy had lost his parents and was staying with his grandparents. Through the harvesting of fish we were able to do something for the orphans in the village like the boy shown in the picture" *(Participant# MK_C2).*

Further, the participant added that as a result of providing school uniform from the money earned from fish farming, children increased attendance at school:

"When we had finally harvested the fish and gave money to the Gogos they did not think of using the money for their own personal needs but they considered to help the orphans so they decided to buy some school uniforms for them because some did not go to school because they did not have any uniform because they were staying with grandparents who were too old to do any work to support them. Now the children are able to go to school again" *(Participant# MK_C2).*

Another female participant emphasized the value of partaking in fish farming in providing a safety net for her household in times of hardship:

"It is very important because sometimes when I have financial problems I just go the pond and do partial harvesting to get money and also I will go to the pond for food… with this picture others will be able to appreciate that from fish farming I am able to earn money and get food" *(Participant# ML_C6).*

In contrast, the few male participants more commonly mentioned the benefit of receiving cash as income for the purchasing of school uniform and supporting livelihoods, for example:

"We agreed we should take some money and use it to see how we could help people – those orphans, elderly and with HIV/AIDS- in the village… as a group we wanted to full fill what we agreed and this photo shows our success in being able to purchase school uniform from fish farming… whenever people are involved in fish farming they should consider using the benefits to assist the vulnerable and other people in their community rather than using the benefits for themselves and their households" *(Participant# MK_C1).*

Theme 2.2) Improved Food and Nutritional Security

Theme 2.2, Improved Food and Nutritional Security, draws upon the direct and indirect benefits of fish farming for improved food and nutritional security at the household and community levels. Over half of all participants from both study sites reported food and nutritional benefits arising from their involvement in fish farming (see representative photographs in figure 5.3). However, differences between gender groups and sites occurred with respect to specific reported benefits obtained which include: direct fish consumption, indirect benefits from income and reuse of pond water as well as nutritional benefits. The majority of all participants, both male and female, that reported food and nutritional benefits most frequently discussed the improved availability and access of fish for direct consumption, as mentioned by this male participant from Malundu:

“I chose this photo because one can see that from fish farming one can get food for their relish” *(Participant# ML_C4).*

Similarly, a female participant from Makawa described the direct benefit of improved access to fish for food consumption from her involvement in fish farming:

“The picture is showing very well that the people here in the village are engaged in fish farming and so people will have the opportunity to buy some fish from their own fish pond and have a taste of the Chambo” *(Participant# MK_C5).*

Although no gender differences emerged with regards to the reporting of the direct consumption of fish, differences between study sites exist. The majority of participants that discussed improved direct consumption of fish were from Malundu. This observation suggests that the importance and value of fish is more commonly attributed as a ‘food crop’ for home consumption in Malundu in comparison with Makawa where participants more commonly mentioned the importance of fish as a ‘cash crop’ to benefit the community. Interestingly, only one female participant commented on her photograph (figure 6.3d) and highlighted that through her involvement in fish farming she was able to benefit both directly from improved fish consumption as well as indirectly from purchases of other animal protein:

“The picture is showing the benefits of fish farming because I had relish for the day… I went to the fish pond, harvested some fish and used it for the relish that day. Also I use money earned from fish farming to buy other meats for relish sometimes” *(Participant# ML_C7).*

It was interesting to note that only a few male participants raised awareness of the nutritious value of farmed fish, for example:

"I would encourage others to join fish farming because they will be able to eat good food like fish" *(Participant#ML_C4).*

Similarly, another male participant added:

"When I eat fish it is very delicious and I know that it is a good food to eat" *(Participant#ML_C3).*

Further, a few male and female participants emphasized their personal reasons for consuming fish, including preference of fish species. For example, one male respondent commented on his photograph (figure 5.3d) and highlighted contentment felt by a woman who had brought farmed fish…

"The woman is looking happy and is smiling as she is showing others that she has brought some fish. … the picture is showing very well that the people here in the village are engaged in fish farming and so people will have the opportunity to buy some fish from their own fish pond and have a taste of the chambo" *(Participant#MK_C4).*

Another female participant expressed pride in fish farming only Chambo as a preferred species:

"I would let others know that if they wanted to join their farming group or if they wanted to buy a fish from us then they should know that the fish that we are farming is chambo and no other species like mlamba" *(Participant#MK_C5).*

Surprisingly, one male respondent (as detailed in category 1 Activities) reported the indirect benefits to food security obtained from reusing pond water for irrigating vegetables:

"This would be a way of ensuring maximum use of resources in this case water because water in the fish ponds is used for watering other agricultural plants like sugar cane. I have also planted sweet potatoes which are watered from the water in the fish ponds" *(Participant#ML_C4).*

Interestingly, one female participant highlighted that fish farming can provide stability to securing food security via providing a direct source of food during times of food shortages and financial hardship:

"This is a message of encouragement to other fish farmers to make sure they feed the fish well to make sure they can get enough money as well as food for their household from fish farming…It is very important because sometimes when I have financial problems I just go the pond and do partial harvesting to get money and also I will go to the pond for food" *(Participant#ML_C6).*

Theme 2.3) Improved Well Being

Theme 2.3, Improved Well-Being, draws upon wider non-material benefits received from fish farming which included enjoyment and pride as experienced by participants as well as the relative ease of adoption of fish farming in comparison with other livelihood options. Over half of all participants, both men and women, attributed great pride to partaking in fish farming which was often expressed within their discussions of images captured. For example, one female participant was very proud to share her experience of partaking in fish farming with the aspiration for others to be encouraged to follow suit:

"This will be important to tell others because others would be glad to hear that we are clearing the fish pond and upon seeing the photo and learning that we are preparing the pond to be filled with water again then others will be encouraged to do the same" *(Participant# ML_C3).*

Interestingly, a few female only participants emphasized contentment from being involved in fish farming from both study sites, as this woman mentioned:

"What we are doing there is very exciting as we are feeding our fish maize bran… I am very happy to see myself being involved in fish farming especially to know that I and my other fellow fish farmers feed our fish in the village" *(Participant# MK_C7).*

Finally, it was interesting to note that one male participant mentioned the ease by which people can become involved in fish farming as a core benefit in his decision to partake in fish farming in comparison to other livelihood options:

"It is very important to engage in fish farming for one to earn money rather than doing other manual work like working in somebody's garden but it is better to work in fish farming as it is easier" *(Participant# ML_C1).*

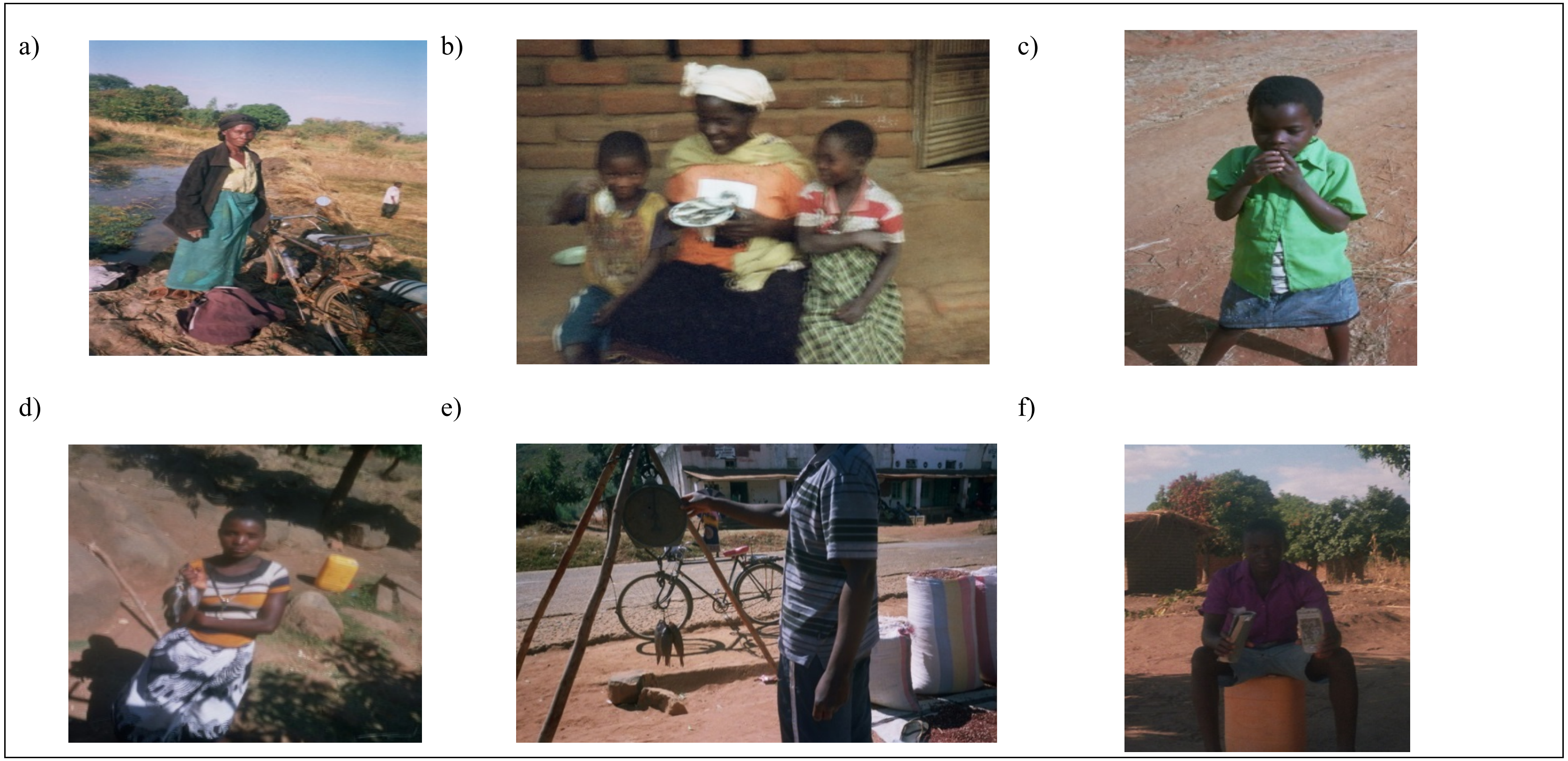

Figure 6-3 An overview of representative photographs captured under theme 2.1. Improved income and asset wealth; & 2.2. Improved Food and Nutritional Security.

From top left clockwise; a) A women with a bicycle (Participant# ML_C2); b) a women with her two children showing 1) fish for food; 2) income from selling of fish used to purchase clothing (Participant# ML_C7); c) an orphaned girl wearing school uniform purchased by income from fish farming (Participant# MK_C1); d) A women holding farmed fish in her hands to be used for self consumption (Participant# MK_C4); e) fish being weighed on scale ready to be purchased by consumer; and sold for income (Participant# Ml_C6); f) an orphaned boy wearing school uniform provided to him by the community by money earned from fish farming (Participant# MK_C2).

6.4.6 Theme: 3) Constraints to the Sustainability of Fish Farmer Livelihoods

Through analysis of interview transcripts and accompanying photographs, three major themes emerged in response to participants' perspectives regarding perceived challenges experienced to fish farming: 1) Constraints to Social Sustainability; and 2) Constraints to Economic Sustainability; and 3) Constraints to Environmental Sustainability. These sub-themes draw upon the most frequently raised constraints to fish farmer livelihoods that were mentioned by the participants which include: resource conflicts, lack of technical knowledge and outsider support, access to markets and marketability issues, feed availability and affordability, biological challenges as well as water availability issues. The results of these themes are presented below with the use of verbatim quotes to illustrate the words of the participants as well as accompanying photographs (see figures 6.4, 6.5 and 6.6).

Theme 3.1) Constraints to Social Sustainability

Theme 3.1, Constraints to Social Sustainability, draws upon the social risks experienced by participants that affect the sustainability of their fish farmer livelihood which includes: equity and access to resource issues, lack of skilled knowledge as well as social cohesion challenges. Many participants from both study sites reported challenges to social sustainability of their involvement in fish farming (see representative photographs in figure 6.4). The majority of participants most often identified conflicts over resources as presenting significant challenges to the sustainability of fish farming. Interestingly, theft and water resource conflicts were exclusively reported by male participants from both study sites. For example, one male respondent from Malundu highlighted that theft of fish was a major concern and occurred frequently within the village:

"Theft is a very big problem and it seems to happen most days" *(Participant# ML_C5).*

Similarly, one male participant from Makawa commented on his photograph (figure 6.4a) that theft of fish was a major problem but that tactics recommended by stakeholders can be used to overcome this challenge:

"This is very important for others who are planning to get engaged in fish farming as they will need to be aware that one of the challenges they are likely to encounter is one of stealing…. It is a very big problem here in the community but there are some tactics that the fish farmers do to address the challenge. The tactics were advised by the fisheries department and they were told to use some pieces of timber and to peg some nails into the pieces of timber and then to peg it down on the bottom surface of the fish pond so that when the thieves come the nails will pierce them" *(Participant# MK_C4).*

Further, a few male participants from Malundu reported conflicts arising over accessibility challenges of water due to limited water availability, for example:

"Indeed there are conflicts arising from the water problem because when it dries up at the source everyone wants some so they block the water channel and stop it from going to other people's fish ponds so that the water mainly goes to their ponds… rules are there but some people choose not to follow them" *(Participant# ML_C5).*

This gender difference in reporting of social conflicts may be a result of gender divisions in labour, as reported in theme activities above, which revealed the exclusive role of men in partaking in guarding of fish as well as their predominant role in water maintenance activities. A lack of skilled knowledge was also raised as a challenge to the sustainability of fish farming by both male and female participants from Malundu. For example, one female participant commented on her photograph (figure 6d) that a lack of technical knowledge resulted in the poor construction of a fish pond and added that working as a group enabled them to re-build the pond correctly:

"In the chiefs pond there was no technical knowledge when constructing the pond so we came together and decided to drain the water to dig it to the same level…When fish farmers have problems they should come together and work out a solution together. In this respect the depth of the fish pond was not good and there was also too much grass. People should always work out a solution together" *(Participant# ML_C7).*

As mentioned in theme activities above, only one male participant reported carrying out water management practices via re-suing pond water to irrigate crops. The reported little adoption of this activity hints at the lack of technical know-how among fish farmers, as highlighted by this male participant in reflection of photograph (figure 6.4b):

"The message remains that fish farmers should consider reusing the water that they are using in their fish ponds for other things like watering other plants like sugar cane… it is not common… many fish farmers have not realised that you can do this process" *(Participant #ML_C4).*

It was surprisingly to learn that one male participant from Malundu expressed distrust with an organisation and raised the issue of lack of outsider support in helping fish famers to manage their ponds:

"Fish farming become massive here and many people entered into fish farming. What happened is that an organisation came here and told the committee that they were going to give us some fingerlings and that people should raise them. When the fish are matured they will then come and buy them from us. When people harvested we weighed them and everyone would be paid money with respect to the kg that each fish farmer harvested but they did not return until 6 months and only paid us half of the money they promised and not until 6 months later… it was like they stole our fish" *(Participant# ML_C5).*

Interestingly, one female participant raised the concern over the equitable distribution of benefits arising from fish farming. The participant from Makawa raised personal concerns over the expense of distributing benefits from fish farming to others instead of towards meeting her personal needs:

"Our desire is for well-wishers to assist us in constructing a bigger pond as our pond is small as we constructed it on our own. If we could have two ponds then we could harvest from both ponds and our group could realise a good amount of money out of which we can use some to assist the poor and vulnerable and perhaps the remaining money for ourselves. As much as we are assisting the poor and the vulnerable out of the money we are earning from fish farming we are also lacking" *(Participant# MK_C2).*

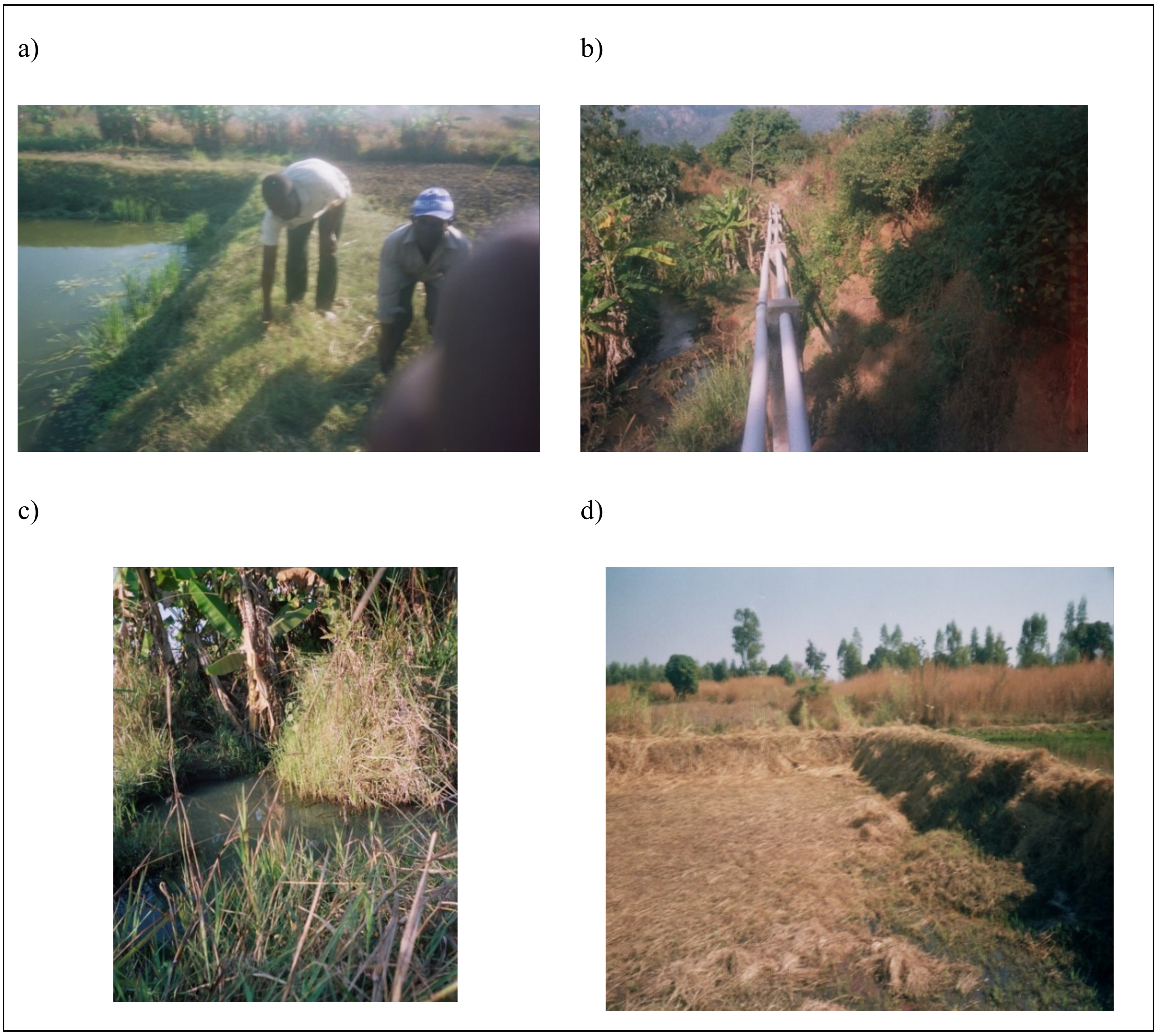

Figure 6-4 An overview of representative photographs captured under theme 3.1.Challenges to Social Sustainability. *From top left clockwise; a) two men preparing to be on guard at the fish pond site at night as a result of the high risk of theft of fish in the village (Participant# MK_C4); b) water pipes captured to highlight the need to be couragous in overcoming water conflicts (Participant# ML_C4); c) a picture capturing the lack of sufficient water availability in a fish pond which has led to social conflict (Participant# ML_C6); d) a poorly constructed pond as a result of the lack of technical knowledge (Participant# ML_C7).*

Theme 3.2) Constraints to Economic Sustainability

Theme 3.2, Constraints to Economic Sustainability, draws upon the operational and financial risks experienced by participants that affect the sustainability of their fish farmer livelihood. Just over a third of all participants, both men and women from both study sites, commonly reported challenges to the economic sustainability of fish farming which included: market constraints, lack of affordable feed and lack of tools and labour (see representative photographs in figure 6.5). Gender differences in the reporting of economic challenges occurred, with the majority of male participants reporting market constraints whereas women predominantly reported issues concerning lack of input resources. In relation to market constraints, a few participants from Makawa commonly reported issues concerning the lack of buyers, market competition and marketability (relating to knowledge and quality of fish). Of these participants, both women and men raised the concern regarding lack of buyers to purchase farmed fish within Makawa. For example, one male participant commented on his photograph (figure 6.5a) and highlighted concern over the lack of buyers to purchase farmed fish which may arise as a result of poor quality of farmed fish:

"The most likely challenge that one would face is the lack of buyers when you take the fish to the market… Apart from having to plan for transport, others should also ensure that they find out the situation at the market because if they go there with their fish and find out that there is somebody who has fish of higher quality than them it means that they will end up making losses as they won't be able to sell their fish" *(Participant# Mk_1).*

A few male participants from Makawa also highlighted that a lack of knowledge in identifying buyers prevented fish farmers from making greater financial profits, as mentioned by this participant when describing his photograph (figure 6.5b):

"When we harvest the fish and there are not enough buyers to buy the fish then we will take the fish to the market to sell but we have never had this scenario… in our case when the buyers have brought the fish the remaining fish are brought amongst ourselves on a credit basis via instalments… There is a need for others to assist us in identifying potential buyers so that we can realise good amounts of profits" *(Participant# Mk_2).*

In terms of deciding what price to market fish, one male participant commented on his photograph (figure 6.5b) and emphasized the need to determine the price of fish by unit of weight in order to achieve good profits:

"I chose this picture because it is very advisable and recommendable that when one has harvested their fish they should take their fish to the market, sell them by way of weighing the fish and charge them by kg and that way they will be able to realise good profits" *(Participant# Mk_6).*

Despite awareness of good practice in setting the price for fish, another participant highlighted that competition with local Lake Chilwa capture fishery species presents a major challenge. For example, the participant commented on his photograph (figure 6.5a) and emphasized the need to time the harvesting of farmed fish when wild fish stocks are low in order to reduce competition and ensure fish are sold:

"Fellow villagers and others from outside the village should first of all make sure they find out the situation at the market so that they can see if they should take their fish to the market or not otherwise they won't be able to sell their fish at profitable prices… one should consider the time when they harvest their fish. A good time should be when the Lake fish are scarce like in June so that they can be able to make a good amount of money" *(Participant# Mk_1).*

A few participants, both male and female, from both study sites commonly mentioned issues concerning the affordability of the locally available maize bran used in fish feed. For example, one female participant commented on her photograph (figure 6.5d) and expressed concerns over the lack of affordable feed which was placing financial stress on fish farmers:

"The picture is highlighting that maize bran is very expensive but fellow fish farmers still manage to buy some because they don't want the fish to starve so we are finding it difficult to manage our fish" *(Participant# Mk_6).*

Limited availability of labour and tools to maintain and expand fish farming operations was exclusively mentioned by a few female participants from both study sites, as mentioned by this participant:

"If we could have two ponds then we could harvest from both ponds and the group could realise a good amount of money … It is our great wish that another fish pond is constructed but some tools are still needed such as shovels and hoes… at the same time it will be difficult for us to do the construction of the dam on our own like we did when we constructed the first pond because this year we have not been able to harvest any good amounts of crops so it will be difficult for people go there, do the work and come back to the households and have no food. More people would prefer to look for casual labour instead of going to the fish pond to work" *(Participant# Mk_2).*

Figure 6-5 An overview of representative photographs captured under theme 3.2. Challenges to Economic Sustainability.*From top left clockwise; a) fish being sold at a rural market highlighing lack of buyers and competition between farmed and wild fish (Participant# MK_C1); b) a market scene captured to highlight the need to identify buyers in advance at harvest time (Participant# MK_C2); c) a picture of some fish being weighed highlighting the need to sell farmed fish by kg to make more profits (Participant# MK_C6); d) a man spraying maize bran into his pond indicating the challenge with purchasing maize bran due to the high cost of feed (Participant# ML_C7).*

Theme 3.3) Constraints to Environmental Sustainability

Theme 3.3, Constraints to Environmental Sustainability, draws upon the environmental constraints experienced by participants that affect the sustainability of their fish farmer livelihood. Half of all participants exclusively from the Malundu study site commonly reported challenges to the environmental sustainability of fish farming which included: biological risks such as predation, climatic shocks affecting resource availability as well as interactions and dependencies constraints on resources (see representative photographs in figure 6.6). It was surprising to learn that no participants from Makawa discussed environmental concerns associated with fish farming, suggesting that environmental challenges were less common and of concern in this study site. Distinct gender differences in the reporting of environmental challenges occurred. Male participants for example exclusively mentioned the challenge of water availability, whereas women discussed a more diverse range of environmental challenges which included: limited water availability, predation, poor water quality, limited availability of feed and poor construction of ponds. Overall, the priority environmental challenges reported most frequently by the majority of participants were: lack of water availability and predation. The majority of all participants from Malundu, both male and female, most frequently identified the limited availability of water as a major concern to the productivity of fish ponds. For example, as mentioned above in theme social sustainability, one male participant emphasized that challenge of maintaining a reliable supply of water to his fish pond due to competition with other fish ponds:

"Water problems are becoming a very big concern as far as fish farming is concerned in this village… indeed there are conflicts arising from the water problem because when it dries up at the source everyone wants some so they block the water channel and stop it from going to other people's fish ponds so that the water mainly goes to their ponds". *(Participant #ML_C5).*

The participant added that water availability becomes a significant problem during the dry season and as a result of the heavy clustering of many ponds:

"This is the main source of the water which is used for the 46 ponds. During the hot season sometimes the water dries up which it is not properly conserved as there is no dam as it is just a well which we constructed… the availability of the water is a problem from September to November" *(Participant# ML_C5).*

Further, one male participant captured a picture of water pipes (Figure 6.6d) and used the image an as analogy to emphasize that water problems can be overcome by being courageous and committed:

"This is a word of advice for those who really want to do something like fish farming but find it difficult to have the water where they want it to be... it is a word of encouragement to others that when you want to achieve something then you really have to be courageous and keen and you do not have to give up when you see a challenge as it is still possible to do anything like in this case to carry the water over a tough landscape through pipes" *(Participant# ML_C4).*

A few female participants voiced concerns over biological risks in relation to the threat of predation of farmed fish by birds and monitor lizards. Many of these female participants described the risk of predation as being a direct result of poor management of the ponds in relation to water quality and availability. For example, one participant described how low water levels heightened the risk of predation of fish by birds as captured in her photograph (figure 6.6c):

"When water levels in the pond are very low then fish farmers should be aware that birds will come to predate on the fish. One therefore needs to watch over the water levels in the fish pond carefully… the challenge with fish farming is that of bird predation which is a very big problem in the ponds in Malundu" *(Participant# ML_C2).*

Further, another participant commented on her photograph (figure 8b) and emphasized that fellow fish farmers should manage the water quality of their ponds through fertilisation in order to reduce the risk of predation by birds…

"I want others to appreciate that when no manure is applied into the fish pond then the water is not green and birds come to predate the fish so when one goes to harvest there will be only a small amount of fish. R: The intention is to let other fish farmers know that is they don't apply manure to fish ponds then they will let fish be eaten by the birds so it is important to ensure they apply manure" *(Participant# ML_C6).*

Further, one female participant mentioned the impact of recent severe flooding in Malawi on the availability of feed. For example, the participant commented on her photograph (figure 6.6a) and expressed concern over the foreseeable shortage in fish feed as a result of significant poor crop yields arising from the flooding:

"I and my sister have agreed to go to buy some extra feed for our fish because this year we anticipate that we will encounter some problems with respect to the availability of feed for the fish… I am just anticipating this year that because people have not harvested enough for food many pond owners may not have enough maize bran to feed their fish … this picture is to remind fish farmers that their fish need to be fed… as of now it is not a problem but sometime this year this will become a problem" *(Participant# ML_C3).*

Figure 6-6 An overview of representative photographs captured under theme 3.3. Challenges to Environmental Sustainability.*From top left clockwise; a) a woman feeding fish at the pond highlighting the challenge with lack of availability of maize bran (Participant# ML_C3); b) a pond with a goat grazing nearby highlighting the need to fertiliser the pond regularly to maintain good water qualtiy (Participant# ML_C6); c) a heron at the fish pond indicating the challenge of predation of fish by wading birds (Participant# ML_C2); d) water pipes constructed near the village of Malundu and captured to highlight the need to be courageous to overcome water availability problems (Participant# ML_C4).*

6.5 Discussion

6.5.1 Overview of Results

As described by Williams (2008), gender is a relational concept that considers the roles, responsibilities, and relationships between men and women. Furthermore, Williams and colleagues (2012a) highlight that “gender roles and contributions need to be understood within their context and characterized with respect to economic, social and individual assets and people’s needs”. Questions pertaining to the contribution of men and women within the aquaculture sector, differences in the distribution of socio-economic returns as well as constraints to participation, to name but a few, are poorly understood and warrant deeper assessment (Harper et al. 2013; HLPE, 2014; Morgan et al 2016; Williams et al. 2012a). Moreover, a recent review of the litertature by Bene et al (2016), emphasise that women’s roles in fisheries and aquaculture are unrecorded and undervalued and more attention is required to understand divisions in labor, power and responsibilities as well as the role of gender dynamics to food security. Within the population groups directly linked to fish production, such as fish farmers, gender is known is play a central role in the livelihood pathways to improved food security (HLPE, 2014). The aim of this chapter was to address these gaps by implementing a modified Photovioce methodology to advance our understanding of context specific socio-cultural dimensions operating throughout the aquaculture development process. Through the lens of photography, research findings presented in chapter 6 captured rich descriptive information about the livelihood strategies and outcomes of male and female fish farmers revealing gender divisions in labour and responsibilities, needs and benefits linked with involvement in aquaculture production.This concluding section discusses the results in light of this aim, current literature as well as the prospects of the Photovoice method for future research in the area of fisheries and aquaculture development.

Understanding Fish Farmer Livelihood Strategies

Firstly, Photovoice was a useful process for understanding livelihood strategies adopted by fish farmers and contributed new insights into how social cultural norms shape the capacity of various groups to participate in and the differential experiences of aquaculture. As presented in section 4.1. of this thesis, Chambers and Conway (1991, p. 6), describes a livelihood as one that ‘‘comprises the capabilities, assets and activities required for a means of living”. As detailed in section 4.1. the sustainable livelihoods approach comprises five dimenions with livehood strategies defined as the activities and choices made in pursuit of livelihoods (DFID, 2000). Photovoice illuminated the day to day lives of fish farmers and revealed the activities and choices made by fish farmers in pursuit of fish farming as a livelihood. Overall, findings presented in the theme activities revealed a diverse range of day to day activities carried out in relation to aquaculture across both studied communities. Four major activities in particular stand out: feeding of fish, grass removing, water maintenance and guarding of fish. These findings link with previous research in which small-scale aquaculture is typically characterised by a range of low capital input activities as well as labour intensive operations with attendant demands for regular inputs and maintenance (HLPE, 2014; Russell et al 2008). Surprisingly, findings revealed that tasks such as water irrigation and pond fertilisation were rarely carried out by all participants, suggesting that a lack of human capital may limit participation in certain activities. These findings are consistent with previous research in which fish farmers in Sub Sahara Africa, unlike parts of North Africa and Asia, are known to have less extensive traditional knowledge of fish farming and skills and knowledge must be acquired to carry out tasks such as water management (Harrison 1991; Russell et al 2008; Bunting 2013). The findings presented in the theme activities also draw attention to the different combinations and components of capital assets required to permit adoption of fish farming as a livelihood strategy (e.g. land, water, skills, knowledge) and how socio-cultural dynamics shape all processes of aquaculture development.

As commonly reported world-wide, most work in fisheries and aquacutlure is highly differenitatied by gender, with women's roles typically less visbile than those of men (HLPE, 2014). Livelihood strategies adopted by households influence how aquaculture production is carried out and how patterns of use link to outcomes such as improved food security, wellbeing and income. Attention to the gender divisions in labor in aquaculture production provides a better understanding of the different ways in which men and women participate in fish farming and the associated links to needs and benefits arising from their particioation. Findings presented within chapter 6 revealed that both men and women are important agents of small-scale aquaculture in Malawi, accomplishing many varied but different tasks revealing clear gender divisions in labour. For example, the findings presented in chapter 6 revealed that women predominantly participated in maintenance activities such as feeding of fish whereas men participated in a more diverse and physically intensive set of activities which included exclusively carrying out harvesting, guarding of fish and water irrigation tasks. These findings correspond with previous research in which gender norms are known to directly shape men's and women's capacity to participate in aquaculture (Jahan et al. 2010; Shirajee et al. 2010; Fapohunda 2005; HLPE, 2014; Morgan et al 2016; Thisled et al 2016). Wider literature highlights tha gender norms are known to indirectly limit women's participation in aquaculture due to constraints on their mobility, physcial capability or time (Jahan et al. 2010; Shirajee et al. 2010; Fapohunda 2005; Veliu et al. 2009). Findings within this study suggests that the homestead nature of aquaculture provides women with opportunities to participate more actively in aquaculture though the primarily task of fish feeding but that more physically intensive or precarious tasks were restricted to men (e.g. guarding at night, harvesting).

At the same time, findings presented in the theme activities also revealed differences in the range of activities carried out between the two studied communities. For example, water irrigation and maintenance, harvesting of fish and pond fertilisation activities were exclusively reported to be carried out at the study site Malundu. These findings are not surprising given that cluster fish pond communities such as Malundu, compared with single pond communities like Makawa, typically experience heightened water competition thus requiring greater water maintenance (Kam et al 2008). The livelihood strategies of fish farmers can also be influenced by other important socio-cultural dynamics, such as cultural norms of collectivism (Morgan et al 2016). Findings from this study revealed differences in the organisation of activities between the two studied communities. For example, the task of feeding fish was reported to be shared by a range of participants on a rota basis in the study site of Makawa. These findings support other research where the responsibility of guarding and maintaining ponds has been taken by the entire community (Ndah et al. 2011).

Understanding Constraints to the Sustainability of Aquaculture & Fish Farmer Livelihoods

Second, the Photovoice process provided new insights into livelihood constraints experienced by fish farmers and revealed richer, more unpredictable information. As detailed in section 4.1, the sustainable livelihoods approach also comprises the vulnerability dimension- trends, shocks, seasonality, and other factors that affect livelihood sustainability; as well as the transforming structures and processes dimension- institutions and organisations that influence access to assets; 4) livelihood strategies- activities and choices made in pursuit of livelihoods; 5) livelihood outcomes- include changes in human well-being, income, health, and food security (DFID, 2000). Photovoice further helped to illuminate the influence of gender dynamics on challenges to the buidling and sustainability of fish farming as a livehood strategy. A variety of challenges concerning the environmental, social and economic sustainability of aquaculture were expressed by participants. Six major constraints to the livelihoods of fish farmers emerged from discussions: social conflicts concerning equity and access to resources; lack of water availability; lack of access to markets; lack of technical knowledge; lack of available and affordable feed; predation of fish. Findings revealed that these constraints were attributed to transformative structures and processes as well as socio-cultural norms that influenced access to assets and the vulnerability context within both studied communities.

As highlighted in the literature, gender divisions in labour, power and responsbilities are likely to affect access to crucial assets necessary to achieve a sustainable livelihood. Given the gendered nature of aquaculture, contraints intrinsic and external to aquaculture production are likely to affect and to be perceived differently by men and women. Furthermore, given the underreported nature of women participation in aquaculture, women's sectoral needs tend to have been ignored in management practices (HLPE, 2014). Although both men and women reported a wide range of constraints experienced in relation to their livelihood as fish farmers, distinct gender differences emerged with respect to specific sustainability issues and needs. In addition, findings revealed that a number of sustainability constraints were particular to a specific community. With regards to social constraints, social conflicts in relation to theft of fish and access to water, lack of technical knowledge and lack of outsider support were common problems discussed by participants. A lack of technical knowledge was commonly reported by both gender groups suggesting weaknesses in relation to access to human capital across both studied communities. Interestingly, social conflicts and lack of outsider support were exclusively reported by male participants. These findings may be explained by the distinct gender divisions associated with guarding of fish and water maintenance tasks revealed within this study. Further, these social constraints are likely to be attributed to weak institutional structures and processes as well as inequalities within communities which may hinder access to assets and livelihood outcomes (Allison and Horemans 2006; Morgan et al 2016). The absence of appropriate market infrastructure and availability of inputs were further raised as major economic constraints to fish farmer livelihoods by participants. Findings presented in the theme economic sustainability revealed three major economic constraints: market constraints (competition with wild fish; lack of buyers) and market knowledge, a lack of tools and labour as well as a lack of feed affordability. These findings expand previous analysis which highlights a lack of access to basic market infrastructure and services to limit aquaculture success (Penrose-Buckley, 2007; FAO, 2014). Furthermore, aquaculture and wild harvest fisheries can overlap and compete for market access (HLPE 2014). The economic constraint of competition with wild-harvested fish reported within this study is an important finding as limited knowledge exists regarding the interplay between these two sub-sectors in Malawi. Interestingly, findings within this study revealed gender differences with respect to the economic constraints experienced. Male participants predominantly discussed market constraints, such as lack of buyers, competition with local wild species and a lack of market knowledge. On the other hand, female participants commonly expressed concern over a lack of resources to maintain and expand their fish farming operations as economic constraints to their livelihoods. A lack of feed affordability was a major economic problem expressed by both gender groups. A number of environmental constraints to fish farmer livelihoods were also reported by participants. Findings presented in the theme environmental sustainability revealed three major environmental problems: a lack of water availability; predation of fish and a lack of feed availability. Climate induced changes to freshwater systems are increasing being observed world-wide (Barange et al 2009) and can impact directly and indirectly on the crucial resources necessary for aquaculture growth. Findings from this study revealed that a lack of water availability due to climate shocks was a major environmental constraint experienced exclusively by male participants from the study site of Malundu. In addition, the findings revealed the indirect impacts of climate shocks on the shortage of feed inputs. These findings are important as it reveals that climate shocks such as drought are causing major impacts on access to crucial natural capital such as water and feed with impacts on the sustainability of fish farmer livelihoods. Moreover, the findings emphasize the value of the Photovoice process in capturing the vulnerability context of fish farmer livelihoods and the differential experiences of aquaculture by gender groups. Interestingly, female participants from Malundu reported a greater set of environmental challenges compared with male participants, which includes: predation of fish by birds and monitor lizards, poor construction of ponds, poor water quality and limited availability of feed availability. Overall, Chapter 6 revealed that women fish farmers more commonly reported issues concerning the lack of access to key capital assets (e.g. financial, feed, land, water) to sustainable their livelihood. In contrast, male fish farmers more commonly reported issues concerning ownership conflicts and market contraints. Such findings may be explained by the gendered division of labour reported within this chapter as well as wider culture norms relating to gendered differences in power and ownership of resources (Williams, 2008; HLPE, 2014; Fiorela et al 2014).

Understanding the Development Outcomes from Aquaculture

Thirdly, Photovoice was a useful process for understanding the pathways through which aquaculture contributes positively to livelihoods, including direct and indirect parthways to improved food security and well-being. As detailed in section 4.1, another dimension of the sustainable livelihoods approach is livelihood outcomes which includes changes in human well-being, income, health, and food security (DFID, 2000). Photovoice further helped to illuminate how gender dynamics mediate outcomes from the adoption of fish farming as a livelihood strategy in relation to improved food security, wellbeing and increased income. Overall, this study confirmed that aquaculture has brought about positive social and economic benefits to people involved in aquaculture. A diverse set of livelihood outcomes from involvement in fish farming was reported by all participants across the two studied communities. Major social and economic benefits perceived by all fish farmer participants centred on the ability to meet community or household basic food and income needs. Findings revealed that aquaculture contributes positively to food security via a myriad of direct and indirect pathways. For example, findings revealed that participants benefited directly from increased fish consumption as well as indrectly through improved access to a greater variety of food via increased purchasing power. Interestingly, the results within this study also highlighted the additional indirect benefit to improved food security of reusing pond water for irrigating vegetables, albeit with little adoption amongst fish farmers.

Interestingly, findings also revealed differences in the pathways to food security between studied sites. For example, the studied community of Makawa valued farmed fish more as a cash crop whereas participants in the studied community of Malundu more frequently valued farmed fish as a food crop. Overall, these findings are important as it highlights that fish farmer livelihoods can contribute directly and indirectly to food security; supporting numerous emerging studies that recognise the crucial role of fisheries and aquaculture for food security (Dey et al 2006; HLPE, 2014; Bene et al, 2016; Allison and Horemans 2006; Villasante et al 2015). Furthermore, the reuse of pond water for crop irrigation highlights the additional livelihood outcome of achieving a more sustainable use of natural resources through involvement in fish farming. The findings also revealed social-cultural dynamics related to nutritional security whereby participants expressed greater preference for the consumption of the species Chambo. Fish farmers also revealed economic benefits derived from aquaculture via the obtainment of assets; such as clothes, kitchen tools and bicycles. These findings show that fish farmer livelihoods can also contribute to the alleviation of poverty through improved wealth generation. In addition, findings revealed that improved social economic conditions obtained from aquaculture can provide a safety net for participants during times of financial hardship and food shortages. This finding is significant as it further reveals that aquaculture can lead to reduced vulnerability and improve the sustainability of food security.

As detailed, gender can affect divisions in labour and perceived sectoral needs among male and female fish farmers due to its influence in determing entry into aquaculture, the type of livelihood activities adopted as well as access to crucial capital assets necessary to sustain aquaculture as a livehood strategy. Due to the gendered nature of aquaculture, gender can further have a significant role in determining the different mechanisms and processes that determine livehood outcomes such as improved food security, well being and increased income (HLPE, 2014; Morgan et al 2016). Although both male and female participants portrayed common positive livelihood benefits from their involvement in fish farming, gender differences emerged with regards to reported livelihood benefits obtained from aquaculture. For example, both gender groups experienced direct and indirect benefits to improved food security from involvement in aquaculture. However, female fish farmers exclusively reported the benefit of increased purchasing power to buy other food item as well as the importance of aquaculture in providing a safety net during times of food shortage and financial hardships. Moreover, female fish farmers reported the obtainment of a greater variety of assets such as household goods and clothing which were used for the purpose of meeting family needs. These findings reaffirm existing evidence that women play a dominant role in prioritising and meeting household food security and basic needs (Geheb et al 2008; Quisumbing et al. 1995; Porter 2012). Male fish farmers on the other hand exclusively reported the indirect benefit to food security obtained from the reuse of pond water for crop irrigation. Furthermore, male participants exclusively expressed the perceived improved nutritional security obtained from fish farming direct the increase in fish availability and consumption. These findings are important as it highlights the differential role of gender groups in determining livelihood outcomes obtained from fish farming. Furthermore, these findings provide a valuable contribution to the literature in deepening our understanding of complex social-cultural dynamics influencing aquaculture development outcomes (HLPE, 2014; Morgan et al 2016).

Finally, findings further revealed non-material benefits obtained from fish farming in the form of improved well-being, including individual pride, self-actualisation, identity, independence, job satisfaction and self-reliance. Both male and female participants expressed pride in participating in fish farming as a livelihood. In contrast to male participants, female fish farmers further expressed in-depth self-actualisation, self-reliance and empowerment with being able to participate in various activities associated with fish farming. These findings revealed that the majority of fish farmers perceived their involvement in fish farming as also a way of life that enabled them to improve their standard of living. This supports findings by Weeratunge et al (2010) which highlights the important role of aquaculture and fisheries to improved wellbeing and adds depth to our understanding of differential experiences by gender groups.

Immanent vs assistance intervention approaches to aquaculture

The success of aquaculture can also be influenced by other important socio-cultural dynamics such as cultural norms of collectivism (e.g. Ndah et al. 2011 in Cameroon and Joffre & Sheriff 2011 in Vietnam). The findings from this study revealed distinct differences in relation to the distribution of livelihood outcomes from fish farming as well as challenges to fish farmer livelihoods between the two studied communities. Within this study, the studied community of Makawa was classified as an immanent form of aquaculture whereby the local community accepted full ownership and responsibility for the development and maintenance of an aquaculture system. Here, social capital appeared to be a strong community attribute, with strengthening of cooperation and trusting relationships developed through the development of aquaculture. These findings reaffirm Cramb's (2006) recognition of the importance of social capital in community development. In contrast, the studied community of Malundu was classified as an interventionist form of aquaculture where larger clusters of aquaculture operations were introduced and owned by individual community members through outsider support. Here, signs of weak social capital were revealed with the presence of competition and individualism associated with the practice of aquaculture. Results further revealed that aquaculture contributed to improved food security through direct and indirect pathways within both studied communities. However, the distribution of food security outcomes varied across sites. In Makawa, benefits obtained from aquaculture were distributed to the most vulnerable members in the community. In contrast, in the studied community of Malundu, benefits obtained from aquaculture were distributed to the individuals and households directly involved in aquaculture. Moreover, findings revealed signs of improved technical skills in the studied community of Malundu through the presence of water management practices which were absent in the community of Makawa. This finding suggests that the interventionist model of aquaculture has given rise to improved access to human capital via improved skills and knowledge obtained from outsider assistance. Differences between sites were all also evident in relation to the non-material benefits derived from aquaculture. Interestingly, fish farmer participants from the studied community of Makawa expressed greater well-being benefits such as job satisfaction and pride in comparison with fish farmers from Malundu. The findings also revealed commonalities as well as distinct differences between the two studied communities with respect to the perceived scope and nature of challenges experienced by fish farmers. Theft of fish and lack of affordable feed were common constraints to fish farmer livelihoods across both studied communities. However, findings revealed that specific issues were particular to one community. Poor access to physical and human capitals was perceived to present major constraints to the economic sustainability of fish farmer livelihoods within the studied community of Makawa. For example, fish farmers from Makawa stated a lack of buyers, access to markets and a lack of technical knowledge were major constraints to their fish farmer livelihoods. Moreover, fish farmers from Makawa also expressed economic constraints relating to competition with local wild fish species. This finding is important as it extends previous research into revealing an overlap between aquaculture and wild harvested fisheries with implications to the economic sustainability of aquaculture (Brummett 2000). In contrast, issues concerning access to aspects of social and natural capitals were reported to be major constraints to fish farmer livelihoods in the studied community of Malundu. Surprisingly, environmental challenges, social conflicts over access to resources and relationship issues with outsider bodies were exclusively reported by fish farmers from Malundu. For example, issues over access to limited water resources to sustain aquaculture were especially contentious in Malundu where competition between fish farmers and wider members was reported. Furthermore, trust issues concerning the relationships with outsider organisations providing assistance to aquaculture development were expressed by a few fish farmers in Malundu. These findings are of significant importance as it reveals that social and environmental constraints to fish farming livelihoods were greatest within Malundu. This may be explained in part by recent findings by Tran et al (2013) who highlighted that conflicts over access to water may be heightened in larger, cluster fish farming settings such as Malundu. Further, the results presented here are consistent with previous studies that found issues concerning outsider support to be common constraints in aquaculture communities due to the 'receiver mentality' adopted by fish farmers as a result of heavy donor led development in Malawi (Andrew et al 2003; Russell et al 2008).

Overall, these findings are of significant importance as it reveals that differences in the type of aquaculture development (Brummet et al 2011) - whether adoption was immanent (as in the case of the Makawa community) or due to assistance interventions (as in the case of the Malundu community) - can influence access to certain components of capital assets that ultimately facilitate or hinder the outcomes and likelihood of success of fish farmer livelihoods. Furthermore, findings reaffirm previous research that highlight positive livelihood outcomes from small-scale aquaculture (Ahmed, 2009; Morgan et al 2016) and also contributes new knowledge to deepening our understanding of how different forms of aquaculture development influence pathways to food security and issues of sustainability to fish farmer livelihoods.

6.5.2 Evaluation of Photovoice as an assessment tool in the elicitation of perceptions of marginalized diverse groups

For the first time, this study applied the participatory Photovoice methodology within the context of small-scale and inland fisheries. The results from this study revealed that Photovoice proved to be an effective and engaging tool in providing a deeper understanding of context specific social and ecological aspects of aquaculture from diverse marginalized groups. The following discussion is centred on evaluating the effectiveness of implementing the modified Photovoice method presented within this study in accordance with the following three goals of Photovoice: (1) to enable communities to identify their strengths and concerns; (2) to promote critical dialogue around key issues; and (3) to affect policy (Wang and Burris 1997; Wang and others 1998). Results presented within this study as well as notes obtained from the field provide the basis for this evaluation. In relation to these goals, the application of the modified Photovoice methodology in the context of small-scale aquaculture was effective as follows.

Goal 1: To identify community issues

First, with respect to the identification of community issues, the method allowed participants to capture direct observations of aquaculture issues important to fish farmers in Malawi. By using photography together with narrative building, the Photovoice process allowed community members, and not the researcher, to determine the direction of the research. As experienced by other studies (Bennett and Deardon 2013; Kong et al 2015), this participant led photography process empowered participants to reflect more critically on and discuss more freely what issues were most relevant to them. This process facilitated the development of trust between fishers and researchers, an important pre-requisite in the development of fisheries participatory research

(Jacobson et al 2011). Within this study, the method adopted proved effective in empowering participants to openly explore broad concerns around three lines of enquiry in relation to aquaculture. Further, within the group discussions, the majority of participants expressed that they enjoyed the Photovoice process and the majority of female participants highlighted that it allowed them to voice their perspectives easily. In addition, a few male participants expressed that the process allowed them to gain more knowledge about fish farming. Within the context of this study, the method therefore proved to be an accessible and effective tool in capturing the views of marginalized and vulnerable illiterate fish farmers, particularly women and the elderly. Photovoice also provided an arena to capture gender dimensions in relation to aquaculture issues. Through individual interviews, both men and women were able to discuss in great depth positive and negative aspects associated with their involvement in aquaculture.

Goal 2: To promote critical dialogue

Second, in relation to promoting critical dialogue, Photovoice creates informal conversation forums which allow participants to discuss their concerns. During this study, participants were able to capture issues of concern through photography freely and individual interviews encouraged participants to discuss matters that were important to them openly. In addition and as experienced by Wang and Burris (1997), the method prompted informal conversation between participants and non-participants within both communities due to the novelty of cameras used.

Goal 3: To affect policy

Third, in relation to affecting policy, it is too soon to evaluate. As Beh (2011) points out, the third goal of Photovoice explicitly states to 'reach' policy rather than to endorse policy change (Wang et al 1998). Beh (2011) explains that aspirations to initiate actual change at the policy level are determined by the effectiveness of the outcomes from Photovoice as well as the acceptability of policy makers. These views are shared by other researchers (Hergenrather et al 2009; Bennett and Deardon 2013; Kong et al 2015) who add that the duration of a project also affects the ability to evaluate change and address the third goal of Photovoice effectively. Within this study, objectives of dissemination activities are still to be planned. Further, the short time frame inherent in PhD studies limits the capacity to monitor and evaluate change at the community and policy levels. Several studies have reported difficulties in achieving this third goal of affecting policy (Hergenrather et al 2009; Berbés-Blázquez 2012; Bennett and Deardon 2013). Initiating change at the policy level is a slow process and one that requires a long-term approach to evaluate which has been reported to be difficult to achieve in time restricted studies (Wang and Pies 2004; Bennett and Deardon 2013). Although this study is far from achieving policy change due to the short time frame involved, during the course of this PhD attempts have been made to share research findings with global policy makers and practitioners at world-leading forums including the inaugural World Aquaculture Society in Cape Town, Africa and the Resilience 2017 conference. Furthermore, the Photovoice process does promote community self-organization which may encourage community members in time to become mobilized and advocate for social change.

Limitations of Photovoice

While Photovoice has tremendous potential as a participatory tool in the assessment of fisheries and aquaculture, there are also important limitations. Firstly, completion of the several stages involved in the Photovoice process required a lot of time, resources and commitment by both the researcher and participants. Although careful planning of face to face sessions was made at convenient times and locations for participants, a few participants were not able to attend on agreed dates. Further, the printing of photographs in a local store also required organisation and factors such as transportation to the store, opening hours and estimated time taken to produce the photographs had to be scheduled into plans whilst in the field. As a result, a flexible approach had to be adopted to allow for all participants to complete the full process. Second and as experienced in other studies (Bisung et al 2015; Kong et al 2015), some photographs had to be discarded as they were either taken for personal use or were of too poor quality due to technical issues by users. Although this did not affect the quality of results produced, it affected the scope of discussions by some participants as a result of fewer relevant or of good quality photographs captured. Thirdly, this study was limited to the target population of fish farmers to illuminate the underreported challenges and characteristics of small-scale fish farmers. Fourthly, the rich, complex data that Photovoice produces can be hard to organise, analyse and interpret and these stages often require a lot of time to complete. Few studies have reported the time required to complete the analysis and writing up stages of Photovoice. Within this study, specific measures such as coding of images were adopted in the field to facilitate data management and analysis processes. A lot of time was required in the field to organise the completion of transcripts in time for the final group session were initial key findings were verified by participants. Finally, it is important to highlight that community engagement was restricted to the research design and analysis phases of the Photovoice process. As experienced in other CBPR and photovoice studies (Bisung et al 2015), due to the short term nature of this study the ability to capture the long-term influence to policy as well as involve community members in the dissemination of results were restricted. Further photovoice studies would benefit from having a longer term project in place to facilitate and capture the longer term goals of traditional CBPR.

6.6 Conclusion

For the first time, this study applied a modified Photovoice methodology in the context of aquaculture in a developing country with the aim to investigate the role of gender with respect to contributions, benefits received and challenges experienced in small-scale aquaculture in Malawi. Overall, findings presented within this chapter suggest that small-scale aquaculture contributes to positive livelihood outcomes within the two studied communities, including improved food security through direct and indirect pathways, improved well-being and reduced vulnerability. Results presented within this chapter further demonstrate that both men and women are important agents of aquaculture in Malawi, accomplishing different tasks but also expressing different needs concerning constraints to their participation in aquaculture. The Photovoice method highlighted important differences between men and women in terms of participation in aquaculture, perceptions of benefits arising from participation as well as sectoral needs relating to economic, social and environmental challenges. Findings demonstrate that women predominantly participate in maintenance activities such as feeding of fish whereas men participate in a more diverse set of activities which include exclusively carrying out harvesting, guarding of fish and water irrigation tasks. The results also suggest that major environmental (e.g. lack of water availability), economic (e.g. lack of access to markets) and social (e.g. conflicts over resource use and lack of knowledge) constraints affect the sustainability of fish farmer livelihoods. Furthermore, findings reveal that differences in the form of aquaculture adopted (interventionist or immanent) influence access to capital assets (e.g. social and human capitals) and lead to differences in the outcomes of aquaculture and challenges experienced by adopting fish farmers.

Findings from this study support wider research that reveal that men and women, particularly in Africa, adopt significantly different roles in the construction of sustainable livelihoods (Gladwin 2000; Simtowe 2010). In addition, capturing the lived experiences of fish farmers and the characteristics of their livelihoods has helped to identify the different needs of women and men, thus helping to identify solutions that can better the achievement of more sustainable livelihood strategies. The comparisons made between gender groups further point to the complexity of gender dynamics in affecting access to assets for livehood building and the generation of livelihood outcomes.

Final reflections on the findings presented within this chapter reveal that Photovoice served as a powerful method to portray context specific ´real life´ imagery of aquaculture as a livelihood strategy. The method proved extremely effective in capturing the views of often neglected and marginalized male and female fish farmers, fostering trust, generating rich and unique perspectives and in addressing context specific complex social-ecological issues. A household's livelihood is often challenging to measure, particularly small scale fish farmers given the part-time subsistence nature of aquaculture. Photovoice further proved effective in illuminating gender dynamics of fish farming livehoods, with particular attention to deepending our understanding of the role in gender in the construction of livelihood strategies and outcomes which is often omitted in fisheries and aquaculture livelihood analysis (HLPE, 2014; Bene et al 2016).

This chapter contributes to the methodological literature in fisheries research and provides a timely endeavour to deepening our understanding of context specific factors framing aquaculture development in the context of the sustainable livelihoods approach (Allison and Horemans 2006; Bene et al 2016; Morgan et al 2016). The value and role of aquaculture to local livelihoods, in particular its potential contribution to food security, is further tested and analysed in the following chapters 7.

Chapter 7: The Role of Aquaculture to Sustained Food Security

7.1 Introduction

Worldwide, it is increasingly recognised that fish matters to all four key dimensions of food security (availability, access, utilisation and stability) (HLPE, 2014; Bene et al 2015; Thilsted et al 2016). Understanding the impact of aquaculture for human well-being, such as food security, is critical for sustainable management and it is surprising this remains poorly understood (Bene et al 2015; Bene et al 2016). Acknowledging the rapid rise and evolution of aquaculture, many increasingly important questions remain concerning the complexity of aquaculture's role to food security across scales and contexts. Overall, this literature highlights that small-scale aquaculture plays a complex role in household and community livelihood strategies, providing a range of benefits directly, directly and seasonally. However, conditions favouring adoption of aquaculture do not occur uniformly over geographic space or time (Kam et al 2008). High risks are associated with small-scale aquaculture, particularly in rural dry land communities in SSA, where social and environmental shocks and pressures can result in challenges to the retention and expansion of aquaculture (Tran et al 2013; FAO 2016). Significant gaps in our understanding of the complex role aquaculture can play to household food security – positive or negative- remain, including questions relating to who benefits, what constraints exist to aquaculture development and what context specific factors influence the pathways through which aquaculture can contribute to food security, among others (Bene et al 2016). Food security is by nature multifaceted and its relationship with the environment, including fisheries and aquaculture, is complex and multi-directional (Poppy et al 2014; HLPE, 2014; Burchi and Muro 2016). The assessment of food security requires a combination of interdisciplinary perspectives, measures and indicators to fully capture the complex reality of food insecurity within a given context (Carletto et al 2013; Maxwell et al 2013; Poppy et al 2014). Understanding these core dimensions of food security is critical to examining the contribution of fish farming to household food security in Malawi.

The aim of this chapter is to assess the effect of small-scale aquaculture on household food security, measured by food consumption, food security indicators (e.g. consumption of animal protein, the diversity of major food groups in the diet, and how households cope with short-term food shortages). For this, this chapter investigates the influence of aquaculture on household food security in two rural case study communities in Malawi. Specifically, this thesis assessed the contribution of aquaculture and other socio-economic conditions to household food security within fish farming and non-fish farming households.

7.2 Chapter Aims

This chapter aims to investigate the following research objectives and questions:

Research Objective: To assess and quantify the direct and indirect association of aquaculture to household food security through the comparison of fish farming vs non-fish farming households.

Research question 1: What are the capital assets, livelihood strategies and capabilities of fish farming vs non-fish farming households?

Research question 2: What are the vulnerability concerns in relation to shocks and pressures of fish farming vs non-fish farming households?

Research question 3: What are the livelihood outcomes, in particular the outcome and key determinants of food security, obtained by fish farming vs non-fish farming households?

Contribution: This chapter aims to fill an important gap in the literature via providing a better understanding of the aquaculture sector in Malawi to help inform the future sustainable management of the sector and its contribution to food security.

7.3 Research Method and Data Collection

7.3.1 Household Surveys Data Collection

To assess the effects of fish farming livelihoods and socio-economic variables on household food security, semi-structured interviews were conducted in two rural fish farming villages – Makawa and Malundu in the southern district of Zomba, Malawi during May to August 2015 (see appendix G for the household survey). The methodology section presented in chapter 4 of this thesis provides more information concerning the selection and location of surveyed villages.

Typically, villages in Zomba range between 20-200 households. As per working in data-limited and rural environments, precise information on the number of households and their characteristics is often limited (Allison and Mvula, 2002; Darling, 2014; Fiorella et al. 2014; Villasante et al. 2015).

Household listings were obtained from the village chiefs and through key informant discussions; households actively participating in aquaculture in the past 12 months were approximated. A total of 96 households in Makawa and 117 households in Malundu were identified. Within these constraints, households were selected via stratified random sampling according to participation in fish farming. Households were defined as a group of people living together and eating the same meals. All interviews were conducted with the heads-of household via support from a translator assistant. A sample size for administering the quantitative surveys in each village was determined based on minimum requirements for statistical analysis of stratified groups, accessibility and logistical viability as well as accounting for household listing errors arising from empty dwellings. A total of 137 household heads, 63 from Makawa and 74 from Malundu were interviewed. The case study and sample size is common in local natural resource assessments to gain a deeper understanding of complexities in livelihoods (e.g. Allison and Mvula, 2002; De Silva et al. 2007; Irz et al. 2007; Iwasaki et al. 2009; Kassam, 2013; Darling, 2014; Fiorella et al. 2014; Villasante et al. 2015; Dave, 2016).

While a case study research can provide an in-depth analysis to a certain phenomenon and extend comparisons across cases, there are limits on generalizability, which is restricted to the population from which the sample was drawn. However, the approach provides rich insights into complex factors and processes that shape the role of aquaculture to food security. Furthermore, through a mixed methodology approach, triangulation of findings overcomes challenges in working in data-limited environments. This case study therefore serves to provide a valuable in-depth examination about the relationship of small scale aquaculture to food security, thus addressing the reported significant gaps in the literature and deepening our understanding of the value of aquaculture, particularly in Sub-saharan Africa and remote rural communities.

At the time of this study in 2015, both villagers were actively engaged in fish farming, characterised by two forms of aquaculture development: - immanent and interventionist approaches. The survey questionnaire collected information on the respondent's household, the main unit of analysis, and was designed to capture elements of the Sustainable Livelihoods Approach and multidimensional notion of food security via 8 sections: a) household characteristics; b) human capital; c) natural capital; d) physical capital; e) financial capital; f) food consumption; g) food security; h) social capital. The household survey comprised mostly closed questions, giving opinion, ranking the statements and multiple choice options where applicable. A limited number of open-ended questions were included, for example if participants need to specify options outside those given in the question. The full part 1 of the survey questionnaire is presented in Appendix G. The questionnaire was administered to both fish farming and non-fish farming households from two fish farming villages- Makawa and Malundu. An in-field pilot test was carried out prior to data collection to ensure the questionnaires would be conducted smoothly, within a set time, that questions were easily understood and response categories appropriate. A further stage of validation concerning translation of the questionnaire from English into the local language Chichewa was also carried out with support from a research assistant. On completion of each survey questionnaire, further validation checks were made through a strict field protocol which involved checking for mistakes and inconsistencies which were often corrected via communicating with the surveyed respondent.

Table 7-1 Summary of surveyed households by household type and village.

Village	Fish Farming Households (n, %)	Non-Fish Farming Households (n, %)	Total Households (n, %)
Makawa	32 (52%)	31 (41%)	63 (46%)
Malundu	30 (48%)	44 (59%)	74 (54%)
Total Households Nos.	**62**	**75**	**137**

7.3.2 Data analysis

The household survey data were analysed using SPSS Version 24. A rigorous data cleaning process was carried out to explore outliers, missing data and characteristics of the sampled data resulting in a final clean data set for purposes of SPSS analysis. Descriptive analysis was carried out with all variables (as detailed below in table 7.2) with the aim to compare differences in livelihood strategies, assets, capabilities, vulnerabilities and food security status between the fish farming and non-fish farming households surveyed. A number of statistical tests were used to test the significance of differences and associations between the variables and household type, village groups: Chi square tests for independence are used to test the significance of differences and associations between categorical variables, independent samples t-tests and non-parametric Mann Whitney U tests are used to test the significance of differences between the means of continuous variables; Pearson Correlation and the non-parametric Spearman correlation are used to test the significance associations between the means of continuous variables; and a multivariate analysis of variance (MANOVA) is used to compare groups on a number of difference but related dependent continuous variables. Principle Components Analysis was also used to construct a Wealth Index as a proxy scale for household wealth and further analysis concerning food security. Finally, Multiple Regression was used to provide deeper understanding about the relationship between several independent variables and dependent variables in order to understand what factors determine food security. The sustainable livelihood approach is used an analytical tool to guide the results and interpretation of this study.

7.3.3 Summary of Variables/ Indicators

Table 7.2 provides a summary and description of the social, economic and food security indicators according to the SLA and food security dimensions used within this study to assess the role of aquaculture to household food security. A variety of indicators are currently used for food security analysis, each capturing different, but overlapping dimensions of the multidimensional concept of food security in any given context (Carletto et al 2013; Maxwell et al 2013). The indicators applied to food security analysis range from quantitative to qualitative based measures on perception and self-assessment; individual to regional levels of analysis; direct to indirect measures of non-food indicators (such as education, wealth or other basic capabilities that constitute people's wellbeing, and with some indicators focusing on specific dimensions of food security whilst other are multidimensional (Carletto et al 2013; Maxwell et al 2013; Burchi and Muro 2016). In this study, we apply some of the most commonly used indicators of food security in order to assess the role of small-scale aquaculture to food security via the comparative assessment of food security status of fish farming and non-fish farming households in two rural communities in Malawi. A summary and description of composite and key food security indicators applied within this study are further provided below.

7.3.4 Composite Indexes

The Wealth Index

The wealth index, developed by the DHS Program (Rutstein, and Johnson. 2004), is a composite measure of a household's cumulative living standard and is used as a proxy indicator of household level wealth. The wealth index is constructed using household's ownership of a number of selected assets such as a television and car; dwelling characteristics such as flooring material; types of water access such as drinking water source; and sanitation facilities such as toilet facilities. To create the Wealth Index, DHS guidelines (Rutstein, and Johnson. 2004) were followed which involved using a 'data reduction' procedure known as principal components analysis. It involves replacing a set of correlated variables with a set of uncorrelated 'principal components' which represent unobserved characteristics of the population. Principle Components Analysis can be used to identify a smaller set of underlying factors that help to explain interrelationship among a wider set of variables. The first principal component explains the largest proportion of the total variance and is taken to represent the household's wealth. The wealth index places individual households on a continuous scale of relative wealth. Each household asset for which information is collected is assigned a weight or factor score generated through principal components analysis. The resulting asset scores are standardized in relation to a standard normal distribution with a mean of zero and a standard deviation of one. These standardized scores are then used to create the break points that define wealth quintiles as: Lowest, Second, Middle, Fourth, and Highest. The wealth index allows researchers to identify how much household economic status affects food security as it can be used as a proxy for food access. A summary of the PCA procedure used to calculate the Wealth Index is provided in appendix I.

Table 7-2 Description and summary of social, economic, and food security variables surveyed in two fish farming villages in Malawi.

Indicator	Definition	Food Security Dimension
1. LIVELIHOOD CAPITAL ASSETS		Livelihood strategies, assets, capacities are a means to achieving various livelihood outcomes, including improved food security. These factors, including demographic characteristics, affect food access, food consumption habits and preferences as well as food security vulnerability.
1.1.Human Capital		
Age	Age in years of head-of-household	
Gender	Gender of head of household: Male/Female	
Marital Status	Marital status of head of household (married, divorced, never married, widowed)	
Household Illness or Injury in past month	Household member falling ill or faced an injury in past month (percentage)	
Household Size	Number of people living in household	
Household Structure	Number of adults	
	Number of children	
No. Literate People in Household	Number of literate household members	
Education Level of Head of Household	Household head level of education (Primary, secondary, never been to school)	
Ethnicity of Household	Ethnicity of household head (Chewa, Lomwe, Yao, Nyanja, Sena ethnic groups)	
Religion	Religion of household head (Catholic, Christian, Church of Christ, Islam, Jehovah's Witnesses faith groups)	
1.2 NATURAL CAPITAL		
Land Ownership	Household ownership of land (percentage)	
Land Use	Purpose of owned land (Rent it to others, farm)	
Size of Land	Size of land owned (Hectares and acres)	
Total Land Size	Total size of land owned by household (hectares)	
1.3 PHYSICAL CAPITAL		
Source of Water	Source of Drinking, Washing, Domestic Use Water: Safe- protected wells, boreholes, piped water; Unsafe- unprotected wells, river	
Access to Electricity	Households access to electricity (percentage) and by source	
Household Ownership of Assets	Household ownership of durable good assets (Presence/absence of assets)	
Wealth Index	Composite index for wealth/income	

Indicator	Definition	Food Security Dimension
1.4 FINANCIAL CAPITAL		
Ownership of Livestock	Household ownership of livestock (poultry, guinea fowls, ducks, goats, cattle) (percentage)	
Expenditure	Household expenditure over the past weeks, weeks and month (percentage by item and ranked importance)	
Savings	Percentage of households with savings	
1.5 SOCIAL CAPITAL		
Mutual Relationship with Relatives re.	Households give, receive money (or both) to/from relatives (percentage)	
	Households give, receive food (or both) to/from relatives (percentage)	
	Change in household mutual relationship with relatives (increase, decrease, stayed same) over past 12 months	
Membership of Group	Percentage of households affiliated to a local group and by group type	
	Benefits by group affiliation type (economic, security, recognition, satisfaction, get help from others, none, other)	
2. LIVELIHOOD STRATEGIES		
Occupations	Number of total occupations (part-time or full-time) in the household and number of different jobs (occupational diversity)	
	Ranked household livelihood activity carried out over past 12 months (primary, secondary, tertiary, fourth)	
Farming Preference	Household preferred mode of farming (crops, livestock (excl. poultry), poultry, fish farming)	
Importance of Fish Farming	Importance of fish farming to household by fish farming households only	
Adopting fish farming	Consider adopting fish farming by non-fish farming households only	
	Constraints to adopting fish farming by non-fish farming households only	
Fisheries Role Preference	Household preferred role to partake in within the fisheries sector (fish farming, fishing, fish processing, fish trading, other fish related business)	
3. VULNERABILITY CONTEXT		
Livelihood Shocks/Stresses	Household experiencing one or more shock/stress to livelihood over past 12 months and by shock/stress type	Food vulnerability/stability.

	The impact of livelihood shocks/stress experienced in past 12 months to household income, assets, food production, food stocks and food purchases.	

Indicator	Definition	Food Security Dimension
4. LIVELIHOOD OUTCOMES- FOOD SECURITY		
Food Consumption and Diet Diversity	No. of days per week that eight major food groups was consumed by household (cereals; pulses; fruit; meat, fish and eggs; vegetables, milk, sugar and oils)	Direct food consumption and diet quality.
	No. of days per week that key nutrient food groups was consumed by household (vitamin A, protein)	Indirect indicator of nutritional security, diet diversity.
	No. of days per week that fish was consumed by household	Direct food consumption.
	Meals per day by household member	
Fish Consumption Characteristics	Fish consumption by species, source and preservation status	Food consumption, diet quality, access, availability.
	Fish consumption habits- portion of fish consumed and by household member	Food consumption, intra-household distribution, access, utilisation.
Food Consumption Score	Based on weighted dietary diversity composite score based on dietary diversity, food frequency over a 7-day recall and relative nutrition importance of different food groups).	Food consumption, quantity, diet quality and diversity.
Food Consumption Groups	Food Consumption Groups (describes different levels of food consumption, as measured by the FCS: poor consumption, borderline consumption, acceptable consumption.	
Food Adequacy	Food adequacy over past 7 days (whether food consumed was enough)	Indirect food sufficiency.
Cultural Preferences	Fish consumption preference by species and rationale Constraints to accessing fish for consumption Animal protein consumption preference and rationale	Indirect food consumption preferences, access, utilisation.
Food Source Frequency	Food source frequency (frequency of responses of food sources for all foods consumed in the past 7 days)	Access, availability.
Food Security Vulnerability- Food Coping Strategies Index	Food Coping Strategies Index (FCSI) (frequency and severity of short term coping behaviours) in past 7 days.	Food consumption sufficiency, predicator of food vulnerability/stability.
Long-term Vulnerability	Coping Strategies when not enough household food in past 12 months.	Indirect indicator of long-term food vulnerability.
	Shock/Stress to household food security by type over past 12 months.	

7.3.5 Food Security Measures

Dietary diversity and Food Consumption Patterns

A common method used in capturing food access is dietary diversity, which is of particular importance in developing countries where nutritional and food security is affected by a lack of diet quality (e.g. diets are mostly composed of starchy staples) (Ruel, 2003). Diet diversity measures food items or food groups that people eat and the frequency with which they eat them. Within this study, food consumption patterns of key food groups and items (staples, pulses, vegetables, fruits, meat/fish/egg, milk, sugar, and oil; fish; vitamin A rich foods; protein rich foods) were explored to assess food access and indirect measures of micronutrient deficiencies.

Food Consumption Score & Food Consumption Groups

A widely used proxy indicator of dietary diversity is the World Food Programme's Food Consumption Score (FCS) index, which is a frequency- weighted dietary diversity score, calculated using the frequency with which a household consumed eight food groups (i.e., staples, pulses, vegetables, fruits, meat/fish/egg, milk, sugar, and oil) over a 7-day recall and relative nutrition importance of different food groups (WFP 2008). The FCS used by the WFP is constructed here using the survey data to compare food security between fish farming and non-fish farming households. Within each food group, the consumption frequencies were summed to yield a food group score, truncated to be no higher than seven. Each food group score is multiplied by a pre-established weight based on the nutrient density of a given food group, and the results are then summed to create the FCS. Furthermore, the FCS is used to describe levels of food security according to established Food Consumption Groups (FCGs). The FCG allows for calculation of prevalence, rather than just mean values (as with the FCS) and is used in subsequent analysis and validation of food security within this study. Using the FCS, thresholds are applied to create three food consumption groups: </=21 FCS (poor consumption), 21.5 to 35 (borderline consumption), >35 (acceptable consumption) (see table 7.3 for a summary of the FCS and FCG criteria).

Food Source Frequency

Food source frequency is a proxy indicator for relative food access and describes the frequency of responses of food sources for all foods consumed in the past 7 days. The food sources frequencies are weighted by the consumption frequency, so that the food sources of foods more frequently eaten are counted more than the food sources for foods less frequently eaten. Within this study, source of fish consumption by species was also obtained to understand access and risks to fish consumption.

Coping Strategy Index

The Coping Strategies Index or CSI (Maxwell and Caldwell 2008) captures food security indirectly by measuring food consumption behaviours. The CSI is a proxy indicator of dietary inadequacy and predictor of food vulnerability. The CSI is used to measure the frequency and severity of the coping strategies used by a household to deal with short-term food insecurity and is used for better comparison and validation of food security between different groups (Maxwell 1996; 2013; Coates et al. 2006; Carletto et al 2013). The CSI is constructed from weighted aggregation of information on the severity and frequency of certain coping strategies (Carletto et al 2013). Within this study, six coping strategy behaviours were used that had previously been identified and used successfully in similar studies for understanding food security vulnerability in rural households in sub-Saharan Africa (Darling 2014; Maxwell, 1996): 1) eating less preferred foods; 2) limiting portion sizes; 3) borrowing food or money to buy food; 4) preparing food only for the children as a type of 'maternal buffering'; 5) skipping meals; and 6) going without food for whole days. Surveyed households were asked to estimate the number of days per week that they employed each coping behaviour in response to food insecurity issues as well as their perception on how worried they would be to adopt each strategy (based on a three-point scale from 1 (not worried) to 3 (very worried)). Household's perceived severity scores for each coping strategy behaviours were similar to previously published severity scores by Maxwell (1996) and Darling (2014) (Appendix M). Within this study, the CSI was calculated based on the weekly frequency of each coping strategy multiplied by the published severity scores by Maxwell (1996) and summed across the six strategies.

Food Adequacy Question

Self-assessment subjective measures of current food security status are commonly used in the literature to assess food security (Maxwell et al 2013). Within this study, a food adequacy question concerning whether household food consumption was ''more than adequate''; ''just adequate''; and, ''less than adequate'' were used to assess current household food security status over the past 7 days.

Table 7-3 Summary of food consumption frequency groups, including the FCS eight groups and weights; and the FCGs thresholds.For more in-depth information on calculation of the FCS and FCGs as well as details of weights applied, see the technical document provided by World Food Programme the (WFP) (World Food Programme, 2008).

Food Group	Food Item	Weight
Eight Key Groups (FCS):		
Cereals, tubers, and root crops	Maize, rice, bread and other cereals; cassava, potatoes and sweet potatoes, cocoyam, etc.	2
Pulses	Beans, peas, groundnuts and cashew nuts.	3
Vegetables	Vegetables, relish and leaves (incl. carrots, pumpkin, cabbage, Nkhwani, rape seeds).	1
Fruit	Fruits (incl. mango, papaya).	1
Meat, Eggs and Fish	Poultry, beef, goat, pork, eggs and fish.	4
Milk	Milk, yogurt and other dairy.	4
Sugar	Sugar and sugar products.	0.5
Oils	Oils, fats and butter.	0.5
Other Food Groups:		
Vitamin A rich foods	Milk, Sweet potato, carrot, pumpkin, other green, mango, papaya.	N/A
Protein rich foods	Pulses, milk, meat, Fish and Eggs	N/A
Food Consumption Groups	**Value**	
Poor Food Consumption	0 to 21	
Borderline Food Consumption	21.5 to 35	
Acceptable Food Consumption	>35	

7.4 Results

Here, I assess the effect of aquaculture on household food security, measured by a range of food security indicators (including Food Consumption Score, Food Consumption Groups, Food Consumption Patterns, Coping Strategies Index, cultural preferences and food habits) and non-food indicators (e.g. household wealth, gender, fish farming status), and how households cope with short-term food shortages. I evaluated the influence of small-scale aquaculture on households in two fish farming communities in Malawi. Specifically, I assessed the social and economic drivers of household food security, quantified whether involvement in fish farming affected household food security, and evaluated the contribution of fish farming livelihoods and other socio-economic conditions to household food security. The results section is presented according to key dimensions of the SLA as well as disaggregated by food security measures. A total of 137 interviews were conducted with heads-of-households in two villages; Makawa (n=63); Malundu (n=74). In each village, I surveyed households that were engaged in fish farming (n=62) and households that were not engaged in fish farming (n=75). Table 7.4 provides a summary of key indicators and results by household type. In addition, further results are presented in Appendix K and all statistical tests can be found in Appendix J. Due to the case study and small sample size, the results are limited in the ability to generalise beyond the sample population. However, the aim of the study was not to achieve predictive power but rather to adopt a case study and mixed methodology approach to provide rich insights into the complexity of the relationship between aquaculture and food security that can inform future larger scale research. In addition, through triangulation with qualitative methods, as discussed in Chapter 8, further insights into directions of associations can be gained and validation of findings increased.

7.4.1 Livelihood Capital Assests

Human Capital

Fish farming and non-fish farming households were comparable in some demographic characteristics and in relation to the obtainment of capital assets while different in others (See Table 7.4 below). Respondents in fish farming and non-fish farming households had similar ages, size of households, marital status for head of household, composition of ethnicities and faiths, percentage of female headed households, level of education and number of literate household members (Independent sample t-tests, Chi Square tests and Mann-Whitney U tests, all p.>0.05) (See Appendix J). Across the full sample, females headed 65% (n=89) of households, the majority of respondents were married (67%, n=91) and very few obtained secondary level education (9% n=12). Fish farming household typically had more number of adults in the household (Mann-Whitney U=1653.0, p=.0.002, p≤.05, 2-tailed) than non-fish farming households (table 7.4). Whereas, non-fish farming households typically had more number of household members who had fallen ill in the past 4 weeks (χ^2 (1, N=137) = 4.337, p=0.037) than fish farming households (table 7.4). Findings further revealed similarities and differences in demographic characteristics and the obtainment of human capital assets of households by village (see table 7.9, in Appendix K). Typically, households from Malundu had a higher number of literature members in the households and level of education status of the household head than households from Makawa (Chi Square tests and Mann-Whitney U tests, all p.>0.05) (See Appendix J). Households from

Makawa had a higher proportion of female heads of households ($\chi^2(1,N=137)= 8.414$, $p=0.004$) than households from Malundu.

Natural Capital

The majority of all households owned land (98.5%, n=135) which was predominantly used for farming purposes (76%, n=104), irrespective of household type or village (Fishers exact test results, p=>0.05) (See appendix J). There was a significant difference between total land size (ha) and household type (Mann-Whitney U=1787.000, p=<0.033, p≤.05, 2-tailed) and village (Mann-Whitney U=1738.500, p=<0.018, p≤.05, 2-tailed). Typically, fish farming households owned larger size of land for farming (average 0.74 total land size area (ha)) than non-fish farming households (average 0.52 total land size area (ha)) (Table 7.4). Furthermore, households from Malundu owned larger size of land for farming (average 0.72 total land size area (ha)) compared with households from Makawa (average 0.50 total land size area (ha)) (see table 7.9, in Appendix K). There were significant differences between type of water source for drinking, washing and domestic purposes and household type and village (all statistical tests p=<0.05). Typically, fish farming households had greater access to safe sources of water for drinking, washing and domestic purposes than non-fish farming households (Table 7.4). Furthermore, households from Makawa had greater access to safe sources of water for drinking, washing and domestic purposes than households from Malundu (see table 7.9, in Appendix K).

Physical Capital

Two indicators were used to quantify physical capital: access to electricity and household ownership of assets. The majority of all households had no access to electricity with only a few households from Malundu 1.5% (n=2) reporting to have access to electricity from solar sources (see table 7.9, in Appendix K). Table 7.4 shows the percentage of household ownership of assets according to three categories- consumer goods, production durable goods and household dwelling goods - by household type. Fish farming and non-fish farming households were comparable in most ownership of household asset items (such as motorcycle, bicycle, ox cart, phone, radio, fishing boats, fishing nets, TV, iron sheet roofing) while different in a few others. As expected, a significant difference occurred between household type and ownership of fishing ponds (X2(1,N=137)= 28.329, p=<0.001) with only fish farming households reporting ownership of this type of asset (38%, n=20). Typically, a higher percentage of fish farming households (17%, n=9) owned modern furniture compared with non-fish farming households (6%, n=3) (X2(1,N=137)= 4.697, p=0.030) (See appendix J, table A for all statistic results).

Household wealth was further evaluated by a multivariate Wealth Index based on the presence or absence of various household assets, such as a radio, dwelling characteristics and source of safe or unsafe drinking water (Rutstein, and Johnson. 2004). These items were combined in a Principal Component Analysis (PCA) where the first PCA axis explained 24% of the variation in wealth among households. A bicycle, phone and radio items categorised as electronics and transport goods loaded strongly on component 1 (see Appendix I for PCA results). Ownership of a bicycle was selected to be the simpler factor and used in further analysis as a proxy for household wealth.

Financial Capital

This section looks at financial capital, measured according to three indicators: ownership of liquid assets in the form of livestock, household expenditure and percentage of households with savings. Fish farming and non-fish farming households were comparable in all ownership of livestock (poultry, guinea fowls, ducks, goats, cattle) (all statistical tests p=>0.05) (Table 7.4). There was a significant difference between ownership of poultry livestock and village type (*(X2(1,N=137)= 4.697, p=0.030*) (see table 7.9, in Appendix K). Typically, households from Malundu owned more poultry livestock (71%, n=44) compared with households from Makawa (41%, n=18). Households were further asked about household expenditure over the past week(s), month by expenditure item. Milling fees (93%, n=127), personal beauty (88%, n=119), clothes (60%, n=81), health care (58%, n=79) and education (46%, n=62) were the most common expenditure items by all households (table 7.10, appendix K). There was a significant difference between the top ranked type of priority area of expenditure and household type, village and gender (p=>0.05). Typically fish farming households prioritised milling fees first (11%, n=14) where as non-fish farming households prioritised expenditure on both milling fees and personal beauty (both, 17%, n=22) (Figure 7.11, appendix K). Approximately 45% (n=50) of all households reported to have financial savings. Although a slightly high percentage of fish farming households had savings (24%, n=27) compared with non-fish farming households (21%, n=23), there was no significant difference (p>0.05).

Social Capital

Three indicators were used to quantify social capital: the mutual relationship with relatives in relation to food, cash and changes over time; whether the household was affiliated to a local group by type of group and what benefits were received. Overall, the majority of all households had both given and received food to relatives over the past 12 months (69%, n=95). There was a significant difference between household type and whether households gave or received food from relatives (p=0.006) (table 7.11, appendix K). A higher proportion of non-fish farming households (44%, n=60) both gave and received food from relatives compared with fish farming households (23%, n=35). Overall, the majority of all households did not give or receive cash to relatives (45%, n=62) with some households stating they both gave and received cash (30%, n=42) over the past 12 months. There was no significant difference between whether households gave/received cash and household type ($p>0.05$) (table 7.11, appendix K). Overall, the majority of households stated that forms of mutual aid had stayed the same (57%, n=78) with many also indicating a decrease (35%, n=48) over the past 12 months. There was no significant difference between changes in mutual aid and household type ($p=0.531$) (table 7.11, appendix K).

Overall, 75% (n=102) of all households indicated that a household member was affiliated to a local group. There was a significant difference between the percentage of household members affiliated to a local group and household type ($p=0.003$). Typically, more fish farming households (87%, n=54) were affiliated to a local group compared with non-fish farming household (65%, n=48) (see table 7.4). In relation to type of membership affiliation, type of affiliation group was similar for both fish farming and non-fish farming households with the majority of households affiliated to a local governance committee (18%, n=57) followed by local festivals (15%, n=49) and a community group (13%, n=43). There was a significant difference between membership of a NGO supported group ($p=<0.001$) between household type. Typically, a higher percentage of fish farming households were affiliated to a NGO supported group (48%, n=26) compared with non-fish farming households (15%, n=7). The type of benefits received differed by association group. Difference in benefits was revealed across affiliation type (Figure 7.12, appendix K). Of the households affiliated to a community group, the most common benefits identified were security (34%), followed by get help from others (33%) and recognition (11%). In relation to membership of a governance committee, the majority of households identified satisfaction (41%), economic (29%) and get help from others (21%) as common benefits. Households affiliated to a NGO group commonly identified economic (21%) benefits. Households participating in festivals commonly identified obtained help from others (36%) and no benefits (28%).

7.4.2 Livelihood Strategies

Respondents were asked about the number and type of livelihood income activities employed over the past 12 months as well as their importance to household income (primary, secondary, tertiary and fourth). The vast majority of households were engaged in two livelihood income activities (See Table 7.4) with fish farming households typically engaged in a greater diversity of occupations (Mann-Whitney $U=1521.000$, $p=<0.001$, $p\leq.05$, 2-tailed) compared with non-fish farming households. There was a significant difference between the ranked primary livelihood activity and household type ($X2(11,N=134)= 21.893$, $p=0.025$) and village ($X2(11,N=134)= 38.867$, $p=<0.01$) (See

Table 7.4 below). Typically, the majority of fish farming households were primarily engaged in farming (42%, n=26), agricultural wage labour (11%, n=7), petty business (10%, n=6) and fishing (10%, n=6). In contrast, the majority of non-fish farming households were primarily engaged in farming (32%, n=23), petty business (26%, n=19), non-agricultural wage labour (14%, n=10) and agricultural wage labour (13%, n=9). Only 3% (n=2) of fish farming households reported fish farming to be their primary livelihood income activity, contributing an average 70% to household income. However, the majority of households revealed fish farming to be a secondary (13%, n=8), tertiary (47%, n=16) or fourth (33%, n=4) overall livehood income generating activity.

Table 7.4 shows farming preference by type between fish farming and non-fish farming households. There was a significant difference between farming preference and household type *(X2(3,N=107)= 9.735, p=0.021).* Typically, fish farming households preferred to farm crops (42%, n=12), followed by livestock (excl. chicken) (24%, n=12) and fish (20%, n=10). In contrast, non-fish farming households preferred to farm livestock (excl. chicken) (44%, n=25), followed by crops (37%, n=21) and poultry (16%, n=9). Household farming preference was similar across villages with no significant association *(X2(3,N=107)= 1.812, p=0.612)*. The most common reasons for farming preference selected among all households were higher income (44%, n=69), preferred food consumption (20%, n=31), ease of practice (14%, n=22) and higher yields (11%, n=17) (See also table 7.12 and figure 7.13 appendix K). All households were further asked what would be their preferred role to partake in within the fisheries sector - fish farming, capture fisheries (fishing and other fishing business) fish processing, fish trading. The preferred type of fisheries sector role was similar between fish farming and non-fish farming households (p=0,489) (table 7.13, appendix K). Overall, the most popular roles preferred by all households were fish farming (60%, n=80) and fish trading (23%, n=32) with few opting for fishing or fish processing (1.5%, n=2 for both). There was a significant difference between preferred type of fisheries sector role and village type (p=<0.001). Whilst the majority of households from Makawa and Malundu preferred to partake in fish farming, slightly more households from Makawa preferred to partake in fish trading compared with households from Malundu (table 7.13, appendix K).

Fish farming households were further asked about their perspective concerning the importance of fish farming to their household. Of the respondents that replied (n=30), the majority of fish farmers stated that fish farming was an important source of household food (52%, n=16), income (48%, n=15) as well as being important to the wider community (40%, n=12) (table 7.14, appendix K). There was a difference between perceived importance of fish farming and village type. In Makawa, the majority of households perceived fish farming to be important to the wider community (40%, n=12) whereas fish farming households in Malundu perceived fish farming to be important to household food (52%, n=16) and income (48%, n=15). Non-fish farming households were asked about whether they would consider becoming involved in fish farming and if yes, whether there were any constraints to entering into fish farming. Over 65% of all non-fish farming households (n=49) stated they would consider adopting fish farming. There was no significant difference between non-fish farming households considering to adopt fish farming and village type (p=>0.05). Furthermore, the majority of non-fish farming household (80%, n=41) revealed constraints to wishing to adopt fish farming. Figure 7.14 (appendix K) shows the reported type of constraints to joining fish farming by non-fish farming households across villages. There was a significant difference between the perceived type of constraint to joining fish farming and village type (p=0.007). Typically, non-fish farming households from Malundu identified a higher number of constraints than non-fish farming households from Makawa. The major constraints to joining fish farming identified by non-fish farming households from Malundu were personal physical constraints (26%, n=7), theft (22%, n=6) and cost of construction (11%, n=3). In contrast, the major constraints to joining fish farming identified by non-fish farming households from Makawa were membership challenges (43%, n=6), personal physical constraints (22%, n=3) and time constraints (22%, n=3).

7.4.3 Vulnerability Context

Our analysis further explores exposure of household livelihoods to stressors and shocks over the past 12 months and their impact to household income, assets, production, food stocks and food production. Figure 7.1 shows the percentage of households experiencing one or more shocks over the past 12 months by shock type between fish farming and non-fish farming households as of 2015. The data demonstrates that livelihood stressors and shocks arise from multiple sources, including social, ecological and economic disturbances. The most common shocks experienced by all households were flooding (93%, n=125), followed by high prices for food (85%, n=115), drought (63%, n=84) and high level of crop pests or disease (50%, n=68). Overall, the most commonly ranked most severe shock experienced by all households over the past 12 months was flooding (49%, n=66), followed by a high price for food (13%, n=18) (See Table 7.15, appendix K). There was a significant difference between the top ranked most severe shocks and household type (p=0.047). For example, the most common ranked most severe shocks experienced by fish farming households were flooding (51%, n=31), high prices for food (12%, n=7), drought and high costs for agricultural outputs (both 8%, n=2). In contrast, the most commonly ranked most severe shocks experienced by non-fish farming households was flooding (48%, n=35), high prices for food (15%, n=11), serious illness (10%, n=7) and death of a household member (8%, n=6). Table 7.16 (appendix K) shows the impact of shocks to income, assets, food production, food stocks and food purchases (according to whether they increased, stayed the same, or decreased) by household type. Overall, the majority of households reported a decrease to income, assets and food production as a result of shock(s) experienced in the past 12 months. However, there was a significant difference between type of impact to food stocks (p=0.017) and food purchases (p=0.038) from shock(s) experienced over the past 12 months by household type. For example, all non-fish farming households reported a decrease to food stocks (100%, n=73) compared with fewer fish farming households (92%, n=56).

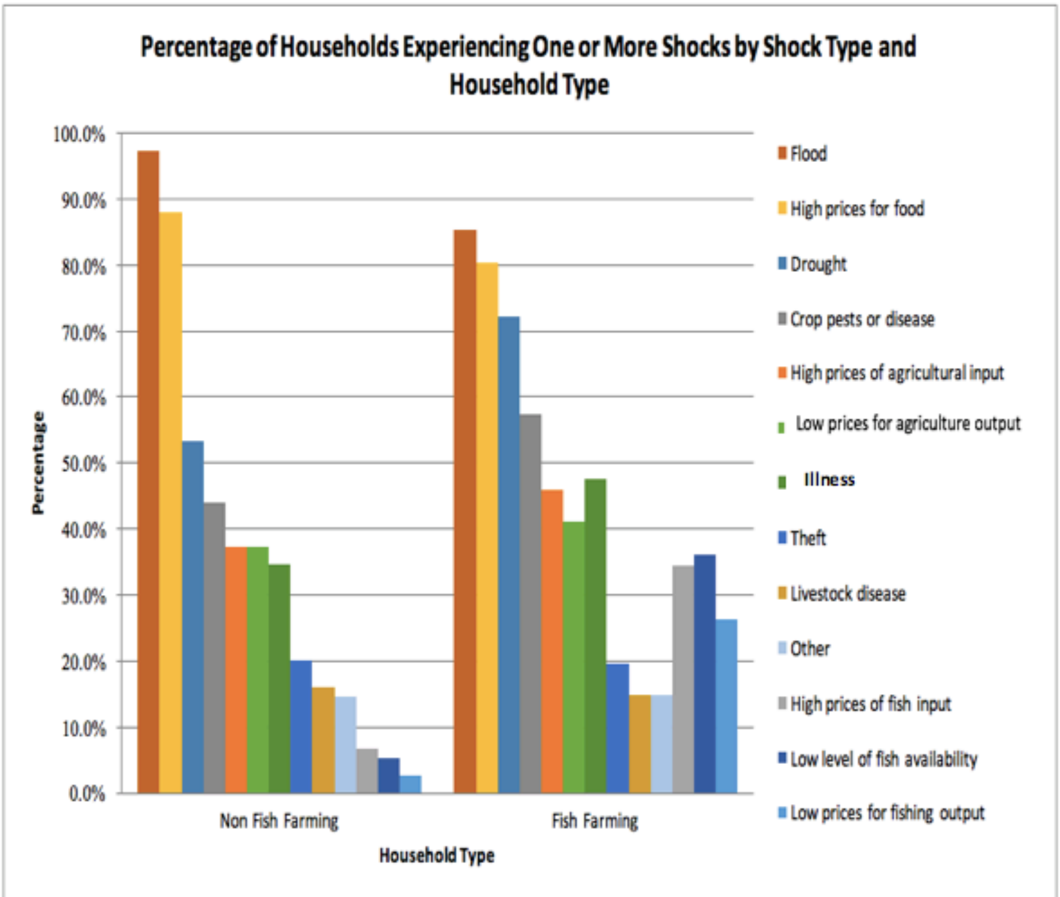

Figure 7-1 Summary of exposure to stressors and shocks between fish farming and non-fish farming households. Bars indicate percentage of total survey respondents that experienced each stressor or shock in previous 12 months.

Table 7-4 Summary of household demographic characteristics by household type.

	Non-Fish Farming Household		Fish Farming Household		P-Value**
	N	% / mean (SD), median [range]*	N	% / mean (SD), median [range]*	
HUMAN CAPITAL					
HH Head Gender	75		62		0.238
Female	52	69%	37	40%	
Male	23	31%	25	60%	
HH Head Marital Status	75		61		0.058
Married	45	60%	46	75%	
Divorced	13	17.3%	9	15%	
Never Married	4	5.3%	0	0%	
Widowed	13	17.3%	6	10%	
HH illness/ injury past 4wks	66	88%	46	74%	0.037*
HH Head Age	72	37 (18 to 88)	62	40.5 (20 to 75)	0.538
HH Size	75	4.65 (-2.03)	62	4.9 (-1.79)	0.451
No. Literate People in HH	74	2 (0 to 7)	61	2 (0 to 6)	0.158
HH Head Education Level	**75**		62		0.261
Primary	52	69%	50	81%	
Secondary	7	9%	5	8%	
Never Been to School	16	21%	7	11%	
Ethnicity of HH	75		62		0.296
Chewa	4	5%	2	3%	
Lomwe	17	23%	8	13%	
Yao	32	43%	27	44%	
Nyanja	21	28%	25	40%	
Sena	1	1%	0	0%	
Religion of HH	75		62		0.052
Catholic	4	5%	3	5%	
Christian	31	41%	21	34%	
Church of Christ	5	7%	0	0%	
Islam	34	45%	38	61%	
Jehovah's Witnesses	1	1%	0	0%	
NATURAL CAPITAL					
Land Ownership	74	99%	61	98%	1.000
Total Size of Land (ha)	74	0.52 (0.042) Median 0.40 (0 to 2)	61	0.74 (0.086) Median 0.51 (0 to 4)	0.033*
Source of Drinking Water:					0.003*
Safe	34	45%	45	73%	
Unsafe	41	55%	17	27%	
PHYSICAL CAPITAL					
Access to Electricity	1	1.3	1	1.6	

HH Assets:					
Consumer Goods	31	41%	29	47%	
Production Durable Goods	2	3%	26	42%	
Household Dwelling Goods	11	15%	21	34%	
FINANCIAL CAPITAL					
Livestock Ownership					
Chickens	32	60%	30	57%	0.503
Livestock Other	10	13%	19	31%	0.267
HH with savings	23	21%	27	24%	
SOCIAL CAPITAL					
HH Membership Type					
Political Party	3	6%	4	7%	1
Community Group	25	52%	18	33%	0.078
Governance Committee	25	52%	32	59%	0.466
NGO Supported Group	7	15%	26	48%	<0.001*
Participation in Festivals	26	54%	23	43%	0.321
Other Associations	21	44%	12	22%	0.028*
LIVELIHOOD STRATEGIES & SHOCKS					
Top (1st) ranked livelihood	72		62		0.025*
Farming	23	31.9%	26	41.9%	
Livestock	1	1.4%	0	0.0%	
Fish Farm	0	0.0%	2	3.2%	
Fishing	1	1.4%	6	9.7%	
Fish Trading	2	2.8%	1	1.6%	
Firewood	1	1.4%	3	4.8%	
Agriculture Wage Labour	9	12.5%	7	11.3%	
Non Agriculture Wage Labour	10	13.9%	4	6.5%	
Petty Business	19	26.4%	6	9.7%	
Business	3	4.2%	5	8.1%	
Urban Remittance	0	0.0%	1	1.6%	
Other	3	4.2%	1	1.6%	
Number of occupations	75	2 (0 to 7)	62	3 (1 to 9)	
Farming Preference					0.021*
Crops	21	37%	21	42%	
Livestock (excl. chicken)	25	44%	12	24%	
Poultry	9	16%	7	14%	
Fish	2	4%	10	20%	
FOOD SECURITY:					
Food Consumption Score (FCS) over 7 days	75	32.59 (1.443)	62	37.6 (1.707)	*0.021**

** All statistical tests results can be found in Appendix J. Note: Safe drinking water=Protected wells, boreholes, piped water; Unsafe drinking water= unprotected wells, river; Consumer Goods =A car, motorcycle, a bicycle, a phone, a radio, sewing machine, TV; Production Durable Good= An ox cart, fishing boats, fishing nets, fish ponds, treadle pump, plough; Household Dwelling Goods= Iron sheet roofing, cement flooring, modern furniture; Livestock Other =Guinea fowls, ducks, goats, cattle, pigs).

7.4.4 Livelihood Outcomes – Food Security

Dietary diversity and food consumption frequency (food access, dietary quality)

Food Consumption Patterns

Figure 7.2 below shows a summary table of the frequency of consumption of eight major food groups in an average week by household type. Fish farming and non-fish farming households consumed significantly similar diets as described by the average weekly consumption of cereals; pulses; fruit; meat, fish and eggs; and oils (MANOVA, Pillai's Trace= 0.075, $F (8, 128) = 1.303$, $p= 0.248$, partial $\eta^2 = 0.075$). Fish farming households consumed slightly more animal protein (2.76 days week) and vegetables (4.29 days week) than non-fish farming households (2.04; 3.44 respectively days week). Key food groups high in nutrition (protein and vitamin A rich foods) as well as a food group for fish consumption were also constructed by household type and village. There was not a significant difference between fish farming and non-fish farming households when considered jointly on the variables consumption of fish, vitamin A rich foods and protein rich foods (MANOVA, Pillai's Trace= 0.001, $F (3, 133) = 0.054$, $p= 0.983$, partial $\eta 2 = 0.001$). Overall, a high percentage of households did not consume or reported low consumption frequency of vitamin A nutrient rich foods suggesting a high risk of vitamin A deficiencies among fish farming and non-fish farming households (Figure 7.3).

Meals per day by HH member

There was not a significant difference between the number of meals per day by household member and household type (MANOVA, Pillai's Trace= 0.026, $F (4, 132) = 0.898$, $p= 0.467$, partial $\eta 2 = 0.026$). Table 7.17 (appendix K) shows that across all households the median number of meals per day for adults and children was 2. The average number of meals per day for adults and children were similar in households across both villages (table 7.17, appendix K).

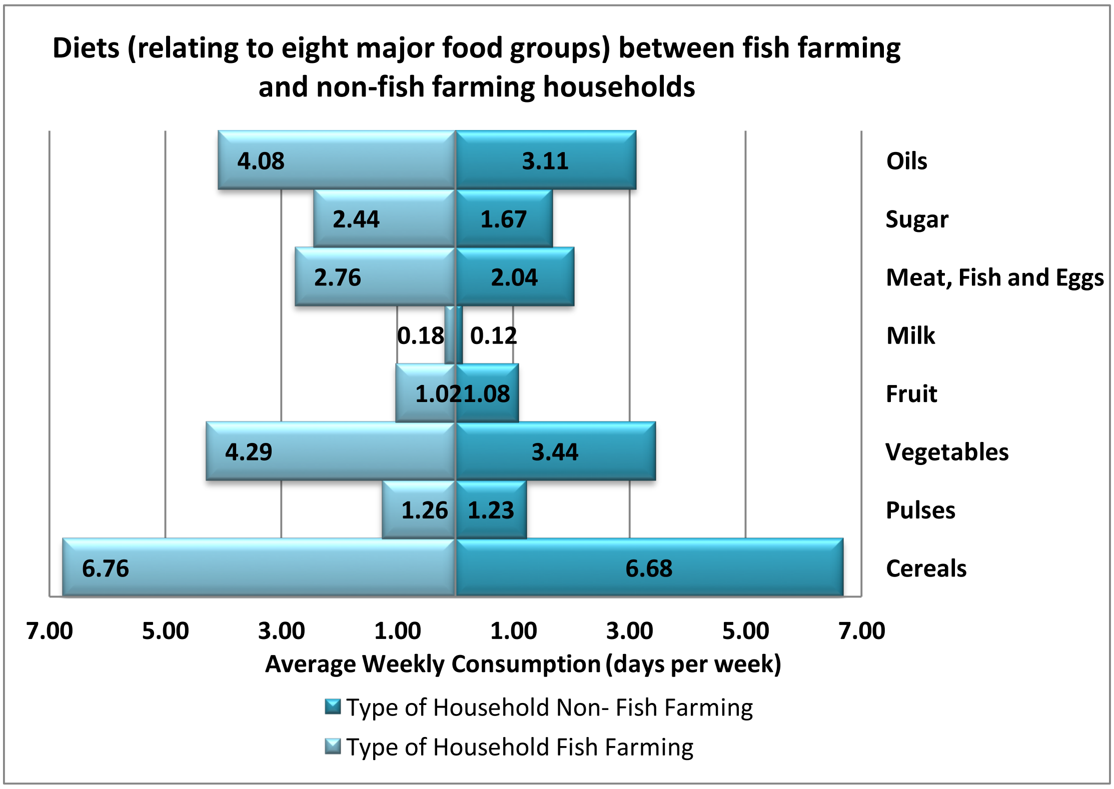

Figure 7-2 Diets of fish farming and non-fish farming households as described by the average weekly consumption of eight major food groups (days per week).

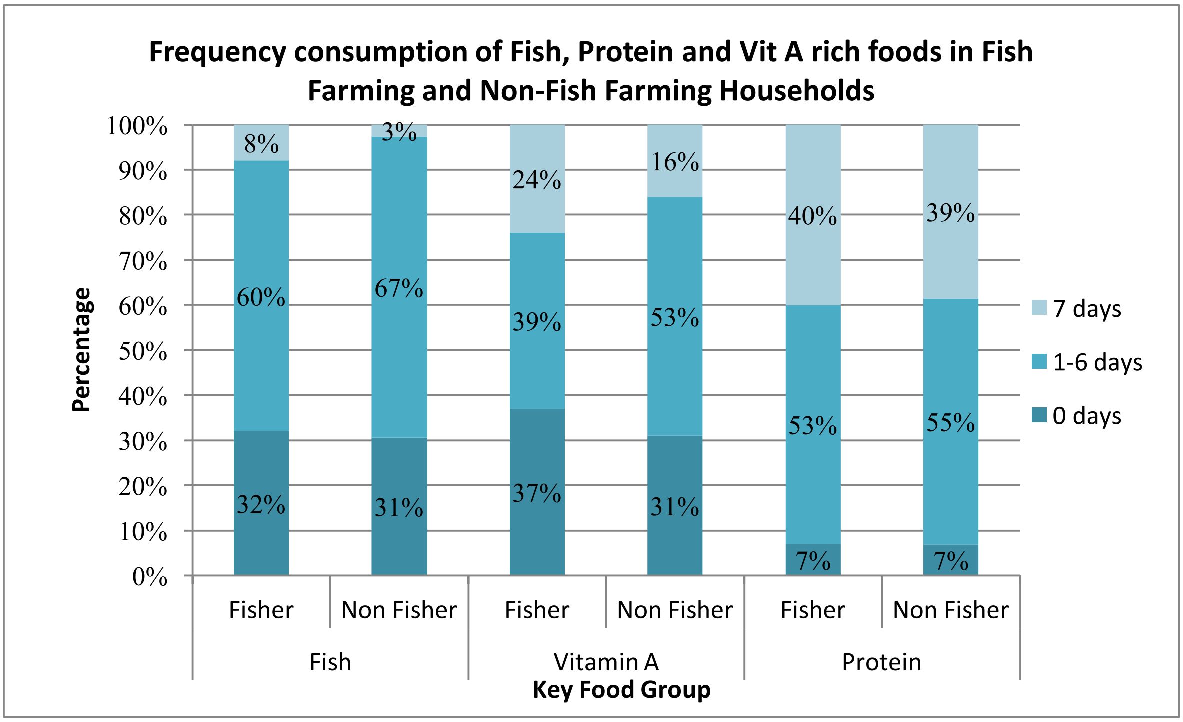

Figure 7-3 Frequency consumption of Fish and Protein and Vitamin A rich foods in Fish Farming and non-Fish Farming Households.

Fish Consumption Characteristics

Over 70% of all households (n=101) consumed fish over the past 7 days. Households were asked about what species of fish was consumed, its source and preservation type (fresh, sun-dried, smoked, iced, other). Figure 7.4 shows the percentage of household fish consumption over the past 7 days by species and household type. A total of 15 different species were consumed by all households with the most commonly consumed species being Matemba (50%, n=51), Mlamba (26%, n=26) and Chambo (18%, n=18) (see table 7.18, appendix K and summary of species in appendix L). Fish species consumption differed between household type and village (see table 7.18, appendix K). In relation to source of fish consumed in the past 7 days, the majority of households consumed fish from Lake Malawi (41%) and Lake Chilwa (40%) with few from aquaculture (3%) (figure 7.15, appendix K). Source of fish differed between fish species (figure 7.16, appendix K). For example, species Makumba (100%), Dondolo (50%) and Matemba (4%) were reported to be completely or part sourced from aquaculture. In relation to preservation type of fish species consumed in the past 7 days, the majority of households consumed sun dried (42%) or fresh (35%) fish (figure 7.17, appendix K). Fish preservation type varied by species with all farmed fish consumed eaten fresh (figure 7.18, appendix K). Fish consumed were obtained from cash purchases, own production/hunted or as a gift. The majority of households, both fish farming and non-fish farming, obtained fish from income purchases (86%). On average, the percentage of fish consumed derived from own production was higher among fish farming households (13%) compared with non-fish farming households (4%). In addition, a significantly higher number of non-fish farming households derived consumed fish via a gift (10%) compared with fish farming households whom reported no consumption via a gift ($p<0.05$). Fish farming households were therefore associated with higher levels of consumed fish obtainment through income purchases and own production.

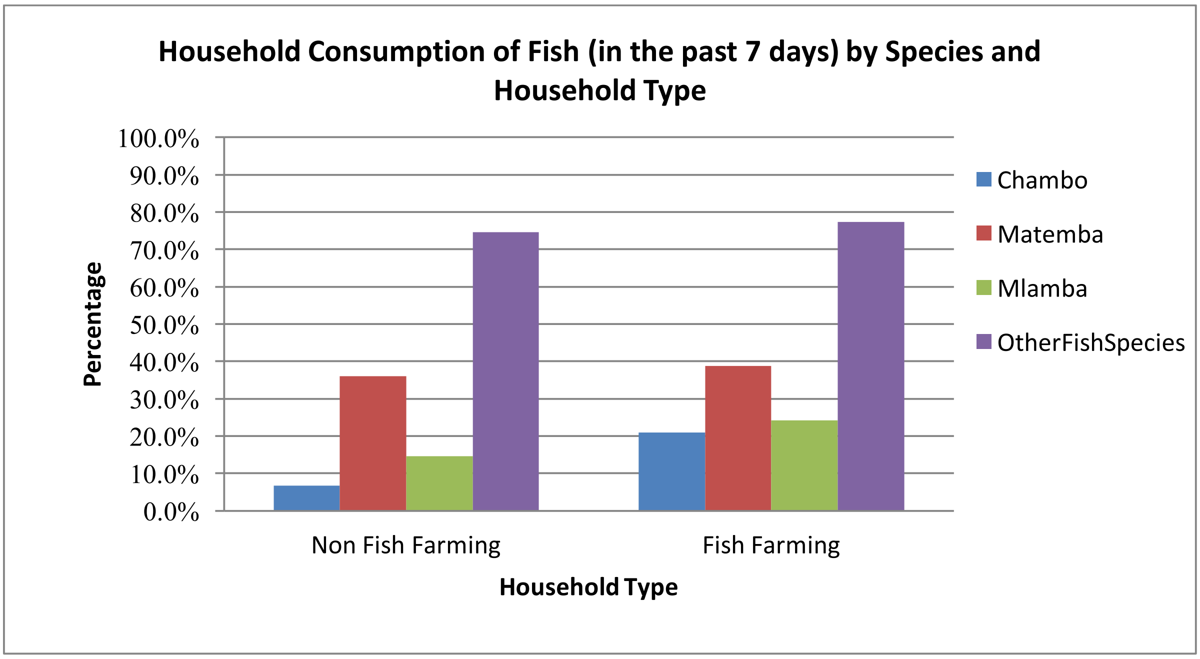

Figure 7-4 Fish Consumption by Species and Household Type- (Category 'Other' includes fish species: Bonya, Dondolo, Makumba, Mbaba, Ncheni, Mputa, Njole, Makakana, Njolingo, Nthibidi, Usipa, Utaka). See Appendix L for a full list of fish species names.

<u>Food consumption score</u>

A Food Consumption Score (FCS) was constructed to allow for a better comparison of food consumption between groups (as outlined in section 5). There was a significant difference between FCS and household type *(Mann-Whitney U=1793.0, p=.0.021, p≤.05, 2-tailed)* and village *(Mann-Whitney U=1581.0, p=.0.001, p≤.05, 2-tailed) (see tables 7.14 and 7.15 in appendix K)*. Typically, fish farming households had a higher average food consumption score (37.6) than non-fish farming households (32.59). Furthermore, households from Malundu had a higher average food consumption score (37.56) than households from Makawa (31.67). To understand the complete level of food security, households were categorised into food consumption groups (FCGs) based on their food consumption score (as outlined in section 5). There was a significant difference between FCGs and household type ($X^2(2, N=137) = 6.247, p=0.044$) (Figure 7.5). A greater proportion of fish farming households (44%) compared with non-fish farming households (40%) had acceptable food consumption. At the same time, fewer fish farming households (6%) than non-fish farming households (21%) had poor food consumption. The results suggest that fish farming households are more food secure than non-fish farming households. However, the pie charts (8.3a. and b.) show that an important proportion of fish farming (56%) and non-fish farming (60%) face inadequate food consumption (poor and borderline food consumption). A significant difference was also revealed between FCGs and village type (X^2*(2, N=137) = 8.987, p=0.011*) (Figure 7.19 appendix K). The majority of households from Malundu have acceptable food consumption (53%) compared with less than a third from Makawa (28%). Furthermore, figure 7.6 shows the disaggregated consumption frequency of fish and nutrient rich food groups between fish farming and non-fish farming households by food consumption groups to provide a more comprehensive picture into diet quality and food security (poor and borderline food consumption are grouped into one and acceptable food consumption). The majority of households classified as food insecure (poor or borderline FC) have a very limited frequency of consumption in fish, protein rich foods and vitamin A rich foods. Furthermore, it was observed that a higher percentage of fish farming households classified as food insecure (51%) did not consume vitamin A in the past 7 days compared with non-fish farming household (35%), suggesting that fish farming households are more vulnerable to vitamin A deficiencies. Figure 7.6 also confirms that an important proportion of households considered with adequate food consumption are facing a risk of vitamin A deficiencies with only 30-40% of all household consuming vitamin A rich foods daily. In relation to frequency of fish consumption, all households classified as food insecure had no or low consumption of fish irrespective of household type.

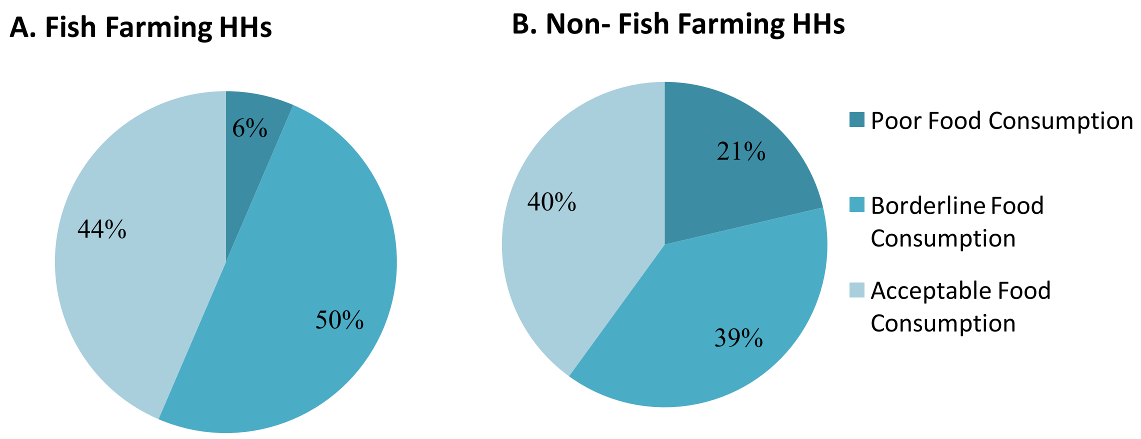

Figure 7-5 Food Consumption Scores according to Food Consumption Groups for (a) fish farming; and (b) non-fish farming households.

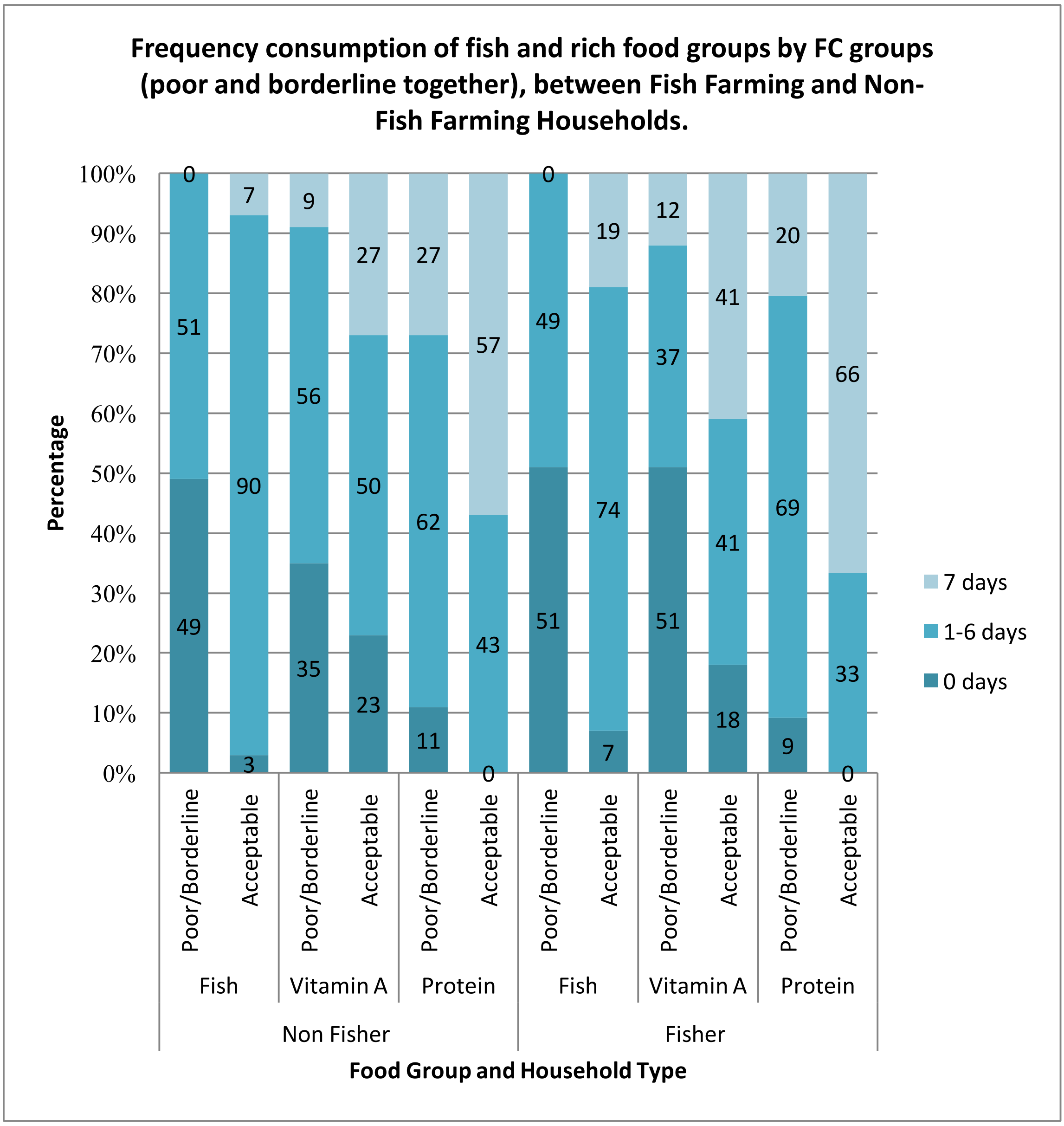

Figure 7-6 Frequency consumption of Fish and Protein and Vitamin A rich foods in Fish Farming and non-Fish Farming Households by poor/borderline grouped and acceptable Food Consumption Group.

Self-Assessment & Cultural Preference

Households were asked whether the quantity of household consumption of fish in the past seven days was adequate according to: more than enough, enough, not enough criterion. Overall, the majority of households stated that their weekly consumption of fish was adequate (82%, n=84). Households were also asked what their preferred fish species to consume was. Overall, households most popular preferred fish to consume was Chambo (33%, n=45), followed by Mlamba (30%, n=40) (Table 7.19, appendix K). There was no significant difference in fish species consumption preference between fish farming and non-fish farming households ($X^2(10, N=135) = 13.856, p=0.180$). There was a significant difference in fish species consumption preference between households from Makawa and Malundu ($X^2(10, N=135) = 39.663, p=>0.001$). Figure 7.7 below shows fish consumption preference and rationale by household type. Overall, household rationale for choosing preferred fish species was due to good taste, size and low cost of purchase. Households were further asked if they faced any constraints to accessing fish for consumption over the past 12 months. The majority of all households (80%, n=109) revealed they faced constraints in accessing fish for consumption with the most common constraints identified as: fish is too expensive to buy (58%, 54% respectively); too expensive to travel to market (23%, 19% respectively) and no money to purchase fish (5%, 15% respectively). There was no significant difference between the type of constraints experienced to accessing fish for consumption between fish farming and non-fish farming households ($X2(6, N=108) = 4.947, p=0.551$) (Table 7.20 appendix K). There was a significant difference between the type of constraints experienced to accessing fish for consumption village type ($X^2(6, N=108) = 26.415, p=0.001$) (Table 7.20 appendix K). Typically, households from Makawa experienced the following major constraints to access fish for consumption: fish too expensive to buy (65%) and no money to purchase fish (14%). In contrast, the majority of households from Malundu experienced predominantly access issues concerning fish for consumption: fish too expensive to buy (47%) and too expensive to travel to the market (39%).

Households were also asked what their preferred animal protein to consume was. There was no significant difference between household animal protein consumption preference by household type and village (p=>0.05). Overall, the most popular type of animal protein to consume by households was chicken (36%), followed by fish (26%) and then goat (25%). Typically, the most popular type of animal protein to consume by fish farming households was fish (30%), followed chicken (27%) and goat (26%) whereas non-fish farming households typically preferred chicken (43%), followed by goat (24%) and fish (21%) (Figure 7.8). Overall, the majority of households reported taste (55%, n=74), cheaper to buy (16%, n=21) and more nutritious (13%, n=18) as the top reasons for selecting their preferred animal protein to consume (figure 7.8). Rationale differed by animal protein type. The majority of households who preferred to consume fish as a source of animal protein (n=35) stated cheaper to buy (37%), taste (23%) and more nutritious (17%) as their rationale.

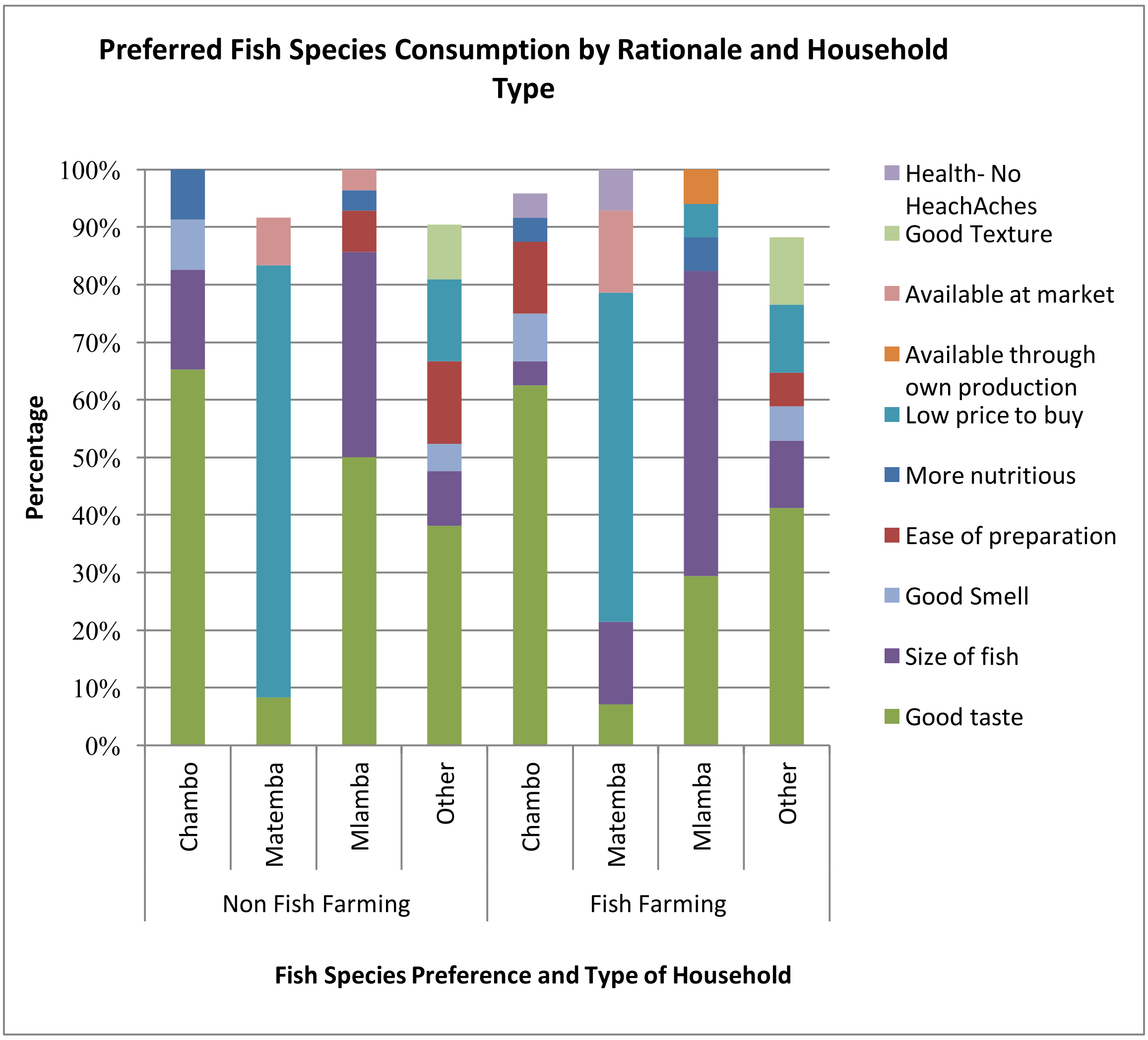

Figure 7-7 Fish Species Preference by Rationale for Fish Farming and Non-Fish Farming Households. (Category 'Other' includes fish species: Bonya, Dondolo, Makumba, Mbaba, Ncheni, Mputa, Njole, Makakana, Njolingo, Nthibidi, Usipa, Utaka). See Appendix L for a full list of fish species names.

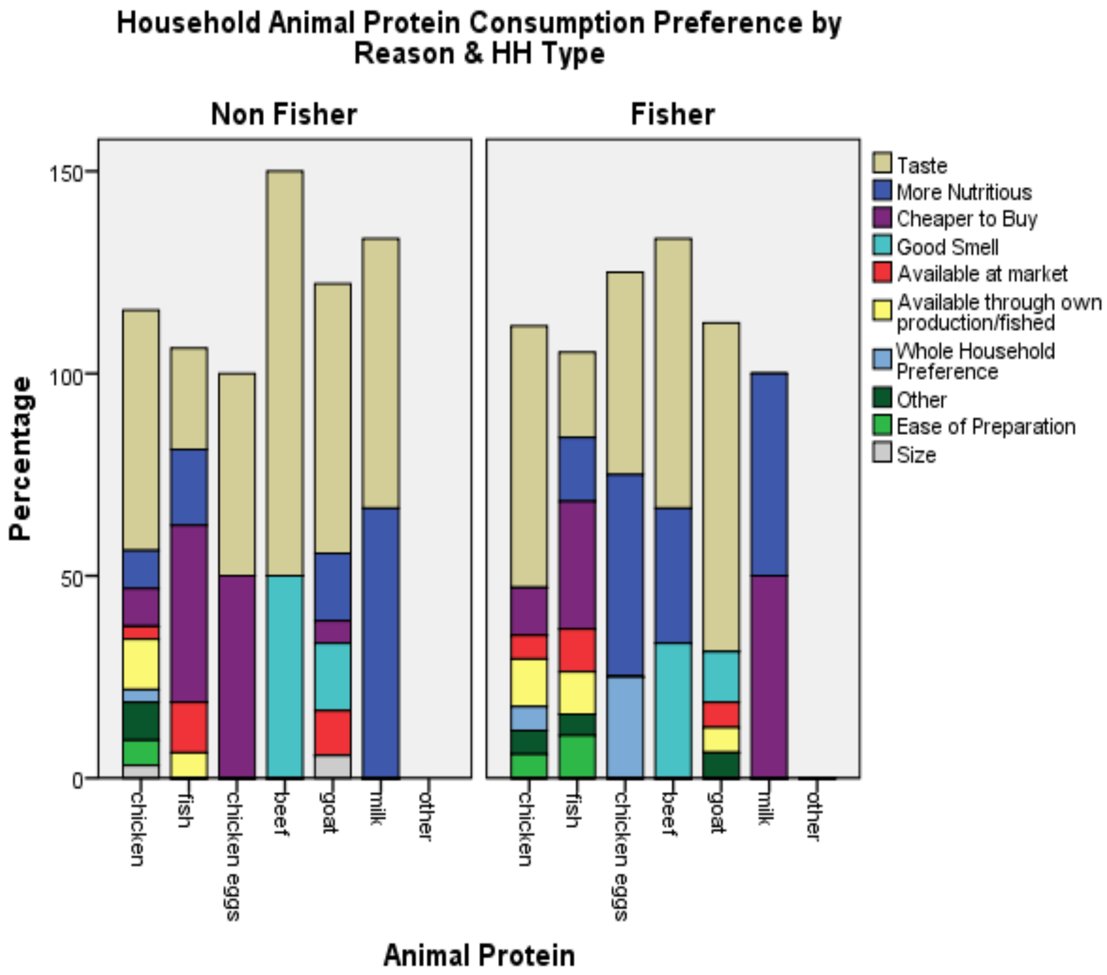

Figure 7-8 Household animal protein consumption preference by rationale and household type.

7.4.5 Food Coping Strategy Index

Each household has a coping strategy index which represents the weighted value of all six behaviours. Table 7.5 provides average FCSI values and average frequency by coping strategy behaviour by household type and village. The data shows that over 80% of all households (n=115) employed one or more coping strategy over the past seven days indicating a problem of food insecurity for the majority of all households surveyed. Overall, the most common employed coping strategies were to eat less preferred food, limit portion sizes and to skip meals. There was no significant difference in the type of coping strategies employed between fish farming and non-fish farming households (MANOVA, Pillai's Trace= 0.069, $F (6, 108)= 1.344$, $p= 0.244$, partial $\eta2 = 0.069$). However, the results revealed that there was a significant difference in the type of coping strategies employed between households from Makawa and Malundu (MANOVA, Pillai's Trace= 0.123, F (6, 108) = 2.535, p= 0.025, partial η2 = 0.123). Typically, households from Makawa more often employed restricting consumption for children (1.43 average days/week) and skipping meals (2.58 average days/week) compared with households from Malundu (0.7 and 1.22 average days/week respectively). All these coping strategies have different severity and thus an analysis of the CSI is used to investigate in more detail the food insecurity status of households by household type and village. Although there was no significant difference in the mean FCSI score between household type *(Mann-Whitney U=1379.5, p=.0.195, 2-tailed)*, fish farming households had a higher average FCSI score (13.35) than non-fish farming household (15.91). There was a significant difference in the mean FCSI score between households from Makawa and Malundu *(Mann-Whitney U=1171.500, p=.0.007, 2-tailed)* with households from Makawa have a much higher FCSI score (17.24) than households from Malundu (12.40).

Households were further asked what coping strategies were employed if households were faced with a situation when they did not have enough food for their household in the past 12 months. Overall, the majority of survey respondents (83% n=88) reported employing one or more coping strategies in response to household food insecurity over the past 12months with the most common strategies identified as: rely on less preferred foods (92%, n=83), limit portion sizes (87%, n=78), skip meals (83%, n=75) and borrow or rely on help (75%, n=67) (table 7.21, appendix K). There were similarities and differences between the type of coping strategies employed to food insecurity over the past 12 months by fish farming and non-fish farming households (Figure 7.9). A higher percentage of non-fish farming households employed the strategies: intensity fishing (7%), consume seed stock (37%), send members to eat elsewhere (26%) and beg (17%) compared with fish farming households (1%, 28%, 8%, 4% respectively). Furthermore, as expected as fish farming households reported the strategy to intensity fish farming in response to food insecurity over the past 12 months which was employed by only a few households (3%). Figures 7.10 below and 7.20 (appendix K) show the ranked causes of household food insecurity over the past 12 months by household type and village. Overall irrespective of household type and village, households most commonly ranked flooding as the most importance cause of not having enough household food in the past 12 months, followed by drought and food too expensive at market. Finally, when asked what food groups were impacted by these causes of household insecurity over the past 12 months, the majority of households reported cereals (99%, n=91) and pulses (33%, n=30) with few households reporting vegetables (3%, n=3) and no reports of meat, fish or fruit being affected (see table 7.22, appendix K).

Table 7-5 Average FCSI values and average frequency by coping strategy behaviour by household type and village.

			Frequency of Coping Strategy (no. days/week)						
			Eat less preferred / expensive foods	**Limit portion sizes**	**Borrow food or money to buy food**	**Preparing food only for the children**	**Skip Meals**	**Going without food for whole day**	**FCSI**
Type of Household	Non Fish Farming	N	67	67	67	67	67	67	**67**
		Mean	2.55	3.13	1.51	1.12	1.79	0.46	**15.91**
		SE	0.278	0.335	0.251	0.187	0.287	0.103	**1.389**
	Fish Farming	N	50	50	50	48	50	50	**48**
		Mean	1.88	2.62	0.72	1.00	2.06	0.36	**13.35**
		SE	0.284	0.364	0.192	0.208	0.394	0.098	**1.563**
Village	Makawa	N	59	59	59	58	59	59	**58**
		Mean	2.42	2.85	1.24	1.43	2.58	0.47	**17.24**
		SE	0.299	0.331	0.234	0.224	0.373	0.095	**1.449**
	Malundu	N	58	58	58	57	58	58	**57**
		Mean	2.10	2.98	1.10	0.70	1.22	0.36	**12.40**
		SE	0.271	0.369	0.246	0.150	0.256	0.109	**1.438**
Total		N	117	117	117	115	117	117	**115**
		Mean	2.26	2.91	1.17	1.07	1.91	0.42	**14.84**
		SE	0.202	0.247	0.169	0.139	0.234	0.072	**1.041**

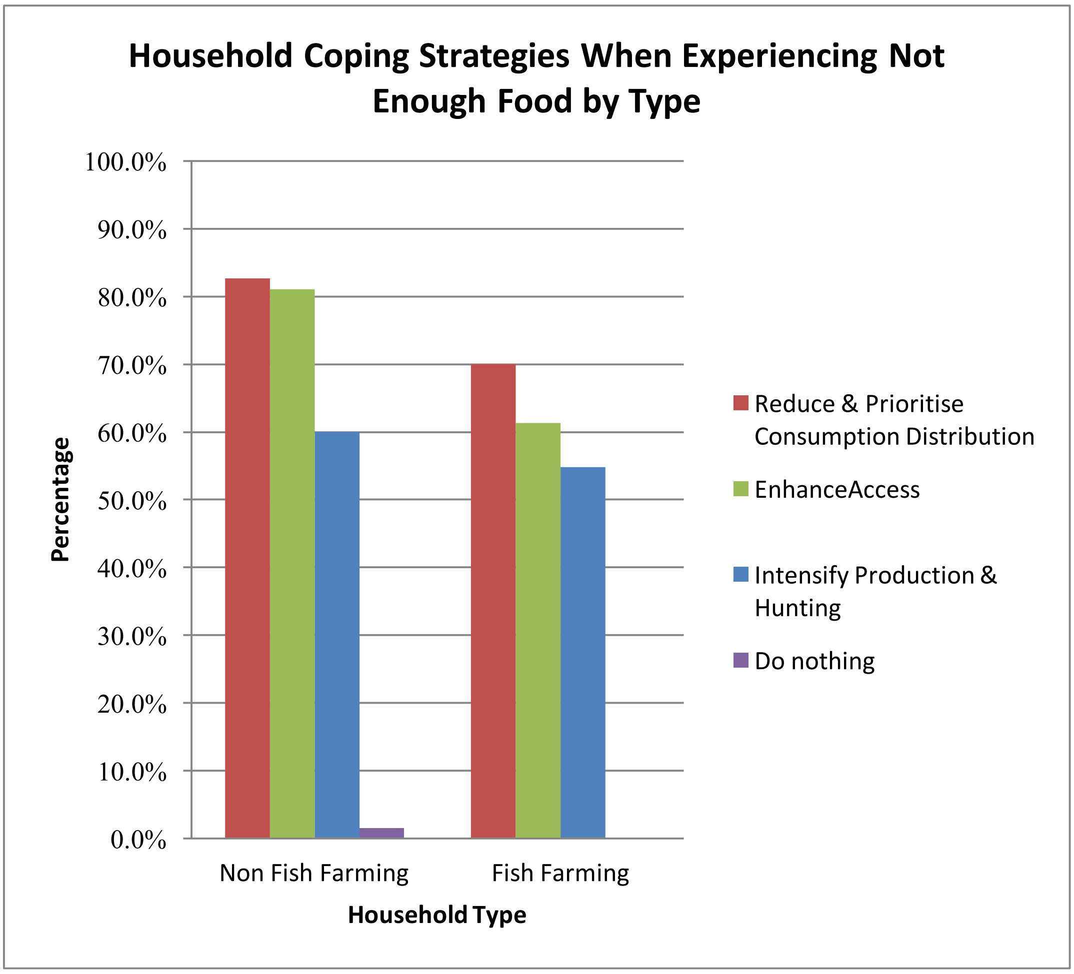

Figure 7-9 Household Food Insecurity Coping Strategies by Household Type. (Category 'Reduce and prioritise consumption' distribution includes: intensify fishing, intensify fish farming, intensify other livelihood activities, fish during closed seasons, use restricted fishing gears; Category 'Enhance Access' includes: less preferred foods, limit portion size, reduce number of meals, skip no days consuming food, prioritise consumption for children and working members of the household; Category 'Intensify Production and hunting' includes: consume seek stock, borrow food, purchase food with credit, send household members to eat elsewhere, beg).

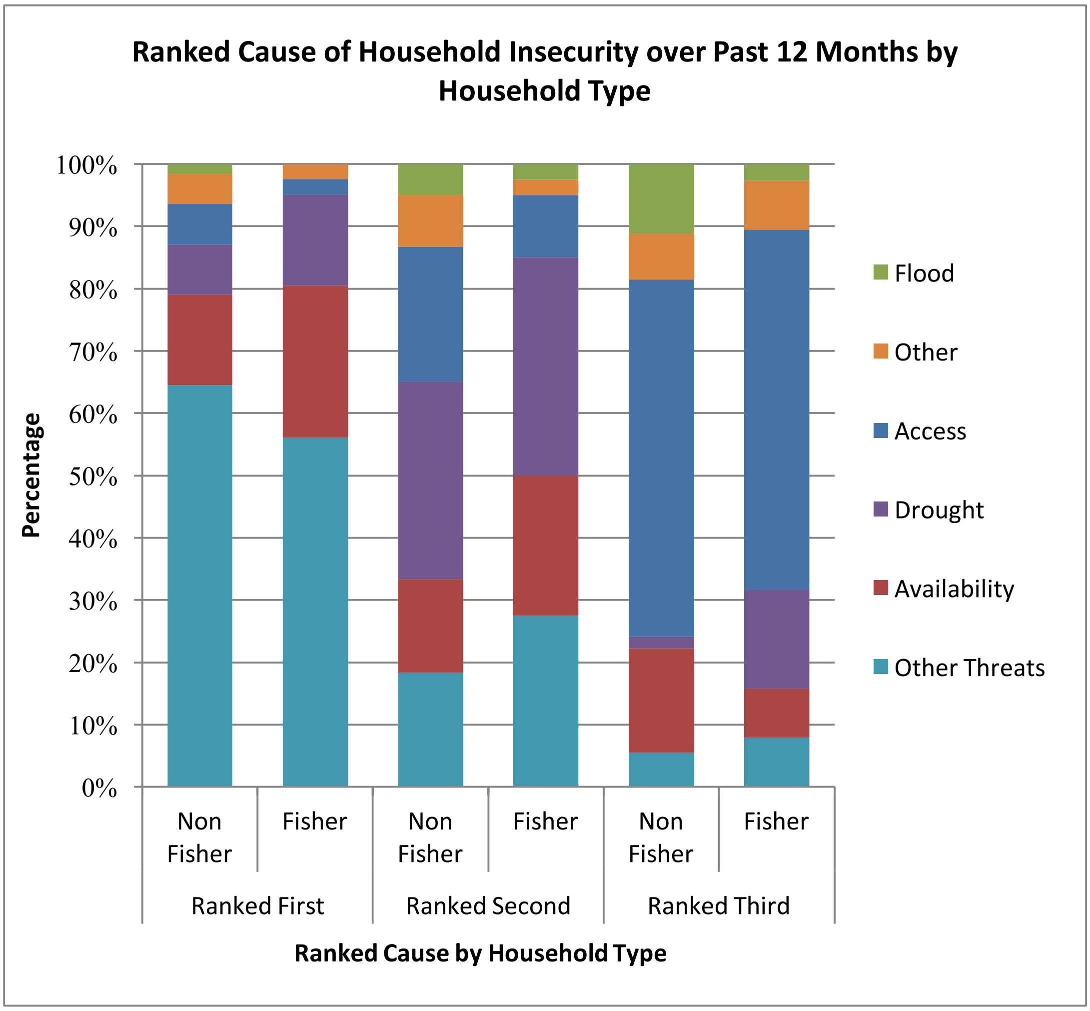

Figure 7-10 Ranked Causes of Household Food Insecurity over the Past 12 Months by Household Type.(Category 'Access' includes: reduction in income, market transport cost, food at the market too expensive, closed season; Category 'Availability' includes: not available at market, too small land, lack of farm inputs; Category 'Other Threats' includes: livestock disease, crop pest damage, theft).

7.4.6 Food Security Validation and Multiple Regression

To validate the diverse indicators used to assess food security, it is common to model the relationship between key variables such as the FCSI with the FCS, Protein Consumption and Household Wealth (As detailed in table 7.6 below). There was a significant negative relationship between CSI and FCS, r (113)= -0.26, p=0.005, as would be expected, meaning that as the CSI increases the FCS decreases. There was a significant negative relationship between CSI and Wealth Index, r (113)= -0.344, p=<0.001.

Table 7-6 Correlations with CSI comparing CSI to other food security proxies.

FCS	Pearson Correlation	-0.26
	Sig. (2-tailed)	0.005
Protein Consumption	Pearson Correlation	-0.236
	Sig. (2-tailed)	0.011
Wealth Index (PCA 1)	Pearson Correlation	-0.344
	Sig. (2-tailed)	<0.001

To further assess and quantify the drivers of food security, a standard multiple regression was applied to assess both food consumption and food vulnerability. For each of the two measures of food security (Food Consumption Score and Coping Strategy Index), I assessed the ability of eight control measures (independent variables) ((Village, HH Type, HH Gender, HH Age, HH Education, HH Size, HH no Occupations, HH Ownership of a Bicycle as a proxy for household wealth (see PCA analysis appendix I) to predict food security (dependent variable). These eight independent variables were measured as follows: gender is coded as 0=Male, 1= Female, age in measured in years, education is coded as 1=Secondary, 0= Primary or Never been to school; household size is measured in total number of adults and children; village is coded as 1=Makawa, 0= Malundu; household type is coded as 0= Non-Fish farming, 1= Fish Farming; number of occupations is measured as total number; ownership of a bicycle is coded as 0=no, 1=Yes. Analyses were performed using SPSS. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Multiple regression analyses revealed the association between food security and socio-economic variables. For food consumption levels, the overall model fit was significant at explaining 21.5% of food consumption levels (r2=0.215, F (8, 125) =4.27, p<0.01) (Table 7.7). Whilst controlling for the variation explained by all other variables, indicators which made the largest and significant unique contributions to explaining food consumption levels was gender (beta=-0.185, p<0.05). Village (beta=-0.161, p=0.06), household wealth (beta=-0.151, p=0.07) and livelihood diversity (beta=-0.149, p=0.83) also provided large contributions to food consumption levels however they were not uniquely significant. For food insecurity coping strategies, the overall model fit was significant at explaining 15% of food consumption levels (r^2=0.150, F (8, 104) =2.29, p<0.05) (Table 7.8). Whilst controlling for the variation explained by all other variables, indicators which made the largest and significant unique contributions to explaining levels of food insecurity coping strategies were household wealth (beta=-0.241, p<0.05) and village (beta=0.226, p<0.05). Gender (beta=-0.150, p=0.130) and livelihood diversity (beta=-0.139, p=0.157) also provided large contributions to coping strategy levels however they were not uniquely significant. Overall, gender, household wealth and village were identified to be particularly important in explaining food security, measured by food consumption and food insecurity. However different socio-economic factors were associated with food consumption levels and food insecurity coping strategies. Due to the case study nature of this study, the results are limited in the ability to make causal inferences but provide insights into the complex factors and processes that shape the role of aquaculture to local food security.

Table 7-7 Standard multiple regression statistics of socio-economic variables related to food consumption levels (FCS).

Variable	**B**	**B SE**	**β**	***t***	***p***
(Constant)	39.257	5.146		7.629	.000
Age of Head of Household	-.086	.063	-.113	-1.373	.172
Number of people in the household	-.581	.562	-.085	-1.033	.304
Ownership of a bicycle	3.993	2.241	.151	1.782	.077
Total Number of Occupations	1.471	.841	.149	1.749	.083
Village	-4.230	2.231	-.161	-1.896	.060
Household Type	3.476	2.222	.132	1.564	.120
Gender	-5.059	2.365	-.185*	-2.139	.034
Education (Secondary Level)	2.450	3.858	.053	.635	.526
$\mathbf{R^2}$ = 0.215 **F** (8, 125) = 4.27 **S**= 11.99 **p**<0.01					

*p < 0.05, ** p < 0.01

Table 7-8 Standard multiple regression statistics of socio-economic variables related to coping strategy index (CSI).

Variable	**B**	**B SE**	**β**	***t***	***p***
(Constant)	17.056	4.993		3.416	.001
Age of Head of Household	.049	.061	.076	.808	.421
Number of people in the household	.374	.546	.064	.685	.495
Ownership of a bicycle	-5.430	2.174	-.241*	-2.498	.014
Total Number of Occupations	-1.164	.816	-.139	-1.426	.157
Village	5.043	2.165	.226*	2.330	.022
Household Type	-1.822	2.156	-.082	-.845	.400
Gender	-3.502	2.294	-.150	-1.526	.130
Education (Secondary Level)	-.479	3.743	-.012	-.128	.898
$\mathbf{R^2}$ = 0. 150 **F** (8, 104) = 2.29 **S**= 10.68 **p**<0.05					

*p < 0.05, ** p < 0.01

7.5 Discussion

Food producing livelihoods have the potential to contribute to improved food security and nutrition (Fiorella et al 2014). While an emerging body of literature is beginning to examine the links between fisheries and aquaculture to food security, significant gaps in knowledge remain, especially for the understudied and undervalued inland aquaculture sector (Taylor et al 2016; Bene et al 2015, 2016. Challenged by the inherent complexity surrounding aquaculture and food security, holistic and case based research have been called for to enhance understandings of the place based nature of aquaculture systems and its role to all four pillars of food security: availability, access, utilisation, stability. Moreover, research assessments considering the realities and perspectives of stakeholders engaged in the aquaculture sector as well as broader indicators to address relational and subjective dimensions of food security are required to holistically understand the complex pathways through which aquaculture can contribute to food security (Maxwell, 1996; Fiorella et al 2014; Morgan et al 2016; Krause et al 2015; Bene et al 2016). The aim of this chapter was to better understand the pathways through which aquaculture contributes to food security by examining and comparing the livelihoods and food security outcomes of fish farming and non-fish farming households in two studied communities in Malawi. Moreover, this chapter used the SLA as a guide to capture the complexity surrounding aquaculture and food security and was designed to address some of the shortcomings reported in the literature through a more comprehensive assessment of food security indicators (as presented in table 7.2 of this chapter). This section draws on relevant literature to interpret and discuss the key research findings presented within this chapter.

7.5.1 Capital Assets and Livelihood Strategies

As defined chapter 3 of this thesis “A livelihood comprises the capabilities, assets and activities required for a means of living base.” (DFID, 2000). It is understood that people require a range of assets namely - human capital, social capital, natural capital, physical capital and financial capital – to achieve positive livelihood outcomes and carry out livelihood strategies or activities to meet their needs. The findings from household surveys presented within this chapter revealed how households draw on a combination of assets and livelihood strategies to meet their needs and to deal with stressors. In relation to livelihood assets, findings demonstrated that access to the five capital assets varied, thus affecting a household’s capability to achieve a sustained livelihood. Limited access to human capital, such as poor health and a lack of education, can contribute to food insecurity and low levels of adaptive capacity of individuals and households (Burchi and

Muro 2016; Ebhuoma and Simatele 2017). Findings presented within this chapter revealed that the majority of households had limited access to human capital (e.g. low levels of education and high rates of ill-health) and physical capital (e.g. limited access to safe drinking water and electricity). In contrast, households reported good access to natural capital (e.g. high rates of land ownership), physical capital (obtainment of a wide variety of household's consumer, production and dwelling goods), financial capital (high rates of livestock ownership and savings) and social capital (high membership rates of social groups). This chapter further demonstrated that access to livelihood assets differs by type of household, gender and community. For example, findings unravelled that fish farming households compared with non-fish farming households have improved access to natural capital (total land size), physical capital (access to safe sources of water for drinking, washing and domestic; fish ponds and modern furniture), financial capital (savings) and social capital (membership of a group). Financial capital is reported to enhance economic productivity of rural households (Akudugu 2011; Akoijam, 2012), thus it can be suggested that improved access by fish farming households has contributed to the reported increased asset portfolio. Furthermore, social capital is reported to be an essential capital in enhancing access to other assets, contributing to food security and reduced vulnerability (Joshi and Aoki 2014; Simatele and Simatele, 2014; Oni and Fashogbon, 2016; Paul et al 2016). Findings from this study revealed that non-fish farming households in contrast with fish farming households more commonly gave and received food from relatives. In addition, gender differences concerning financial capital emerged specifically relating to prioritisation of household expenditure. For example, the majority of female headed households prioritised expenditure on milling fees compared with male headed households whom prioritised expenditure on personal beauty.

In terms of livelihood strategies, this chapter demonstrated that fish farming households compared with non-fish farming households had a greater diversity of livelihood occupations. In addition, findings revealed that agriculture was commonly identified as the primary livelihood activity whilst fish farming was predominantly identified as a second or tertiary livelihood activity in terms of importance to household income. This finding supports existing literature that highlights that small-scale aquaculture is very much a seasonal activity and it is often carried out in combination with other household livelihood activities (Edwards et al 2002; Little et al 2007; Ahmed, 2009). This chapter also revealed preferences concerning farming and fisheries based livelihood activities. Findings identified that crops and livestock were the most preferred form of farming due largely to higher income and food consumption obtained from these activities whilst fish farming was the least preferred form of farming. However, in relation to fisheries based activities, fish farming was the most preferred activity, followed by fish trading.

7.5.2 Vulnerability context

People's livelihoods and asset status are affected by shocks, critical trends and seasonal shifts referred to as the vulnerability context. As further defined chapter 3 of this thesis, a livelihood is "sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base." (DFID, 2000). As highlighted by recent contributions to the field (Connolly-Boutin and Smit, 2016; Kolding et al, 2016), the vulnerability context is especially acute for resource based livelihoods, including fisheries and aquaculture, in the dry land areas of SSA such as Malawi. This chapter demonstrated that households face multiple livelihood shocks and stressors. Overall, the major stressors experienced by households over the past 12 months included flooding, high prices for food, drought and high levels of crop pests or disease which was perceived to decrease household income, asset status and food stocks. Findings presented within this chapter further revealed differences in the type of shocks and stressors experienced by household type. For example, fish farming households most commonly ranked flooding, high prices for food, drought and high costs for agricultural outputs as the most severe shocks experienced. Whereas non-fish farming households most commonly ranked flooding, high prices for food, serious illness and death of a household member. Moreover, a high proportion of non-fish farming households compared with fish farming households reported a negative impact to food stocks by shocks and stressors experienced over the past 12months suggesting that non-fish farming households experience a higher level of food vulnerability.

7.5.3 Policies, Institutions and Processes

The policies, institutions and processes may crucially determine access to assets, terms of exchange between capitals, influence which livelihood people pursue as well ultimately shaping livelihood outcomes (DFID, 2000). Civil society, including NGOs, as well as societal norms and beliefs are included within this area and may grant or deny access to assets or livelihood activities. As detailed in chapter 2 of this thesis, the type of aquaculture model adopted (immanent vs interventionist) as well as societal norms can influence participation in, characteristic of and outcomes arising from small-scale aquaculture (Morgan et al 2016). Findings within this chapter demonstrated that constraints to joining fish farming as well as the perceived outcomes arising from aquaculture differed by type of aquaculture model (immanent vs interventionist) and were also influenced by societal norms. For example, non-fishing households from the immanent aquaculture community of Makawa most commonly identified membership challenges, personal physical constraints and time constraints to joining aquaculture. In contrast, non-fishing households from the interventionist aquaculture community of Malundu most commonly identified personal physical constraints, theft and cost of construction. Findings suggest that in the studied community of Makawa, community power relations and societal norms limit entry into aquaculture. In contrast, in the studied community of Malundu, societal norms, conflicts arising from ownership of fish ponds as well as poor access to credit limit entry into aquaculture. The influence of societal norms and power relations experienced between the two studied communities could be explained by the structures and processes characterising the immanent and interventionist forms of aquaculture.

7.5.4 Livelihood Outcomes: Improved Food Security

Livelihood outcomes are the achievements of livelihood strategies and should be viewed in light of what people consider to be important. Livelihood outcomes can include: increased income, increased wellbeing, reduced vulnerability, improved food security and a more sustainable use of natural. This chapter assessed the effect of household type and broader socio-economic indicators on the livelihood outcome of household food security, measured through a combination of qualitative and quantitative indicators as detailed in table 7.2. Overall, this chapter revealed that participating in aquaculture as a livelihood was associated with improved household food security and reduced vulnerability compared with non-fish farming households.

Findings concerning the assessment of direct food consumption patterns and diet quality revealed that fish farming households consumed more animal protein and vitamin A rich foods and had greater diet diversity. Subsequently, fish farming households may struggle less to meet daily protein requirements than non-fish farming households. Overall, the consumption of fish over the past 7 days across households was high and comprised 15 different species, with Matemba, Mlamba and Chambo forming the most common major species consumed. The majority of fish consumed was sourced from capture fisheries with few from aquaculture. In addition, this chapter revealed a high preference for sun dried and fresh fish. Fish is commonly recognised as a nutritious and vital source of protein for many poor communities, particularly across SSA (FAO, 2016). These findings support previous studies that revealed an association between fish farming and high consumption of fish or protein (Dey et al 2007). The Food Consumption Score (FCS) is the most commonly used food security indicator and was constructed within this chapter to allow for better comparison of food consumption and dietary quality and diversity between households.

Findings revealed that fish farming households had a higher average FCS than non-fish fish farming households, suggesting that fish farming households have greater diet diversity and food consumption. Furthermore, the categorisation of households into FCGs revealed that a significant proportion of all household faced inadequate food consumption (poor and borderline food consumption). Findings further unravelled that fish farming households had greater levels of acceptable food consumption compared with non-fish farming households. In addition, households from Malundu had greater levels of acceptable food consumption compared with households from Makawa.

This chapter further assessed subject measures of household food security through food adequacy and cultural preference questions as indirect proxies of food sufficiency, consumption and access (Maxwell et al 2013). The status of individual or household food security is also influenced by perceptions and preferences concerning what food is eaten, the distribution of food, self-assessment concerning food sufficiency and food habits (Burchi and Muro 2016). This chapter demonstrated that the perceived importance of fish farming to households was identified as providing an important source of food and income, both to households and the wider community. Findings presented within this chapter further revealed that the majority of households perceived their weekly consumption of fish to be enough and that the most preferred fish to consume was Chambo followed by Mlamba. However, findings identified that the majority of households faced constraints to accessing fish for consumption mainly due to fish being too expensive to purchase, the cost of travel to market being too expensive or households had no money to purchase fish. The access pillar of food security determines whether a household has the ability to acquire sufficient food (Maxwell and Smith, 1992). These results suggest that financial and physical issues limit household's ability to acquire sufficient fish for consumption. This chapter further revealed a high preference for chicken, followed by fish, as the preferred animal protein for household consumption largely due to reasons such as taste, cheaper to buy and more nutritious. Increasing contributions to the literature highlight that analyses of individual and household food security requires greater attention to measures of cultural acceptability of food (Burchi and Muro 2016). These findings provide valuable insights into local food preferences and rationale within Malawi which have proven to deepen household food security understandings in wider studies (Burchi and Muro, 2016)

Another element of food security is stability which relates to the secure access to enough food, commonly assessed through capturing the short-term and long-term food vulnerabilities of households (Maxwell, 2013). The Food Coping Strategy Index is an indirect measure of food vulnerability and was used within this chapter to measure the frequency and severity of the coping strategies used by a household to deal with short-term shocks and pressures (Maxwell 1996; 2013; Christiaensen et al. 2000; Coates et al. 2006; Carletto et al 2013). This chapter demonstrated that the majority of households experience short-term food vulnerability, evident through the employment of one or more coping strategies over the past 7 days. Overall, the most commonly employed short-term coping strategies across all households were to eat less preferred food, limit portion sizes and to skip meals. Moreover, this chapter identified that fish farming households had a higher average FCSI score (13.35) than non-fish farming household (15.91), suggesting that fish farming household were less food insecure. In addition, households from Makawa had a higher FCSI score (17.24) than households from Malundu (12.40). The long-term food vulnerability context of households was also captured. Overall, the most commonly employed long-term coping strategies when faced with not enough household food across all households were to rely on less preferred foods, limit portion sizes, to skip meals and borrow or rely on help. In addition, this chapter revealed multiple causes of long-term food insecurity with major stressors identified as flooding; food was too expensive at market; drought; and lack of farm inputs. These findings contribute new knowledge to the literature in deepening our understanding about the factors affecting the local stability of food security in the two studies communities and the capabilities of households to deal with shocks and stressors to secure access to enough food. Findings further support recent contributions to the field that highlight the impact of climatic shocks such as drought and flood in increasing the vulnerability and food insecurity of rural livelihoods in SSA (Kolding et al 2016; Connolly-Boutin and Smit, 2016).

7.5.5 Determinants of Food Security

This chapter modelled the associations between socioeconomic variables (asset index, monthly income, household size) for all households and food security (measured as food consumption using the FCS indicator and food vulnerability using the FCSI indicator). The results of the multiple linear regression presented within this chapter found no evidence that type of household was a predictor of food security. Instead, the model demonstrated that gender was associated with food consumption and that village type and household wealth were associated with food vulnerability. This supports previous case study research that highlight the complex role of socio-economic contextual factors in influencing food security and that factors such as gender and wealth can predict household food security (Darling 2014; Firoerlla et al, 2014).

7.5.6 Limitations of the use of Household Surveys for Assessing Food Security

A number of limitations in this chapter are worth mentioning. Firstly, there are a number of shortcomings commonly reported with the employment of quantitative surveys in livelihood assessments, including: weakness in providing depth and details to a given research topic; respondent bias relating to memory, willingness to provide information and understanding of questions; time consuming and costly to administer, particularly in often remote rural communities; static nature of data obtained (Chambers and Conway, 1991; Hubrich et al 2014; Angelsen et al 2011). This thesis was limited in scope to capturing a static assessment of livelihoods and food security outcomes among rural households in Malawi. Nonetheless, findings from this chapter contributed to the knowledge base concerning the status and influence of aquaculture to improved food security at the time the survey was carried out. Although both communities reported little use of integrated agriculture-aquaculture practices, further research would benefit from investigating whether the consumption of food items were produced from fish pond by-products (e.g. the production of crops from reused pond water). To overcome potential respondent bias issues within the household surveys, time and efforts were granted to: ensuring the accurate translation of surveys into Chichewa; rigorous training of research assistants tasked with administering the survey to respondents to enhance understanding of survey questions; allocating sufficient time to administer the survey and ensure ease and completion of all questions; ensuring surveys were administered at a time and location most convenient for respondents; the appropriateness of question recall periods to enhance accuracy in responses. Moreover, this thesis sought to gather perspectives and contextual understandings regarding the role of aquaculture to food security from a range of mixed methods to enhance reliability and to add depth to our understandings of this topic. Due to the case study and small sample size, the results are limited in the ability to generalise beyond the sample population. However, this case study provided a valuable insight into the factors and processes that influence the role of small scale aquaculture to food security and suggests a relationship between aquaculture and food security that merits further research. This chapter contributed important insights into the complexity surrounding rural livelihoods and the pathways through which aquaculture contributes to food security which should be considered in advancing similar assessments across SSA.

Finally, the holistic nature of the SLA poses the risk of certain elements not being emphasized and the generation of rich and varied information often difficult to manage (DFID, 2000). However, this chapter used the SLA as a checklist to navigate through and capture important elements central to understanding the role of aquaculture to food security.

7.6 Conclusion

This chapter employed household surveys and was guided by the SLA framework as a means to assess and quantity the role of aquaculture to local food security through the comparison of fish farming and non-fish farming households. The interplay between livelihoods, food security and environmental change presents a complex landscape to understand the role of small-scale aquaculture to food security in Malawi. Overall, findings reveal that fish farming households were more food secure and less vulnerable than non-fish farming households who displayed a greater level of coping and food insecurity. This chapter found that small-scale aquaculture has an association with improved food security, reduced vulnerability and also enabled a more sustainable use of natural resources through re-use of pond water for irrigation by adopting households. Subsequently, this chapter builds and expands upon current understandings that small-scale aquaculture links with food security through direct and indirect pathways. Moreover, this chapter revealed that the social and governance context of aquaculture, specifically cultural preferences and the type of aquaculture adopted, influence food access and thus contributes new insights into the complex role of aquaculture in sustaining livelihoods and generating improved food security outcomes. The realities of these complexities cannot be overlooked when encouraging the sustainable growth of aquaculture for food security in future planning of the sector in Malawi. Furthermore, the chapter revealed that a significant proportion of households had low access to human and physical capitals, faced inadequate food security and experienced multiple stressors and shocks affecting the secure access to enough food. Finding solutions that enhance household's capabilities to respond and adapt to vulnerabilities, in particular providing people with increased access to capital assets and support the more effective functioning of social institutions, should be considered when attempting to improve food security and reduce vulnerability of rural communities in Malawi. Reflections on the methodological approach used within this chapter reveals that the SLA was useful in navigating the complexity surrounding how people succeed or fail in sustaining their livelihoods in light of multiple stressors and shocks. Moreover, the SLA proved especially useful in enhancing understandings of the complexity of food security outcomes and the specific role of aquaculture in contributing to improved food security. This chapter provides a timely endeavour to deepening our understanding about the role of aquaculture to local livelihoods and the crucial pathways through which aquaculture contributes to improved food security (Allison and Horemans 2006; Bene et al 2016; Morgan et al 2016). This research represents an important, but preliminary, step toward the holistic understanding of the complex role of aquaculture to food security that merits further investigation and ideally a longitudinal study.

Chapter 8: Synthesis Discussion and Conclusions

8.1 Introduction

Understanding the sustainability and social and economic success of aquaculture development is a critical question for conservation and development practitioners (Brummet et al 2008, 2011; Bene et al 2015). A review of the literature presented in chapter 2 of this thesis reveals that significant gaps exist in the understanding of the impact of aquaculture development, in particular aquaculture's complex relationship to food security remains understudied and unclear (Bene et al, 2016). At the same time, the diversity of aquaculture operations and the ecological, social, economic and political context specific factors framing the sector present methodological challenges to the assessment of aquaculture development (Edwards et al 2002; Little et al 2012; Williams et al 2012b; Troell et al, 2014; Little and Bunting, 2016). In addition, the multidimensional nature of food security requires interdisciplinary perspectives and a holistic approach to the assessment of food security outcomes arising from aquaculture development (Poppy et al 2014; Bene et al 2015). Increasing calls for case study and holistic assessments of aquaculture is emerging in the literature (Bene et al 2016; Krause et al 2015; Cooke et al 2016; Taylor et al 2016), particularly in food insecure regions such as SSA where aquaculture has been identified as having greatest potential for growth but its assessment in the contact of food security is poorly understood and understudied (FAO, 2016). In Malawi, the demand for fish is becoming increasingly urgent and aquaculture has been developed as a means to meet the food fish deficit as well as enhance economic development and support rural livelihoods (Russell et al 2008; Kam et al 2008; Banda et al 2009; NEPAD, 2011; GoM, 2012). However, the growth of the aquaculture sector in Malawi has experienced many bottlenecks and its actual contribution to local food security is poorly documented (Dey et al 2010; NEPAD, 2011). These conditions make Malawi a particularly interesting case study to investigate the complex and actual contribution of small-scale aquaculture to food security.

The central aim of this thesis is to understand the complex role of small-scale aquaculture to food security using the aquaculture sector in Malawi as a case study. The aim of this thesis was achieved through the exploration of three objectives: i) To assess the drivers, barriers and future prospects of the aquaculture sector in Malawi through the perceptions of key stakeholders; ii) to identify gender roles as well as the constraints and benefits associated with aquaculture through the perceptions of women and men fish farmers.; and iii) To assess and quantify the direct and indirect association of aquaculture to household food security through the comparison of fish farming vs non-fish farming households. To capture the complexity of the role of aquaculture to food security, this thesis drew on the SLA framework as well as the sectoral framework provided by the HLPE (2014) as a methodological and analytical guide to deepen our understanding of the aquaculture sector and its contribution to food security. In addition, to achieve the aim of this thesis a mixed methods approach was adopted, drawing on a combination of qualitative and quantitative methods as well as interdisciplinary perspectives to provide a deeper understanding of the perceptions and processes that shape aquaculture's role to food security than what either research method would alone.

This final chapter draws upon the key findings of the three results chapters (chapters 5-7) to address the overarching aim of this thesis and assess the implications of these results. The overall key findings are brought together in a discussion centred around the role of aquaculture to food security by firstly outlining the drivers and constraints to aquaculture sustainability; followed by the role of gender contributions and finally, aquaculture's impact to livelihood outcomes with a focus on food security. The discussion is then expanded to understand the linkages to the SLA conceptual framework presented within this study as well as implications of overall results to policy and methodological discourses. Finally, this chapter provides recommendations for further research and concluding remarks concerning the overall outcomes of this thesis.

8.2 Drivers and Challenges to the Sustainable Development of Aquaculture

Developing an understanding about the drivers and impediments to aquaculture growth as well as needs of the aquaculture sector are of upmost importance to better future management and performance of the sector. However, as revealed in chapter 2 of this thesis, the current limited empirical evidence is inadequate to provide an in depth understanding of the current aquaculture sector in Malawi. The elicitation of stakeholder perspectives engaged in the aquaculture sector is increasingly called for in the literature to improve contextual understandings and improve future management of the sector (Krause et al 2016; Youn et al 2016). Research findings from chapters 5 and 6 drew on perspectives of key informants and fish farmers engaged in the aquaculture sector to understand the drivers and barriers to sustainable aquaculture development in Malawi (as outlined in objectives 1 and 2 of this study).

8.2.1 Drivers of Sustainable Aquaculture Development

Overall, research findings from the key informant interviews presented within chapter 5 both support and expand upon current understanding of the aquaculture sector in Malawi in a new era of development. Research findings from chapter 5 demonstrated that aquaculture development in Malawi is driven by multiple policy drivers - to meet the increasing demand for fish, contribute to improved sustainable livelihoods and food security and nutrition; as well as to alleviate pressure on wild fish resources. However, the achievement of these desired sector goals has faced many shortcomings resulting in a slow and erratic trajectory of aquaculture development since the sector was kick-started in Malawi during the 1970s.

Findings from chapter 5 further revealed recent improvements in growth of the aquaculture sector in Malawi due to significant shifts in policy towards commercialisation across the sector during the mid-2000s. Many stakeholders highlighted that progress had been made in commercialisation of the aquaculture sector through increased private investment and upgrading of small holders to become more business orientated. However, findings presented in chapter 5 also revealed weaknesses in the perceived effectiveness of national aquaculture governance structures. For example, many stakeholders highlighted the lack of implementation of policies, limited capacity and poor quality of extension services as well as limited investment across the sector. Moreover, in reflection of findings presented in chapters 6 and 7, there appears to be weaknesses in the effective delivery of policy goals on the ground. For example, within the two case study villages, aquaculture contributed positively but marginally to food security and fish farmers identified multiple challenges to aquaculture, including: increased vulnerability from climate shocks affecting the available and access to essential inputs; limited access to market knowledge; increasing competition with capture fisheries at market; limited access to financial capital to expand and sustain fish farming operations; social conflicts regarding theft, ownership of ponds and competition for limited water resources; limited access to good quality and affordable fingerlings; as well as poor extension services to enhance technical knowledge. While a strong demand for commercialisation of aquaculture and the graduating of small holders to semi-commercial operations exists in pursuit of improved national food security, at the local level significant more investment and capacity is required to enact aquaculture governance structures in Malawi and achieve the desired commercial production aims of the sector. This is synonymous with previous aquaculture studies across Africa which identified the need for more appropriate, commercially orientated policies to enhance aquaculture growth across Africa (Hishamunu et al 2009; Jamu et al 2012). Finally, further findings presented within chapter 5 revealed that future drivers of aquaculture growth in Malawi are dependent upon addressing multiple research and investment needs of the sector in critical areas including: research, public-private partnerships, improved extension services with enhanced expert training about commercialisation; selective breeding, feed supply and spatial planning.

8.2.2 Challenges to the Sustainability Development of Aquaculture

As with other food producing sectors, aquaculture is facing challenges for sustainable development. A cross-cutting theme that was explored within chapters 5 to 7 was challenges to the sustainability of aquaculture and livelihoods (as outlined in objectives 1-3), captured through the perspectives of key informant stakeholders engaged in the sector and fish farmers. Analysis of key informant stakeholder interviews presented within chapter 5 highlighted multiple new and persistent challenges impeding the future growth and sustainability of the aquaculture sector in Malawi. For example, research findings presented within chapter 5 identified a number of major constraints to aquaculture in Malawi at the sectoral level which included: lack of available good quality and reasonably priced fingerlings; limited access to capital; low investment across the sector; weak social acceptability; climatic shocks; weak governance relating to poor implementation and capacity gaps affecting extension services and monitoring of the sector. Furthermore, chapter 5 highlighted low retention rates associated with interventionist forms of aquaculture whereby adopting fish farmers fail to continue with aquaculture operations in the long-term once donor support ends. By examining the lived experiences of fish farmers through the lens of Photovoice in chapter 6, the research findings further identified a number of major constraints to aquaculture in Malawi. Findings from chapter 6 demonstrated that aquaculture faces major environmental (e.g. lack of water availability, predation), economic (e.g. lack of access to markets and capital) and social (e.g. conflicts over resource use, theft and lack of knowledge) constraints at the local level. Overall, findings from both chapters 5 and 6 build on previous work that highlight constraints to aquaculture in Malawi at certain stages of historic development and contribute new knowledge via advancing the understanding of challenges facing aquaculture development in Malawi today. A participatory exploratory analysis of the lived experiences of fish farmers presented in chapter 6 further demonstrated distinct gender differences and similarities concerning perceived challenges to aquaculture production. Social acceptability issues were commonly reported by both male and female fish farmers however it was revealed that specific issues of social conflicts and lack of outsider support were exclusively reported by male fish farmers. In relation to economic issues, feed affordability was a major challenge reported by both gender groups. However, distinct gender differences concerning perceived economic challenges also emerged. For example, chapter 6 demonstrated that women fish farmers more commonly reported issues about lack of access to capital and resources to maintain and expand aquaculture whereas male fish farmers predominantly reported market constraints such as lack of buyers, competition with local wild species and a lack of market knowledge. The reported competition with capture fisheries was revealed by fish farmers in the village of Makawa, the site closest to Lake Chilwa, during the month of August. As described in the seasonal calendar presented in figure 3.2, section 3.3.2. of this chapter, despite the recommended two production cycles for aquaculture, most fish farmers in Malawi are reported to carry out one production cycle with the timing of harvests determined by household needs (Russell et al 2008). The capture fishery of Lake Chilwa is known to fluctuate seasonally with a closed season for seine fishing during December to March and typically low fish catches observed in the cooler month from May to August (Njaya, 2001). In light of this growing market constraint for farmed fish, harvesting of farmed fish should be more aligned with market knowledge of capture fisheries supply and during times of peak demand such as religious holidays (Russel et al 2008). In relation to environmental challenges to aquaculture, women fish farmers reported a greater set of constraints compared with male participants including: predation of fish by birds and monitor lizards, poor construction of ponds, poor water quality and limited availability of feed availability. In contrast, male fish farmers exclusively reported the lack of water availability due to climate shocks as an impediment to aquaculture production. These findings present new knowledge concerning the different needs of male and female fish farmers in Malawi which is of upmost importance in improving the future management and growth of the sector.

Furthermore, findings from chapter 7 identified multiple shocks and pressures to rural livelihoods in Malawi, including flooding, high prices for food, drought and high costs for agricultural outputs, serious illness and death of a household. Moreover, findings from the more detailed livelihood assessment revealed that shocks more commonly led to a negative impact on food availability and accessibility in non-fish farming households suggesting that households engaged in aquaculture are less vulnerable in relation to shocks to food security.

Finally, when unpackaging consumption patterns of fish, findings presented in chapter 7 revealed that a number of critical financial and physical access constraints affected fish consumption which relatively differed between villages. For example, in Makawa the main constraints to fish consumption identified were the high price for fish and no money to purchase fish. In contrast, in Malundu the main constraints to fish consumption identified were the high price for fish and the cost of travel to market. The possible influence of location of sites as well as the form of aquaculture adopted in influencing financial and physical access issues regarding the consumption of fish demands further investigation.

8.3 Gender Participation in Aquaculture

As presented within chapter 2 of this thesis, a significant gap in understanding gender patterns in aquaculture continues to be widely reported in the literature, especially concerning the under-valued and under-reported nature of women's contribution to the sector (Neis et al 2005; FAO 2009; FAO 2014; Bene et al 2016). Moreover, the often informal, seasonal, low paid nature of small-scale aquaculture presents methodological challenges to the monitoring of aquaculture and has contributed to the reported gaps in understanding characteristics and the value of the sector in developing countries (Lebel et al. 2010; Williams et al. 2012a; Harper et al. 2013; Monfort, 2015, Bene et al 2016; Morgan et al, 2016). Through the lens of photography, research findings presented in chapter 6 captured rich descriptive information about the lived experiences of male and female fish farmers revealing gender responsibilities in aquaculture production. Chapter 6 demonstrated that fish farmers carried out a wide range of day to day activities associated with aquaculture production and that certain activities were gendered. For example, the findings presented in chapter 6 revealed that women predominantly participated in maintenance activities such as feeding of fish whereas men participated in a more diverse set of activities which included exclusively carrying out harvesting, guarding of fish and water irrigation tasks. Findings presented within chapter 6 provide new knowledge concerning the divisions of labour and important contributions by male and female fish farmers within the aquaculture sector in Malawi. These findings correspond with previous research in which gender norms are known to shape men's and women's capacity to participate in aquaculture (Jahan et al. 2010; Shirajee et al. 2010; Fapohunda 2005; HLPE, 2014; Morgan et al 2016; Thilsted et al 2016). While gender norms are known to limit women's participation in aquaculture due to constraints on their mobility or time (Jahan et al. 2010; Shirajee et al. 2010; Fapohunda 2005; Veliu et al. 2009), findings from this study suggests that the homestead nature of aquaculture provides women with opportunities to participate more actively in aquaculture in Malawi. However, the findings reveal that gender norms influence the type of aquaculture activities carried out by women. Women predominantly reported to carry out feeding of fish and were excluded from participating in physically intensive types of work such as harvesting, water maintenance and guarding of fish at night.

8.4 Livelihood Outcomes from Aquaculture and Links to Food Security

Improving our understanding about the actual livelihood benefits of aquaculture, in particular the complex and understudied role to improved food security and nutrition, is critical to improve management and future planning of the sector. Assessing the social-ecological complexity in aquaculture and incorporating evidence into policy has suffered from a lack of a comprehensive integrating 'lens' and gaps in knowledge remain concerning the role of aquaculture to food security (Weeratunge et al 2010; Krause et al 2015; Bene et al 2016). As outlined within chapter 2 of this thesis, more case study research that holistically captures the complex and placed based nature of aquaculture and food security is required to address significant gaps in the literature, especially in the case of inland aquaculture and in food insecure regions such as SSA. To address these gaps and achieve the aim of this thesis, this research applied qualitative and quantitative methods to assess the role of aquaculture to local food security through a holistic lens. A cross-cutting theme that was explored within chapters 6 and 7 was livelihood outcomes from aquaculture development with particular emphasis on the outcome to improved food security and nutrition. A key factor that emerged throughout all chapters was that aquaculture generated positive livelihood outcomes through improved food security and wellbeing as well as improved capabilities and reduced vulnerability within the two studied communities. Chapter 6 provided rich perspectives about the benefits arising from aquaculture through the capturing of day-to-day lived experiences of fish farmers within the two case study communities. Overall, findings presented within chapter 6 identified that improved food security, improved well-being, reduced vulnerability and increased income were direct and indirect livelihood outcomes generated from aquaculture. Chapter 6 demonstrated that aquaculture contributed positively to food security via a myriad of direct and indirect pathways. For example, Chapter 6 identified that aquaculture contributes to food security directly by increased fish consumption as well as indirectly through increased purchasing power used to purchase other foods and increased production of other foods through the reuse of pond water for crop irrigation. Moreover, findings presented in Chapter 6 further identified broader livelihood outcomes including economic benefits via the increased obtainment of a wide variety of household assets; reduced vulnerability via using aquaculture as a safety net in times of hardship; as well as improved well-being, including individual pride, self-actualisation, identity, independence, job satisfaction and self-reliance. Reflections on findings presented in chapter 6 provide a different perspective concerning the role of aquaculture to livelihood outcomes. Through a more detailed and comparative assessment of livelihoods and food security status of fish farmer and non-fish farmer households, chapter 7 demonstrated that aquaculture is associated with improved food security and reduced vulnerability of adopting households. Through the implementation of structured surveys and commonly used indicators of food security, chapter 7 identified that improved access to crucial certain capital assets - natural capital (e.g. total land size), physical capital (e.g. safe sources of water for drinking, washing and domestic use), financial capital (e.g. savings) and social capital (e.g. member of a social group); improved food security (measured by higher average FCS and FCGs scores; higher average Vitamin A consumption frequency) and reduced vulnerability (measured by lower CSI score) were associated with fish farming households.

Moreover, findings from chapters 6 and 7 demonstrated that differences in the form of aquaculture adopted (interventionist or immanent) and socio-economic contexts can influence livelihood outcomes and constraints associated with aquaculture. As outlined in chapters 6 and 7, access to crucial capital assets (e.g. social and human capitals) and the pathways through which aquaculture can lead to improved food security varies by type of aquaculture adopted. For example, chapter 7 demonstrated that in the studied community of Makawa, the immanent form of aquaculture was valued more as a cash crop, more commonly contributing indirectly to improved food security and it was associated with greater access to social capital. In contrast, the studied community of Malundu adopted an interventionist form of aquaculture which was valued more as a food crop thus more commonly contributing directly to improved food security and it was also associated with greater access to financial capital.

In addition, chapter 6 illuminated gender differences with regards to reported livelihood benefits obtained from aquaculture. Female fish farmers exclusively reported the benefit of increased purchasing power to buy other food items and the importance of aquaculture in providing a safety net during times of hardships. In addition, female fish farmers more commonly reported the obtainment of a greater variety of assets compared with male fish farmers and further expressed in-depth self-actualisation, self-reliance and empowerment with being able to participate in various activities associated with fish farming. Male fish farmers on the other hand exclusively reported the indirect benefit to food security obtained from the reuse of pond water for crop irrigation and expressed the perceived improved nutritional security obtained from aquaculture.

Overall, findings support existing studies that demonstrate that aquaculture can generate sustained livelihoods benefits to local populations involved in fish farming (Kumar and Dey, 2006; Islam, 2007; Jahan et al 2010; Belton et al 2014; Haque and Dey 2016). Findings also build on previous studies carried out in Malawi that highlight the continued importance of small-scale aquaculture to local food security today (Dey et al 2007, 2010). More specifically, contrary to a few studies (Kassam, 2013; Thompson et al 2002), Chapter 7 demonstrated that aquaculture has a positive relationship with food security via direct and indirect pathways of adopting households in comparison with non-fish farmer households. Furthermore, these findings provide a valuable contribution to the literature in deepening our understanding of the complex role of aquaculture in household livelihood strategies, revealing that other factors such as gender and type of aquaculture adopted (interventionist vs immanent) influence the type and distribution of livelihood outcomes from aquaculture (Muir, 1999; Ahmed 2009; Belton et al, 2012; HLPE, 2014; Morgan et al 2016; Naylor et al 2016). These identified associations warrant further investigation of the causal affects of the impact of aquaculture to local food security.

8.5 Overall Linkages to the SLA Conceptual Framework

As highlighted in chapter 4, section 4.1 of this thesis, this study drew primarily upon the SLA framework, as well as insights from the sectoral focused framework presented by the HLPE (2014), as a holistic and analytical guide to achieve the overarching aim of this thesis - to understand the complex role of small-scale aquaculture to food security using the aquaculture sector in Malawi as a case study. With a focus on the livelihood outcome of improved food security, the use of the SLA as a guide within this study proved effective in helping to capture and holistically illuminate the multiple forcing factors that shape aquaculture's role to food security. Overall, findings presented within chapters 5-7 support existing studies that demonstrate that aquaculture can generate livelihoods benefits to local populations involved in fish farming (Kumar and Dey, 2006; Islam, 2007; Jahan et al 2010; Belton et al 2014; Haque and Dey 2016).

As highlighted by the HLPE (2014) framework (see section 4.1.1.), there are a number of initial critical elements required for the sustainable production of aquaculture before direct and indirect flows of benefits to improved food security can be generated: water, land, inputs, infrastructure and consideration of competition for and impact on other resources. As revealed from the findings in chapter 5, aquaculture development in Malawi at the sectoral level is driven by demands for increased sustainable fish production, improved food security and alleviation of poverty. While stakeholders revealed progress in improving governance frameworks towards the enhancement of commercialisation across the sector, critical issues concerning affecting production were identified, including: the lack of quality essential inputs (e.g. fingerlings), climatic shocks limiting access to a reliable water source, social acceptability to adopt fish farming, lack of financial and technical support to adopt and sustain aquaculture production, among others. Increased investment across the sector was called for, particularly in areas such as up-scaling of small-holders to commercialisation, enhanced capacity and training of extension workers, improved technical and financial support to fish farmers.

When contextualising aquaculture as a livelihood strategy within the SLA framework, findings from chapters 6 and 7 revealed the diverse ways and characteristics of people making a living from fish farming. As described in section 4.1.2, the SLA framework comprises five dimensions – vulnerability context, livelihood assets, transforming structures and processes, livelihood strategies and livelihood outcomes.

Findings from chapters 6 and 7 revealed the availability and access to five central assets/ resources (human, social, physical, natural, financial) necessary for people to purse a livelihood strategy by fish farming and non-fish farming households (Scoones 1998). Findings from both chapters revealed that although fish farming households had improved access to natural, social, physical, financial resources compared with non-fish farming households (e.g. land size, safe source of drinking water, savings, social group), issues affecting the critical access to certain resources existing, including: competition for water, limited feed availability, risk of predation and theft of fish, lack of access to financial support and markets, limited access to technical knowledge.

Findings from chapters 6 and 7, further revealed that access to these five resources were shaped by the vulnerability contexts and the transforming structures and processes which affected the ultimate achievement of food security outcomes. For example, chapter 7 revealed that multiple shocks and pressures, including flooding, high prices for food, drought and high costs for agricultural outputs, serious illness and death of a household, affected the ability of rural households within two studied communities to sustain their livelihoods. Moreover, findings from chapter 7 revealed that the shocks experienced by households often led to a negative impact on food availability, especially for non-fish farming households suggesting that households engaged in aquaculture are less vulnerable in relation to shocks to food security. In relation to transforming structures and processes, findings from both chapters 6 and 7 revealed that the different type of aquaculture model – interventionist or immanent- affected access to the five resources differently. For example, chapters 6 and 7 revealed that the immanent form of aquaculture adopted in the village of Makawa resulted in greater household access to social capital as well as greater importance placed on aquaculture as a cash crop with indirect benefits to improved food security. This is contrary to the interventionist model of aquaculture adopted within the village of Malundu, whereby results presented in chapters 6 and 7 revealed a greater household access to financial capital as well as greater importance placed on aquaculture as a food crop thus contributing directly to improved food security. Furthermore, findings from chapter 5 further revealed that the interventionist form of aquaculture is more commonly associated with low retention rates of aquaculture, thus affecting the sustainability of livelihoods.

In relation to livelihood strategies, chapter 6 illuminated the day to day lives of fish farmers and revealed characteristics of fish farming as a livelihood strategy. For example, findings presented within chapter 6 revealed that both men and women are important agents of small-scale aquaculture in Malawi, accomplishing many varied but different tasks and also expressing different needs concerning constrains to their involvement in aquaculture. Findings from chapter 6 further revealed that women predominantly participated in feeding of fish whereas men participated in a more diverse and physically intensive set of activities which included exclusively carrying out harvesting, guarding of fish and water irrigation tasks. Chapter 6 further revealed distinct gendered differences with respect to fish farming livelihood needs. For example, women more commonly reported issues concerning the lack of access to financial capital and resources to expand aquaculture; predation of fish, poor water quality, poor construction and limited feed. In contrast, male fish farmers more commonly reported issues concerning the lack of market buyers, competition at market with capture fisheries, lack of water availability and social conflicts such as theft. Findings from this study thus support wider research that reveal that men and women, particularly in Africa, adopt significantly different roles in the construction of sustainable livelihoods (Gladwin 2000; Simtowe 2010).

In relation to livelihood outcomes, this study drew upon the SLA framework with a focus on the livelihood outcomes of food security and its associated four dimensions as described in section 4.1.2. Overall, findings support limited information that small-scale aquaculture contributes marginally but positively to local livelihoods through complex direct and indirect pathways to improved food security, improved well-being and reduced vulnerability. However, the achievement and degree of livelihood outcomes to improved food security were shaped by a number of factors including: gender, transforming structures and processes, vulnerability contexts and context specific sectoral characteristics, drivers and pressures. Omitted from the sectoral framework presented by the HLPE (2014), findings from this study revealed that small-scale aquaculture in Malawi can indirectly contribute to food security through the reuse of pond water to irrigate the production of other food crops. Furthermore, this study illuminated the role of gender in shaping livelihood outcomes, a crucial element hidden from both the HLPE (2014) and the SLA frameworks. For example, chapter 6 revealed differences in the pathways by which aquaculture contributed to food security by male and female fish farmers, attributed to differences in perceptions and gendered divisions in labour. For example, findings presented in chapter 6 revealed that female fish farmers more commonly received increased income from aquaculture which was used to purchase other food items and assets. In contrast, male fish farmers exclusively reported the indirect benefit to food security obtained from the reuse of pond water for crop irrigation.

Finally, as described in section 4.1.2, a livelihood is sustainable if people are able to reduce their vulnerability, have access to assets; maintain activities that are not detrimental to the natural resource base and improve their standard of living (Allison and Ellis, 2001; Allison and Horemans, 2006; Paul and Vogl, 2013). Findings presented in chapter 5 revealed that interviewed stakeholders perceived that an interventionist approach to aquaculture faced a high risk of abandonment compared with an immanent form of development due to the typical lack of sustained social and financial support once donor support is discontinued. However, an important limitation of this study is that it serves to provide a snap shot in time regarding the assessment of aquaculture's role to food security in Malawi. Further research would benefit from understanding the reasons for abandonment of fish ponds from former fish farmers, the sustainability of essential resources necessary for aquaculture (e.g. water, land, inputs) as well as the longer term trends of social, biophysical and economic pressures comprising the vulnerability context to livelihoods.

8.6 Reflections on Methodology

This research examined the role of small-scale aquaculture to food security in Malawi through the adoption of a mixed method, interdisciplinary approach guided by the sustainable livelihoods framework approach as presented in chapter 3 of this thesis. The complexity and placed based nature of aquaculture coupled with the multidimensional notion of food security presents special methodological challenges to the assessment of the role of aquaculture to food security (Lebel et al. 2010; Blythe 2013; Morgan et al, 2016). The informal and seasonal nature of aquaculture further presented methodological challenges to capturing the role of gender contributions to the sector and benefits to livelihoods. Moreover, the assessment of sustainable aquaculture and its impact to livelihoods has suffered from a lack of a comprehensive integrating 'lens' as well as policy blindness concerning the actual lived experiences of fish farmers, especially women, and the complex factors that influence the flows of benefits arising from the sector (Weeratunge et al 2010; Krause et al 2015; Bene et al 2016). This study contributes to the methodological literature in fisheries research by using a range of qualitative and quantitative methods, including the creative Photovoice method, to deepen our understanding of aquaculture's role to food security in the two case studies communities. The purpose of this form of research is that the combination of qualitative and quantitative methods can provide a deeper understanding of the conditions and processes that shape aquaculture's role to food security than what either research field approach would alone. The study further used the SLA framework as an analytical tool to usefully achieve a holistic understanding of livelihoods in the context of aquaculture and unravelling its role to food security. Overall reflections on the use of mixed methods reveal that all three methods as presented in chapters 5-7- key informant interviews, Photovoice, household surveys- elicited rich perspectives that both supported existing studies and contributed new knowledge to the holistic understanding of the role of aquaculture to food security. The elicitation of stakeholder perspectives engaged in the aquaculture sector as presented in chapter 5 enhanced contextual understandings of the drivers, constraints and future needs of the sector in Malawi. For the first time, this thesis modified and applied the participatory Photovoice methodology as a creative means to capture rich descriptive information about the characteristics, benefits and constraints of aquaculture within the context of small-scale and inland fisheries. The results from this study as presented in chapter 6 revealed that Photovoice proved to be an effective and engaging tool in providing a deeper understanding of gender contributions as well as the benefits and challenges of aquaculture to sustained livelihoods. The application of the improved Photovoice method applicable to small-scale fisheries contributes to the growing methodological literature in fisheries research and provides a timely endeavour to advancing wider social-ecological understandings of small-scale fisheries and aquaculture sectors. Finally, the use of household surveys proved valuable in providing a more detailed understanding of household livelihood complexities and the impact of aquaculture to livelihood outcomes, especially food security.

8.7 Thesis limitations and Further Research

An evaluation of the limitations experienced in applying specific methods is provided in the respective results chapters (5-7) presented in this thesis. Overall, a number of broader challenges were experienced concerning data collection in Malawi which included: the time and quality of translating and interpreting method designs and results from English to Chichewa and back again; the lack of up to date baseline national aquaculture data for selection of case study communities; time and budget constraints for field work. However, several actions were taken to improve the reliability of research methods and results. For example, extensive time was taken to recruit and train research assistants, including translation and cross validation of Chichewa into English and vice-versa. In addition, close collaboration with experts in the field at WorldFish was taken to improve accuracy and up-to-date knowledge about the underreported aquaculture sector in Malawi and to aid efficient selection of case study sites. In relation to further research, chapter 2 within this thesis presented an overview of the latest interdisciplinary perspectives framing the overlapping discourses of fisheries and aquaculture, livelihoods, food security and environmental change. Findings from the literature review revealed significant gaps in knowledge and the recent emerging call for more case study research to assess the socio-economic complexity of the rapidly evolving aquaculture sector and its impact to food security. In addressing these gaps, this thesis has supported and expanded upon existing research as well as revealed important areas for further research. In reflection of overall research findings as well as the findings presented within chapter 5 of this thesis, important areas for further research include: selective breeding, feed formulation, improved spatial planning, socio-economic complexities of medium scale aquaculture operations, direct impacts of aquaculture to nutritional security and research concerning the factors leading to long-term retention of aquaculture. Furthermore, and as detailed in chapter 6, an important limitation of this study is that the use of photography research was restricted to deepening the understanding of the underreported characteristics of fish farmers in Malawi. Further research would benefit from applying Photovoice to fish farmers and non-fish farmers to illuminate a deeper understanding of wider livelihood strategies and the relative importance of aquaculture.

As presented in chapter 7, a significantly low proportion of fish consumed over the past 7 days by households was sourced from aquaculture. This may be explained by a number of limitations in data collection procedures - the main phase of field work was restricted to the summer months of 2015; household surveys involved a 7-day recall at the point of survey execution- as well as the part-time, seasonal nature of fish farming presenting challenges for research methodological designs and the assessment of aquaculture to household food security (Russel et al 2008; Dey et al 2010).

Although there is a growing number of case studies attempting to assess the relationship between fish and food security (e.g. Irz et al 2007; Kassam, 2013; Darling, 2014; Fiorella et al 2014; Villasante et al 2015), empirical evidence to support this hypothesis is still incomplete particularly in the context of small scale aquaculture and in Africa. The complex and multidimensional nature of aquaculture and food security has presented methodological and policy uptake challenges when considering the role of aquaculture to food security and nutrition. Moreover, the informal nature of small-scale aquaculture and the lack of robust data presents further challenges to the holistic assessment of aquaculture as a livelihood (Cooke et al 2016). Although the results presented in chapter 7 are limited in the ability to generalise and to make causal inferences (as experienced in other case study research e.g. Irz et al 2007; Darling, 2014; Fiorella et al 2014), this case study provides a valuable contribution to the literature via deepening the understanding of complex factors and processes that shape the role of aquaculture to food security. Furthermore, the use of a mixed methods approach to the assessment of aquaculture within the context of the SLA importantly helped to holistically capture rich and diverse information. Overall, the combination of findings suggests a positive relationship between aquaculture and food security that merits further investigation. A beneficial next step would be to further investigate the relationship between aquaculture and food security, including the assessment of seasonal changes, gender dynamics within households, the relative contribution of other livelihood strategies to food security and a deeper investigation into the factors of location and type of aquaculture model in influencing livelihood outcomes.

Finally, through the lens of photography, Photovoice proved powerful in portraying context specific ´real life´ imagery of community issues through the unique perspectives of participants over and above what other traditional methods can capture (Kong et al 2015, Bennett and Deardon 2013). In addition, the Photovoice process allowed marginalized peoples, particularly female fish farmers, to become empowered and voice their perspectives (Wang et al 1998). Further research comparing the application of the modified Photovoice method presented within this thesis with other social methodologies in the context of small-scale fisheries would be useful to identify strengths of Photovoice over and above other tools.

8.8 Implications for policy

Overall, findings presented within this thesis provide a significant and timely contribution to the field via advancing our understanding of the aquaculture sector and its association to food security in Malawi in a new era of development and at a time when the demand for fish as a nutritious source of protein is increasingly urgent. One of the overriding challenges to conserving freshwater fisheries and aquaculture is our inability to accurately assess the status of these sectors and effectively capture the reality of fisher folk livelihoods within policy making processes to better understand the threats and future needs of these sectors (FAO, 2016; Krause et al 2016; Youn et al 2016). The adoption of a mixed method and case study approach within this thesis allowed for the elicitation of rich stakeholder perspectives engaged in the aquaculture sector leading to improved contextual understandings of aquaculture in Malawi. The assessment and unravelling of the status of aquaculture in Malawi, its constraints to sustainable development as well as its perceived importance and value to food security by those engaged in the sector has contributed important policy-relevant knowledge to improve the future management and planning of the sector. As demonstrated in this thesis, aquaculture development in Malawi is driven by multiple policy goals but faces multiple challenges which must be addressed to improve sustainable growth of the sector and achieve expected benefits. Major constraints to aquaculture development in Malawi as reported in chapters 5 and 6 were lack of available and affordable inputs (feed, fingerlings); limited access to financial capital and markets; low investment across the sector; weak social acceptability (e.g. theft, conflicts); climatic shocks affecting the quality and availability of water; weak governance relating to poor implementation and capacity gaps affecting extension services and monitoring of the sector. Many of these challenges to aquaculture in Malawi are synonymous with threats faced to aquaculture development across Africa (SARNISSA, 2010; Hishamunda et al 2009). For example, a review of aquaculture development across Africa by Hishamunda et al (2009) identified a number of common constraints to aquaculture across the region as well as highlighted a number of mitigation strategies as solutions (see Hishamunda et al 2009, p.37, Appendix 1). Findings from this thesis have implications for the current implementation of Malawi's latest National Fisheries Policy II. Building on the work by Hishamundu and colleagues (2009), possible mitigation strategies to overcome constraints to aquaculture growth in Malawi include: development of a strong legislation to promote investment; the inclusion of stakeholders in the development of the sector; improving access to credit and knowledge for fish farmers; improved training and development of both hatchery and feed industries; improve training and resources for extension officers; adapt and improve investment in research; build capacity and adopt integrated planning. Furthermore, chapter 6 illuminated the overlooked but valuable contributions of both male and female fish farmers as important agents of aquaculture in Malawi, accomplishing different tasks but also expressing different needs regarding constrains to their participation. Policy developments should recognise the valuable gendered contributions to the sector and seek solutions to meeting the needs of fish farmers to ensure the long-term sustainable development of the sector in Malawi. This would require cooperation of stakeholders involved in the sector in future policy decision making processes (Pita et al, 2010; Youn et al 2016; Krause et al 2016). As the challenge to meeting demands for food fish in conformity with the SDG targets and the Rome Declaration intensifies, good governance is key to ensuring aquaculture can adapt to multiple threats, including climate change, and contribute to improved food security and economic development through the sustainable management of the sector (FAO, 2006). During the course of this thesis, several attempts have been made to share research findings with policy makers and leading practitioners in the field (see appendix N).

8.9 Overall Conclusion

World-wide, small-scale aquaculture is often promoted as an opportunity to alleviate pressure on wild capture fisheries, increase economic development, enhance food security and nutrition and deliver wider social benefits for those involved along supply chains. Aquaculture's increasing contribution to the global food basket and anticipated role in mitigating future shortfalls in fish supply warrants increased attention and assessment, especially in regions such as SSA where the demand for a nutritious source of protein is urgent and where aquaculture has been identified as having greatest potential. A full appreciation of the complexity surrounding aquaculture and its role to food security requires more holistic and policy relevant assessment protocols than those used to date.

In addressing the reported gaps in the literature, this thesis adopted a mixed method, case study approach to assess the role of small-scale aquaculture to food security in Malawi. Overall, this thesis provides a valuable and timely contribution to the knowledge base by generating new insights into the complexities, impact and challenges associated with aquaculture development in Malawi. The use of a mixed method approach, guided by the SLA and HLPE frameworks, proved valuable in capturing the complexity surrounding the emerging interdisciplinary fields of aquaculture and food security. Findings presented within this thesis confirmed that small-scale aquaculture is associated with positive social and economic livelihood outcomes within the two studied communities, including improved food security through direct and indirect pathways, improved well-being and reduced vulnerability. However, aquaculture in Malawi faces multiple economic, social, environmental and governance challenges to its sustainable development and growth that limit the sector's ability to achieve desired policy goals.

Overall, findings support limited information that small-scale aquaculture contributes marginally but positively to local livelihoods through complex pathways to improved food security, improved well-being and reduced vulnerability. However, significant economic, social and environmental challenges were also identified that limit fish farmer's ability to realise aquaculture's full potential as well as retain operations in the long-term. Moreover, the results helped to illuminate that both men and women are important agents of small-scale aquaculture in Malawi, accomplishing different tasks but also expressing different needs concerning constrains to their involvement in aquaculture. In addition, the type of aquaculture adopted (interventionist vs immanent) was revealed to influence livelihood outcomes and challenges experienced in relation to aquaculture.

Improving fish farmer's access to crucial natural (e.g. water and feed), social (trust and networks), financial (market access and credit) and human (e.g. technical skills and knowledge) capitals is imperative in order to improve the likelihood of achieving and sustaining expected benefits from aquaculture in Malawi. Furthermore, in light of the emerging transition to a commercialisation of the aquaculture sector in Malawi, significant investment across the sector and enhancement of government capacities are required to enact national policies and to enhance small holder farmer's capabilities to overcome risks as well as enhance and sustain aquaculture production.

Future fisheries governance needs to be sensitive to multiple, interacting social-ecological factors mediating the productivity and livelihood outcomes from aquaculture. Moreover, future policy developments need to recognise the valuable but different contributions and needs of male and female fish farmers engaged in the sector as well as the different outcomes arising by type of aquaculture adopted. Given the heightened interest to put fish on the menu in the global debate on food security and aquaculture's increasing contribution to the global food basket, this thesis provides a timely endeavour in addressing knowledge gaps in the literature, contributing to methodological approaches in the field as well as providing policy rich information to support the future sustainable management of the aquaculture sector within the region. Ultimately, richer, context-specific research of socio-ecological dynamics influencing the sustainability of aquaculture and outcomes to food security is critical if aquaculture is going to continue to expand across Africa for conservation and development purposes. I encourage fisheries and aquaculture researchers to consider the economic and social aspects of their work through the use of mixed methods and creative participatory tools like Photovoice.

Appendices

Appendix A

Key informant interviewee participant summary.

01 Government Agencies;	4	Department of Fisheries; National Aquaculture Centre; Department of Economic and Planning.
02 Academia	3	Bunda College, Chancellor College.
03 International Intergovernmental Organisations;	5	United Nations Development Programme (UNDP); United Nations Food and Agricultural Organisation (FAO).
04 Non-Governmental Organisations (NGOs)/ Charities;	4	WorldFish; Concern Universal; Oxfam.
05 Private Sector	1	MALDECO.
TOTAL 17		

Appendix B

Key Informant Interview Guide.

Questionnaire Checklist for different key informant groups	
Semi-structured interviews with key informants – guided questions/topics Objective: To understand the status of the aquaculture sub-sector in Malawi in detail and identify future drivers and priorities	
Questions/Topics	**Possible follow up questions**
Could you briefly describe your role and work within your organisation?	
Can you tell me about your experience or involvement in the fisheries sector in Malawi?	What is your role with regard to aquaculture?
In your opinion, what is the importance of inland fisheries in Malawi/ and or for your organisation?	Do you think aquaculture is an important sub-sector? Why? Does aquaculture contribute to food and nutritional security in Malawi? If so, can you describe how?
Can you tell me about the development of aquaculture in Malawi?	What are the main species cultivated? What are the main production types?
What are the most serious problems to date in developing aquaculture in Malawi?	How can they be resolved? Are there any existing programs or management strategies in place to address these issues?
Should aquaculture be encouraged and why?	What factors would contribute to aquaculture development in the future? What should we turn our attention to?
Where should investments be targeted to promote aquaculture?	
Do you think policies and legislation to date have been effective in promoting aquaculture development? Why? (please provide examples)	What specific examples of strategies and outcomes? Do you think policies have adequately addressed major problems in the sector? What ought to be improved to support the growth of the sector?
How appropriate are current policies and legislation in supporting the future growth of the sector? (e.g. the National Fisheries Policy II (2012-2017)?	How is aquaculture positioned in other policies and departments outside of the fisheries sector? Is this adequate?
What role do extension services have in promoting aquaculture?	Is this effectively delivered? If not, why?
Who ought to be involved in the development of aquaculture policies and management plans?	Can you tell me about your experience?
What role may international guidelines and stakeholders play in sustaining aquaculture development?	
What do you think the main information gaps in the aquaculture sub-sector are?	Is this currently being addressed? What should we turn our attention to?

<table>
<tr><td>Can you tell me who are the most important stakeholders involved in the aquaculture sub-sector?</td><td>Can you recommend any further participants for this study?</td></tr>
<tr><td colspan="2">Thank you very much for taking the time to participate in this study. Is there anything else you would like to tell me before we finish?</td></tr>
<tr><td colspan="2">Possible list of probes if needed:
Can you explain that further? Can you say more? Could you give an example? I’m sorry I don’t understand. Please describe what you mean. Is there anything else? Tell me more about that. Can you give me more detail?</td></tr>
</table>

Appendix C

Participatory Models To Fisheries Research.

A summary of participatory models to fisheries research as described by the typical relationships between fishers and scientists. (Adapted from Hoefnagel et al. 2006; Wiber et al. 2009; and Jacobson et al. 2011).

Models	Description	Examples	Benefits	Challenges
1. Deference Model	The role of fishers as research assistants to scientists.	• Recreational and commercial fishers assisting with tagging studies e.g. National Marine Fisheries Service Cooperative Shark Tagging Program. • Participation of local fishermen assisting with long-term data collection for a stock assessment (Ticheler et al. 1998).	• Relatively cheap method to collect large quantities of reliable scientific data. • First step to enhance awareness for community management of resource.	• Rewarding or motivating fishers due to sacrifice of time and money.
2. Experience-Based Knowledge (EBK) Model	Emphasizes fishers' observations as a supplement to research-based knowledge of scientists.	• FP7 GAP 2 Project Case Study Norway. Scientists and local fishers cooperating to develop a fisheries-based monitoring system for Norway's coastal cod. • EU KNOWFISH project (Wilson et al. 2006).	• Reliable source of local and contextual knowledge. • Local fishers can have say in the design and implementation of the project.	• Cultural differences between scientists and fishers. • Participation by marginalized inaccessible fishers.
3. Competing Constructions Model	Understanding science as competing constructions of nature where stakeholder groups have different multifaceted objectives leading to biases in presenting knowledge.	• Scientists working in management agencies tend to construct a picture of nature that is more amenable to bureaucratic management than it really is (Jacobson et al. 2011) • Finlayson (1994) gives an extensive description of the politics of fisheries science related to the collapse of the northern cod.	• Address multifaceted objectives of various interest groups (Mackinson et al. 2011).	• Biases in knowledge (Peterman 2009). • Carries more significance to outsiders than to the community.

4. Community Science Model	Collaborative fisheries science is made in the context of cooperative management. Incorporates the other three models along with effective open communication.	• Nova Scotia Fishermen and Scientist Research Society- a partnership with emphasis on information collected from fishers to enhance stock assessments. It sets its own research priorities. • Scotland's Fishing Industry Science Alliance. A close partnership between fishermen, scientists, Scottish Government which combines expertise to gather data and advance research.	• Builds trust between fishers and scientists. • Greater mutual understanding and likelihood of long-lasting partnerships. • The relevance of scientific research and availability of EBK to management is improved.	• Institutional blocks- narrow funding limits flexibility to respond to participants' suggestions. • Time required for feedback and communication.

Appendix D

An evaluation of photovoice studies applied to natural resource management ***(Adapted from Hergenrather et al 2009).***

Author/ Year	Topic	Context	No of Participants	Participant Description	Length of Study	Discussion Trigger	Data Analysis Involvement	Outcomes
Bosak 2008.	Biodiversity conservation.	India, Garhwal Himalayas	10 villagers from 8 communities (7 men and 3 women).	Individual semi-structured interviews and group discussion.	Unclear. <1 month.	Facilitator questions.	Author driven based on content analysis of the images and identification of broad themes.	Photographs.
Castelden et al 2008.	Natural Resource Mgmt- Indigenous Knowledge.	Canada, Vancouver.	40 (male 25, female 15).	Individual semi-structured interviews.	6 months.	Facilitator questions.	Participant selection. Author identification of themes through coding.	Photographs, interview transcripts and follow up community dinners, newsletters, posters.
Baldwin and Chandler 2010.	Climate change and coastal communities.	Australia.	16 participants (divided into 3 groups). .	Group discussions and captions.	1 month.	Facilitator questions.	Participant selection and discussion of emerging themes.	Photographs, captions, exhibition and online web gallery.
Beh 2011.	Conservation education.	Kenya.	26 participants (stakeholders within 1 district).	Individual semi-structured interviews and group discussion.	7 months.	Facilitator questions.	Participant selection and discussion of emerging themes (‘coding’). In addition, further identification of themes by the lead author.	Photographs, interview transcripts and gallery exhibits.
Tanjasiri et al 2011.	Env. Sciences- Tobacco Control.	USA, (Asian American and Pacific Islander (AAPI) Communities.	32 participants from 4 community agencies.	Individual semi-structured interviews and follow up workshop.	Unclear. Overall project total 3 years.	SHOWED*.	Participant selection. Author identification of themes.	Photographs, interview transcripts and follow up workshop/stakeholder meeting.

Berbe´s-Blazquez 2012.	Ecosystem services.	Costa Rica, pineapple agriculture.	12 participants divided into small groups of 3-4.	A modified transect walk, followed by group discussions.	5 months (entire wider project).	SHOWED*.	Participant selection and discussion of emerging themes. In addition, identification of themes by the lead author according to the Millennium Assessment Framework.	Photographs, interview transcripts.
Bennett and Deardon 2013.	Social and Ecological Change.	Andaman Coast of Thailand, coastal/ marine communities	20 from 2 villages (9,11 respectively).	Individual semi-structured interviews, group workshops.	2-3 months (entire wider project).	Facilitator questions.	Participant selection and discussion of emerging themes. In addition, further identification of themes by the lead author.	Photographs, interview transcripts, books (online and hard copies).
Bisung et al 2015.	Water-Health nexus.	Kenya, lake-shore community.	8 participants (all females) from 1 community.	Individual semi-structured interviews, group discussions and community meeting.	3 months.	Facilitator questions.	Participant selection. Author identification of themes with the use on Nvivo.	Photographs, interview transcripts and follow up workshop/community meeting.
Crabtree and Braun, 2015	Natural disaster management.	Hawaii.	Unclear, 1 community.	-unknown.	-unknown.	-unknown.	-unknown.	-unknown.
Kong et al 2015.	Env. Sciences-Land Management.	South Africa.	25 participants from 2 study sites (14, 11).	Individual semi-structured interviews and group discussion.	Unclear, est. 1 week. Project length 9 months.	Facilitator questions.	Participant selection. Author identification of themes through coding in NVivo 10.	Photographs, interview transcripts and follow up community meeting.

***NOTE:** Wang and others (1998) recommend to facilitate a Photovoice discussion by the mnemonic SHOWED, which stands for ''What do you See here? What is really Happening here? How does this relate to Our lives? Why does this concern or strength Exist? What can we Do about this?'' (p. 80).*

Appendix E

PHOTO-VOICE SMALL-SCALE FISHERIES MANUAL PROTOCOL FOR FIELD WORK (ENGLISH)

Reference FAO Paper: Simmance, A., Simmance, F., Kolding, J., Madise, N., Poppy, M. G., 2016. In the Frame: Modifying Photovoice for Improving Understanding of Gender in Fisheries and Aquaculture. Pages 77- 90 in W. W. Taylor, D. M. Bartley, C. I. Goddard, N. J. Leonard, and R. Welcomme, editors. Freshwater, fish and the future: proceedings of the global cross-sectoral conference. Food and Agriculture Organization of the United Nations, Rome; Michigan State University, East Lansing; and American Fisheries Society, Bethesda, Maryland. ISBN 978-92-5-109263-7.

Eight step methodology:

1. COMMUNITY CONNECTION & CONSULTATION; Building trust.
2. PLANNING; Funding, logistics, ethics.
3. RECRUITMENT & TRAINING Participant identification, introduction, camera distribution & instructions
4. PHOTOGRAPHY ASSIGNMENT & COLLECTION; Periodic check-in on participants, camera collection & development.
5. DISCUSS PHOTOGRAPHS THROUGH INTERVIEWS; Develop narrative, reflect on images.
6. DATA ANALYSIS; Coding of main topics and themes.
7. PRESENTATION OF FINDINGS & DISCUSSION OF OUTCOMES; Cross-check interpretations, discussion on outcomes & implications.
8. DISSEMINATION; Ownership, desired audience- academia, public, policy.

A. PRIOR TO THE EXERCISE (STEPS 1&2)

1. Identify case study villages and plan all field logistics accordingly.
2. Introduce the aims of the study to community traditional leaders within the case study villages. Build a level of trust with the community via regular communication and transparency in study aims.
3. Identify adult females actively engaged in fish farming/capture fisheries from the case study villages.
4. Try to locate fishers from a diverse range of wealth status and years of experience in the fishing/aquaculture sub sector.
5. Provide training to the translator and ensure that he/she is informed of the entire procedure in advance of presenting the exercise.

B. PRESENTING THE EXERCISE (STEPS 3 & 4)

6. Recruit a group of 7 to 10 participants via a combination of snowball and purposive sampling of participants. Invite participants to a training workshop in order to present the project.
7. At the moment of presenting the project discuss the following aspects:
    a. The objectives of the research project.

b. The parties involved.

c. Their rights to refuse participation or withdraw from the exercise at any time.

d. The use we intend to give to the images collected (stress that they are not for commercial use).

e. Any form of compensation that may be provided (none, on this occasion, except for giving back all pictures they took).

8. Ask participants to sign the consent form (**attached to this document**) or record a verbal agreement with use of a Dictaphone.

9. Explain the following to all participants:

   a. **<u>Time and length of exercise</u>**: For this study, participants will take pictures about the topics detailed below for a total of <u>two weeks</u>. Explain that each participant will be given a camera and that they only have a limited number of photos to take (specify total cap of photos). Each participant is to therefore think carefully about the questions and ensure pictures that are captured cover each topic. A research member will check-in on participants after 1 week to ensure the exercise is progressing fine. A telephone number will also be provided should participants have queries or problems throughout the exercise.

      Explain that the exercise does not finish when they return the camera but that you will come back to ask a few questions about the pictures she took after the pictures have been taken.

   b. **<u>How to operate the camera</u>**: Use **visual aids** (**attached to this document**) to facilitate instructions of the project. Explain how the camera works. Use a spare camera for this purpose. Make sure she understands how it works.

   Remind participants of the following aspects:

   - The camera has up to (- specify total number of pictures) takes and that there is a counter available.
   - Explain that the camera does not reload automatically.
   - Show them how the flash works for takes in the dark.
   - Explain that it is waterproof and that participants are encouraged to take photos whilst actively carrying out activities in relation to fishing/fish farming.
   - Explain that if they want to take pictures of people or specific objects, they should not be too far away or too close (usually in between 2 to 5 meters).
   - Remind them to be careful with mud and dust since the cameras are not rugged.
   - Once you have explained these topics, hand over the spare camera to the participant to show you that she understood.

   c. **<u>Topics</u>**: Tell the participant that we would like her to take pictures about the following three topics:

      - **<u>WHAT ACTIVITIES</u>** do you carry out in relation to fish farming/capture fisheries? Ask participants to capture pictures about their day to day involvement in the fishery/fish farm. Use the visual aid to explain examples of what this might include (see attachments).
      - **<u>WHAT BENEFITS</u>** do you receive from aquaculture/capture fisheries? Explain to participants that they are to capture pictures about benefits arising from their involvement in the fishery/fish farm. Explain that this may include: increased fish/food for the household, increased income, etc. Ask participants to take pictures about a range of perceived benefits.

- **<u>WHAT CHALLENGES</u>** do you experience in fish farming/capture fisheries? Ask participants to take photos about challenges experienced in the fishery/fish farm. Use the visual aid to explain examples of what this might include (see attachments).

After you explained the subjects. Ask the participant to take one picture for each topic with the spare camera. Review why they took those pictures so as to make sure they understood the subjects.

d. **<u>Safety considerations when taking pictures:</u>** Discuss the following topics with the participants:

– Remind participants that the cameras are rather inexpensive and have a single use (i.e., they are disposable). Consequently, the risk of theft is minimal; however, they should ensure that they do not expose it too much to avoid conflicts.

e. **<u>Ethical considerations when taking pictures:</u>** Remind participants that they cannot take pictures of people freely. In particular remind them the following:

- They can freely take pictures of their family members but if they want to take pictures of other individuals, they should ask for permission.
- There are no restrictions for taking pictures of objects or landscapes (as long as it is safe).
- They MUST not take pictures of very ill or very old people. That is, those who cannot refuse to have their pictures taken.
- They MUST not take pictures of naked people, including children.
- They MUST not take pictures of people in a compromising situation (e.g., in the toilet, conducting illegal activities or after an accident).

f. Once participants have understood the instructions, **<u>agree on a date and time</u>** suitable for the participant for you to **<u>collect the camera</u>** in two weeks' time. Confirm any necessary telephone contact details should the time/date need to change or the participant has any questions during the exercise (reminding them that a research member to check-in in 1 weeks' time).

g. After the pictures have been revealed at a local camera/printing store, **<u>agree on a date and time</u>** suitable for participants to carry out an **<u>interview about what the photographs</u>** mean to participants.

C. DISCUSSING THE PICTURES (STEP 5)

10. On the interview day you should bring all the pictures that the participants took during the 2 week period.
11. Proceed in the following manner:

a. Ask the participant to select **<u>ONE</u>** picture that better illustrates the activities she carries out in relation to fishing/fish farming
b. Once the picture has been selected ask the participant to tell you

i) *What's in the picture?*

ii) *Why did they take the picture?* (explore any special meaning that the objects in the picture may have or if there are any stories / memories associated to this picture)

iii) *Why did they select this picture, what makes it different from the other pictures they took?*

c. Proceed in the same way with the other two topics: benefits and challenges.
d. Now, taking into consideration **all the activities-related pictures** the participant has taken, ask her the following:

Imagine that, of all the pictures you took, we will show ONE picture to others outside of your community to talk about fisheries/fish farming activities in your village. Which one would you choose?

Once the participant picked a picture, proceed to ask the following questions:

i. *What is in the picture?*
ii. *Why did they take the picture?* (explore any special meaning that the objects in the picture may have or if there are any stories / memories associated to this picture)
iii. *Why did they select this picture? what makes it different from the other pictures?*
iv. *What would they like to tell to others with this picture?* What message do they want to transmit?
v. *Why would it be important to give this message to others?*

12. Reflect on conclusions and finalise any comments.
13. Thank participants for their time and inform them that you will return in a weeks' time to validate findings and return the photographs.

D. OUTCOMES, VALIDATION & DISSEMINATION (STEPS 6, 7, 8)

FINAL PHOTO-VOICE GROUP SESSION

The aims of this final Photo-Voice group session are to:

- Share the meanings and stories behind the stories and to ensure that participant voices are accurately captured and represented;
- Discuss outcomes of the project and dissemination activities;
- Capture group perspective on the Photo-Voice experience.

Before we kindly begin the session, are you happy for me to record the session via a Dictaphone?

1.PARTICIPANT CHECKING/REFLECTION:

a. During this exercise, all participants will have the opportunity to share their main messages captured during the discussion over 1-2 weeks ago. Each participant will also be able to ensure that the key messages captured are correct and specify whether you would like to add any further comments.

b. To begin the exercise, we have printed out all pre-selected images captured for topic 1, 2, 3 and overall for each participant. Please take the time to review these photographs in front of you.

c. We will now relay the key messages captured for these images one-by-one for each participant.

Participant 1: core activity and message; core benefit and message; core challenge and message; overall core message. Are there any amendments or further comments?

d. REPEAT FOR ALL PARTICIPANTS.

e. AT END OF INDIVIDUAL DISCUSSION ASK THE GROUP WHETHER THEY HAD ANY FURTHER GROUP PERSPECTIVES ON 1) ACTIVITIES; 2) BENEFITS; 3) CHALLENGES.

2.DISSEMINATION ACTIVITIES

a. We would now like to ask all participants whether you have any wishes for how the findings will be disseminated. This will be an opportunity for you to think about how you want to share your pictures and stories with others in the community and beyond.

b. To begin, we would like to know who you may want to hear your stories? Who do you want to be your target audient- other fish farming communities, stakeholders such as the Department of Fisheries, international organisations and other communities world-wise?

c. Secondly, how would you like your stories and pictures to be shared with the target audience? public exhibition, international academic conferences, online.

d. As a student, I would like to disseminate your findings via a public exhibition and at international conferences. Would you be happy for me to display these photographs in front of you along with the messages captured?

3.REFLECTION ON PV PROCESS

a. We would like to finish this session by asking for group feedback on your experience of participating in the project. This information will be greatly appreciated and will help assess the value of using photography in research projects.

1. What has been your overall experience participating in this project?

2. Was taking photographs a significant or meaningful part of your experience?

3. Has your understanding of yourself and fish farming changed throughout this project?

4. Do you feel like you have gained confidence and/or comfort by participating?

5. What has been the community response to the Photovoice project? Have you seen any changes (in attitudes or action)?

6. Do you feel like your voice and story was heard in this project? Why or why not?

7. How would you change this project if you were to participate again?

8. Is there anything else you'd like to add?

CHICHEWA- MALANGIZO OTSOGOLERA CHITHUNZI NDI MAWU PA ULIMI WA NSOMBA

NDONDOMEKO YA KAFUKUFUKU

Reference FAO Paper: Simmance, A., Simmance, F., Kolding, J., Madise, N., Poppy, M. G., 2016. In the Frame: Modifying Photovoice for Improving Understanding of Gender in Fisheries and Aquaculture. Pages 77- 90 in W. W. Taylor, D. M. Bartley, C. I. Goddard, N. J. Leonard, and R. Welcomme, editors. Freshwater, fish and the future: proceedings of the global cross-sectoral conference. Food and Agriculture Organization of the United Nations, Rome; Michigan State University, East Lansing; and American Fisheries Society, Bethesda, Maryland. ISBN 978-92-5-109263-7.

Ndondomeko zisanu ndi zitatu zoyenera kutsata:

9. Kukumana ndi kudziwana komanso kufunsana mafunso ndi a kumudzi: Kulimbikitsa kudalirana-kukhulupirana.
10. Kukonzekera: kulongosola kayendetsedwe ka ntchito, zachuma ndi chikhalidwe.
11. Kulemba ndi kuphunzisa, kudziwana anthu omwe akhale nawo/ kutenga mbali muntchitoyi, kugawa ma kamera komanso kufotokoza kagwirisidwe ntchito kake
12. Phunziro lokajambula zithunzi: Kuyendera ophunzira ndikuona mmene akutolera ndi kutulusira zithunzi.
13. Kambiranani zithunzi kudzera kufunsana mafunso: Ganizirani komanso pekani nkhani kudzera mzithunzi.
14. Kasanthulidwe kazotsatira: kulembera mitu yofunikira ndi magawo ake.
15. Kufotokoza zazotsatira za kafukufuku; kuzimasulira bwino, kukambira zonse zomwe mwapeza mu kafukufuku.
16. Kugawa zotsatira; kwa anthu akutenga mbali, ongomvetsera, a m'mudzi mwanu, komanso kudzera ndondomeko yotsogolera pogwira ntchito.

A. ZOYENERA KUCHIKA MUSANAYAMBE NTCHITO (GAWO 1 NDI 2)

14. Pezani midzi imene mukukagwira ntchito ndikukonza ndondomeko zamayendedwe ndi zina zoyenera munthawi yabwino.
15. Fotokozani cholinga cha kafukufuku kwa atsogoleri a midzi yomwe mugwire ntchito, yesetsani kulimbikisa kukhulupiririrana, komaso muwalore kufunsa mafunso pomwe akuoneka kuti sakumvetsetsa.
16. Pezani amayi amene akulimbikira usodzi owedza kapena osunga nsomba kuchokera m'midzi imene mukugwira ntchito.
17. Yesetsani kupeza alimi ochokera muzigawo zachuma zosiyana komanso akapezedwe kosiyana omwe amapanga nawo usodzi.
18. Muphunziseni otanthauzira musanapite kumalo a ntchito kuti adziwe ndondomeko yonse yomwe yamomwe zinthu ziyendere.

B. MAGWIRIDWE A NTCHITO (GAWO 3 & 4)

19. Pezani anthu asanu ndi awiri kapena khumi kudzera munjira yosankha, kapena yogwirisa ntchito amene mwamupeza kuti akupezereni ena amene mungawafunse omwe atakhale mamembala a ntchitoyi. Itanirani mamembalawa kumaphunziro ofotokoza zammene mugwirire ntchito.

20. Pamene mukufotokoza za kafukufuku, nenani ndi kukambirana izi:

    a. Cholinga cha kafukufuku .

b. Mbali zokhudzidwa.

c. Ma ufulu awo , kukana kapena kusiyira panjira nthawi yina iri yonse pamene asakumva bwino.

d. Ntchito imene zithunzi zomwe atole igwire (sizamalonda ayi).

e. Cholowa chimene angapeze (apapa palibe koma kupatula zithunzi zomwe apereke).

21. Auzeni ngati amvetsetsa asayine chilolezo (**zomwe zalumikizidwa pothera pa malangizo otsogolerawa**) kapena anene ndipakamwa pamene mukuwatepa pogwiritsa ntchito makina otepera.

22. Fotokozani zotsatira izi kwa omwe mugwire nawo ntchito:

a. **<u>Nthawi ndi kutalika kwa ntchito iyi</u>**: Mukafukufuku uyu, ophunzira adzatola zithunzi mu <u>masabata awiri</u>, pa mitu yalembedwa munsimu. mamembala akuyenera kufotokozeredwa kagwiritsidwe ka kamera kuti zithunzi zomwe adzatole zidzakhala zowerengeka (tchulani muyeso wa kuchuluka kwa zithunzi). Kotero, membala aliyense akuyenera kuganizira za mafunso ndi kuonetsetsa kuti zithuzi zotoledwazo zikufotokoza bwino pa mutu omwe watchulidwa. Poonetsetsa kuti zonse zikuyenda bwino, wowayang'anira adzakhala akuyendera anthu amenewa pa mathero a sabata iliyonse. Komanso, nambala ya lamya idzapelekedwa pofuna kuthandiza onse omwe ali ndi mafunso pa nkhani ya ntchitoyi.

Fotokozerani mamembalawa kuti ntchito imatha pamene mafunso okhuza zithuzi zomwe zinatoledwa ayankhidwa, ndipo osati pamene akukabweza makina otolera zithunzi.

b. **<u>Kagwiritsidwe ntchito ka kamera</u>**: Kagwiritsidwe koyenerera ka ntchito ya kamera ikuyenera kufotokozedwa bwino lomwe, pogwiritsa kamera yapadera ngati chitsanzo, ndipo ophunzira akuyenera kumvetsetsa zomwe zafokozedwazo. Ndipo chinthu chothandizira kuwona zinthu zina (zomwe zalumikidwa) chidzagwiritsidwa ntchito polangiza za project.

Anthuwa akuyenera kukumbutsidwa zotsatirazi:

- Nambala ya zithuzi zomwe kamera ingathe kutola (tchulani kuchuluka kwake) ndipo palinso chotsamitsira makinawa.
- Fotokozani zoti kamera simadzikonza kapena kudzitsogolera yokha.
- Aonetseni anthuwa mmene muuni umagwiritsidwa ntchito potenga zithunzi mu mdima.
- afotokozereni kuti kamerayi itha kugwiritsidwa ntchito pamene ntchito zina zokhuza ulimi wa nsomba ili mkati, malingana ndikuti makinawa ali otetezedwa ku madzi.
- afotokozereni kuti sakuyenera kuyandikira kapena kutalikira pamene zinthunzi za anthu kapena za chinthu chapadera zikutoledwa (akhale pakati pa ma mita awiri kufikira asanu).
- Akumbutseni mmene angathere kusamalira ma kamera ku matope ndi fumbi, chifukwa izi zimatha kuononga makinawa.
- Pomaliza kufotokoza nthambi zimenezi, anthuwa akuyenera kupatsidwa kamera yapadera cholinga choti asonyeze ngati amvetsetsa malangizowa.

c. **<u>Mitu yotsogolera</u>**: anthuwa akuyenera kutola zithunzi zokhuzana ndi mitu kapena nthambi zitatu:

- **<u>NTCHITO ZANJI</u>** zomwe zimachitika zolingana ndi ulimi wa nsomba? Iwowa akuyenera kutola zithunzi za tsiku ndi tsiku zolingana ndi ulimi wa nsomba. Gwiritsani nchito zipangizo zothandizira kuona zithunzi pofotokoza zitsanzo (onani pa zophatikiza).

- **NDI UBWINO WANJI** umene umachokera ku ulimi wa nsomba? Mamembalawa akuyenera kufotokozeredwa kuti pa nthawi imeneyi akuyenera kutola zithunzi zolingana ndi ubwino wochokera ku ulimi wa nsomba. Afotokozereni kuti nsomba zochuluka zimatipatsa chakudya, komanso ndalama tsiku ndi tsiku.
- **NDI MABVUTO ANJI** amene anthu amakumana nawo ochokera ku ulimi wa nsomba? Zitsanzo zidzaperekedwa pakuwaonetsa mamebala zithuzi pakugwiritsira makina omwe amathandizira kuwonera zithu zina.

Pamapeto a kuwafotozera mamembala, auzeni kuti atole chithunzi cha mutu uliwonse omwe wafotokozedwa. Kuti tidziwe ngati amvetsetsa, afunseni anthuwa zifukwa zomwe amatolera zithunzi.

Zofunika zoyenerera kudziwa pakutola zithuzi: Fotokozerani bwino mamembala nthambi zotsatirazi:

– Mamembala akuyenera kukumbutsidwa kuti ma kamera si odula ndipo amagwiritsidwa ntchito kamodzi. Momwenso, umbava umachepa; komabe anthuwa akuyenera kusamalira makinawa poopetsa milandu.

d. **Kutola zithuzi molingana ndi mwambo wa chikhalidwe:** mamembala akuyenera kukumbutsidwa kuti siololedwa kutola zithunzi za anthu mwakufuna kwao. Mamembalawa akuyenera kukumbutsidwa mu zotsatirazi:

- Iwo ali ololedwa kutola zithunzi za azibale awo. Koma ngati zili zithunzi za anthu ena apadera, iwowa akuyenera kutenga chilolezo kwa anthu amenewa kuti awatole chithunzi.
- Mamembala akhonza kutola zithunzi za zinthu kapena za malo (ngati zili zoyenera).
- Iwo siololedwa kutola zithunzi za anthu omwe sangathe kukana kujambulitsa ngakhale asakufuna, monga odwalika kapena anthu okalamba kwambiri.
- Iwo siololedwa kutola zithunzi za ana kapena anthu ali maliseche.
- Palibe chilolezo chotola zithunzi za anthu ali m'malo osakhala bwino. (monga chimbudzi, pakuphwanya malamulo komanso pa ngozi zosiyanasiyana).

e. Ngati mamembala amvetsetsa ndondomeko ya ntchitoyi, mukuyenera **kugwirizana nthawi ndi tsiku lodzatengera kamera** patatha masabata awiri. Tsindikizani zoti ngati pali kusintha kulikonse kapena ngati pali mafunso okhuza ntchitoyi, mamembala atha kuimba lamya pa nambala yomwe iwo apatsidwa (akumbutseni kuti munthu wowayang'anira adziwayendera pakutha pa sabata iliyonse).

f. Zithunzi zikatha kutsukidwa bwino ndi kutuluka, nthawi ndi tsiku zikuyenera kusanthulidwa kuti ophunzira adzafotokoze bwino lomwe zomwe zili pa zithunzizo.

C. KUKAMBIRANA ZA ZITHUNZI (GAWO 5)

23. Zithunzi zomwe zinatoledwa ndi anthuwa zikuyenera kubweretsedwa pa tsiku lokambirana.
24. Tsatirani izi:

a. Funsani anthuwa kuti asankhe chithunzi chomwe chingagwirizane ndi ulimi wa nsomba omwe amapanga
b. Ngati chithunzi chasankhidwa, funsani membala kuti afotokoze;

i) ndichani chili pa chithunzipo?

ii) chifukwa chani anatola chithunzicho? (pezani ngati pali chifukwa chapadera kapena maganizo olingana ndi chithunzicho)

iii) kodi chithunzicho chikusiyana ndi zithuzi zina ? ndipo ndi chifukwa chani asankha chithunzi chimenecho?

c. Momwemo, pitilizani ndi nthambi ziwiri izi: ubwino ndi zobvuta zomwe amakumana nazo.
d. Pa ganizo la **malinganidwe a ntchito ndi zithunzi zomwe zatoledwa**, membala ayankhe mafunso otsatirawa:

Titatenga chimodzi mwa zithunzi mwatolazi kuti tikafotokozere ulimi wa nsomba ku dera kwina, ndichiti chithuzi chomwe mungasankhe kuti tikaonetse ku dera limeneri?

Pitilizani kufunsa mafunso otsatira pamene membala wasankha chithunzi:

i) Ndichani chili pa chithunzipo?

ii) Chifukwa chani anatola chithunzicho? (pezani ngati pali cholinga china kapena maganizo olingana ndi chithunzicho)

iii) Kodi chithunzicho chikusiyana ndi zithunzi zina ? Ndipo ndi chifukwa chani asankha chithunzi chimenecho?

iv) Ndi uthenga wanji umene angauze ena pa nkhani ya chithunzicho? Ndi chani kwenikweni akufuna kuti anthu ena adziwe?

V) Kufunika kwake nkotani pakupereka uthenga umenewu kwa anthu a m'madera ena?

25. Uniikirani pa mapeto komanso tsekerani nthawi ya ndemanga.
26. Pomaliza, yamikirani mamebala pa nthawi imene anakupatsani ndi kuwauza zoti mudzabweranso kudzawabwenzera zithunzi zawo, komanso kudzauza zotsatira za kafukufuku ameneyu mu masabata ali nkudza.

D. ZOTSATIRA ZA KAFUKUFUKU ZOVOMEREZEKA (GAWO 6 NDI 7)

27. Unikirani zomwe mwapeza mu kafukufuku makamaka mu gawo 5, ndikufotokoza uthenga wofunikira kuchokera ku nkhani zomwe zakambidwa mwachindunji.
28. Sungani pamalo abwino zithunzi zomwe mwatola zomwe zili zofanana ndi zithunzi zomwe zinatoledwa ndi mamembala.
29. Gwirizanani ndi mamembala za tsiku ndi nthawi yoti mudzawayendere komaliza.
30. Afunseni ma membala ngati zotsatira za kafukufuku zili zolondora komanso ngati ali ndi choonjezera china chilichonse panthawi imene mukukambiranayi.
31. Pomaliza, afunseni anthuwa ngati kuli koyenera kugawiza zotsatira za kafukufuku. (uniikirani zonse zomwe mwakonzekera kugawiza komanso zomwe zili ndi mabvuto apadera).
32. Bwezerani zithuzi kwa ophunzira.

33. Ayamikireni anthu omwe amawayang'anira mamembala pa nthawi yopambana imene anapeleka pa ntchito imeneyi. Ngati mamembala akufuna kudziwitsidwa za zotsatira za kafukufukuyi, apatseni keyala ya nthumwi ndi tsogoleri wa kafukufukuyi.

E. ZOTSATIRA ZA KAFUKUFUKU ZOVOMEREZEKA (GAWO 8)

- Zochokera pa nthawi ya kafukufuku komanso pamene kafukufuku watha.

ZONSE ZOMWE ZALUMIKIZIDWA:

- GANIZO LOTSOGOLERA;
- CHILOLEZO;
- ZINTHU ZOTHANDIZIRA KUONA ZITHUNZI ZINA.

Appendix F

Photovoice Logsheet.

	Name	Age	Gender (M/F)	Role in Fishing/Fish farming?	Years involved in fish sector?	Consent Y/N		Participant Code & Camera ID No (1-7)	Telephone No	Introduction/ Training Session Date	Wk 1- Check-in? Y/N Date	Wk 1- Collect Camera? Y/N Date	Wk 3- Individual Interview complete? Y/N Date	Wk 4- Final group session complete? Y/N Date
						Oral	Written							
1														
2														
3														
4														
5														
6														

Appendix G

Household Questionnaire (English & Chichewa).

ANNEX II. HH QUESTIONNAIRE

PART ONE – CONDUCTED WITH FISH FARMER AND NON-FISH FARMER HHS; LEADING FISHER IN FISH FARMER HHS. HEAD OF THE HH IN NON-FISH FARMER HHS.

PART TWO – CONDUCTED ONLY WITH FISH FARMER HHS; THE LEADING FISHER.

FILTER QUESTIONS - PLEASE COMPLETE THESE QUESTIONS BEFORE STARTING THE QUESTIONNAIRE

QUESTIONNAIRE NO: _______________________

INTERVIEWER NAME: _______________________

1. Village: _______________________ 2. Date: ____________3.Time: _________________

4. House ID/No: ____________

5. Family Name: ____________

6. Is any member of the household involved in the fishing / fish farming industry? Yes […] No [….]

PLEASE CHECK RESPONSE TO Q5 & Q6 AGAINST YOUR ASSIGNED HH TO ENSURE THE HH IS CORRECT; I.E. FISHER HH OR NON-FISHER HH. IF THE HH DOES NOT MATCH THE CRITERIA, PLEASE STOP AND CHECK WITH PRINCIPAL RESEARCHER BEFORE PROCEED. IF THE HH IS CORRECT, PROCEED WITH BELOW.

7. Interview conducted with: Head of the household [……….] Fisher member [……….] Fisher member who is also head of the household [……….]

8. Name of participant: ___________________________

9. Have you obtained consent from the participant in order to apply this survey? Yes […] No [….]

IF CONSENT NOT PROVIDED – END DISCUSSION AND MOVE TO NEXT HH.

IF CONSENT PROVIDED – PROCEED TO QUESTIONNAIRE BELOW.

PART ONE – HOUSEHOLD LIVELIHOOD AND FOOD SURVEY

A) HOUSEHOLD CHARACTERISTICS

1. Gender of the head of the household/fisher: Male [……….] Female [……….]

Kodi mutu wa banja lanu ndi ndani?

2. Age of the head of the household / fisher: [……….]
Kodi muli ndi zaka zingati?

3A. Household information: Ethnicity […………………] Religion […………………….]

Kodi ndinu a mtundu wanji?

Kodi ndinu a chipembedzo chanji?

3.B. IF MUSLIM (ISLAMIC), PLEASE ASK THE PARTICIPANT IF THEY HAVE BEEN FASTING OVER THE PAST 7 DAYS DUE TO THE HOLY MONTH OF RAMADAN? YES (…………); (NO…………).

4. Residential status of the household

Household lives in village permanently [……….] Household lives in village temporally for seasonal work [……….]
Other specify […………]

Kodi ndinu a m'mudzi uno kapena mumangobwelamo nthawi yolima?

5. Marital status of head of the household; Kodi muli pa banja?

Married [……….] Divorced/separated [……….] Never married [……….] Widowed […….]

6. How many adults (16 years and above) and children (below 16 years) are living in the household? Kodi pakhomo pano pali anthu akuluakulu (osachepera zaka 16) angati? komanso ana (osakwana zaka 16) angati?

Adult Male [……….] Adult Female [……….] Children Male [……….] Children Female [……….]

B) HUMAN CAPITAL

1. Number of people in the household able to read and write? [……….]

Kodi ndi anthu angati amene amatha kulemba ndi kuwelenga pa khomo pano?

2. What is the level of education of the head of the household? Kodi sukulu munafika kalasi yanji?

Nursery / Pre-school [……….] Primary: stnd 1 – 8 [……….] Secondary: form 1 – 4 [……….] University [……….]
Training College [……….] Never been to school […….]

3. During the past 4 weeks has any member of the HH suffered from an illness or injury? Kodi musabata zinayi zapitazi alipo munthu amene anavulala kapena kudwala pa khomo pano?

Yes [……….] No [……….]

C) NATURAL CAPITAL

1.a. Do you own agricultural land? Kodi muli ndi malo kapena munda? Yes [..........] No [..........]

IF NO SKIP TO Q2. IF YES, PROCEED TO Q1.B.

1.b. What is the total size? Kodi malowo ndi a akulu bwanji? Acres [.....]Hectares [.....] Other [.....]

1c. What do you do with the land you own? Please tick all that apply:

1= rent it to others […] 2=use it for animal grazing […] 3=farm […] 4=other [……]

Kodi malo amene muli nawo mumawagwiritsira ntchito yanji?

1= Kubwereketsa […] 2=Kudyetserapo ziweto […] 3=Kulima[…] 4=Zina ndi zina [……]

2. What are the sources of water for: a) drinking? [..........] b) Washing? [..........] c) Domestic Use? […………]

Please input the source number that apply (more than one can be entered): 1=protected wells, 2= unprotected wells; 3=piped water, 4=river, 5=Lake Chilwa, 6=boreholes; 7= other please specify […………….]

a) Kodi madzi amene mumamwa amachokera kuti

b) nanga ochapila amachokera kuti? 1=zitsime zosamalika, 2=pa mpopi, 3= unprotected wells; 4=mtsinje, 5=Ku Nyanja yaChilwa, 6=mjigo; 7= Other please specify […….]

D) PHYSICAL CAPITAL

1. Indicate whether the household possesses the following items, how many?

Kodi mwakatundu uyu ndimungati amene muli naye?

PLEASE READ OUT THE LIST AND INPUT THE NO. OF THAT ASSET OWNED. IF NONE, INPUT ZERO.

PLEASE CHECK WHETHER THE ASSET IS OWNED BY THE HH OR PART OWNED AS A COMMUNITY GROUP. IF GROUP, PLEASE WRITE 'G' NEXT TO THE NUMBER LISTED FOR THAT ASSET.

Asset	**No.**	**Asset**	**No.**
Car/Motorcycle Galimoto/njinga ya moto		Fishing boats / Mabwato	
Plough / Khasu la ng'ombe		Seine nets / Ukonde (including Matemba seine nets, Nkacha seine nets)	
Bicycle / Njinga		Fish pond (please specify number of ponds) zidazogwiritsa ntchito pa ulimi wa nsomba	
Ox cart / Ngolo		Sewing machine / Makina osokera	
<u>Working</u> Cell phone / Foni ya m'manja		Treadle pump	
Radio / Wailesi		TV set / Wailesi ya kanema	
Livestock Ziweto - chicken		**THE FOLLOWING BELOW TO BE <u>OBSERVED</u> ONLY WHERE POSSIBLE AND <u>NOT ASKED</u>:**	

Livestock Ziweto - guinea fowls		House – iron sheeting roofing (Yes; 1 or No; 0)	
Livestock Ziweto - ducks		House – cement flooring (Yes; 1 or No; 0)	
Livestock Ziweto - goats		Modern furniture / Mipando, tebulo, kama ndi katundu wina wa makono wa m'nyumba (Yes; 1 or No; 0)	
Livestock Ziweto - pigs		**Others / Zina:**	
Livestock Ziweto - cattle			

2.a Does your household have access to electricity power? **NOTE: PLEASE OBSERVE** Yes [..........] No [..........]

2.b. If yes, what is the source of electricity power? Please tick all that apply: Grid [……….] Solar Panel [……….] Generator [……….] Other please specify [……….]

Kodi munyumba mwanu mumawunikira chani?

E) FINANCIAL CAPITAL

<table>
<tr><td colspan="4">1.a What are the sources of your household livelihood activities over the last 12 months?
Kodi mumapanga chani kuti mupeze zofunikira pakhomo panu mumiyezi khumi ndi yiwiri yapitayi?

PLEASE LET THE RESPONDANT ANSWER INITIALLY AND THEN PROBE WITH THE LIST OF ACTIVITIES. (tick all that apply)

IF THE HH IS NOT INVOLVED IN THAT ACTIVITY, INPUT ZERO</td><td>1.b What are the top 4 HH activities by income for the whole year? And what % do these contribute to overall HH income?
Tchulani zithu zinayi mwazinthu zimene mwatchula zija zimene zimabweretsa ndalama kwambiri kuposa zinazonse.</td><td colspan="2">1.c Of the top 4 income sources, specify how many adults of the HH partake in that activity by gender.
Ndi amuna kapena akazi angati amene amatengapo gawo muntchito kapena zinthu zimenene zimabweretsa ndalamazi?

IF NONE, INPUT ZERO</td></tr>
<tr><td>1.a. Source</td><td>Tick</td><td>1.a. Source</td><td>Tick</td><td>1.b. Rank
INPUT SOURCE NO.</td><td>1.c. No. Adult Males</td><td>1.c. No. Adult Females</td></tr>
<tr><td>1.Farming (crops, vegetables)</td><td></td><td>9.Bird hunting
Kusaka mbalame</td><td></td><td><u>1st</u></td><td></td><td></td></tr>
</table>

Kulima mbewu				**%**		
2.Livestock rearing Kuweta ziweto		10.Agriculture wage labour Ntchito zogwira muulimi		**2nd** **%**		
3.Fish culture / farming Ulimi wa nsomba/kuweta nsomba		11.Non agri. wage labour Ntchito zimene zili zosagwirizana ndi ulimi		**3rd** **%**		
4.Fishing (crew member or gear owner who is actively fishing) Usodzi/kuwedza nsomba		12.Petty business Bizinesi/malonda ang'onoang'ono		**4th** **%**		
5.Fish processing Kukonza nsomba		13.Business Bizinesi/malonda				
6.Fish trading Kugulitsa nsomba		14.Urban remittance Ndalama kapena katundu wochokera kwa achibale akutawuni				
7.Other fish related business Malonda ena okhudzana ndi nsomba		15.House helper/maid Wantchito wapakhomo				
8.Firewood / Nkhuni		16.Handicraft Luso lamanja				
		17.Others (specify) Zina				

2. For each of the top four ranked livelihood activities, when did your household carry out each of these livelihood activities over the past 12 months?

Muzinthu zinayi mwatchulazo, ndi liti limene munapanga zintu zotsatilazi mu miyezi khumi ndi iwiri yapitayi ?

PLEASE RE-LIST ACTIVITIES AS RANKED IN Q1.B. AND INPUT IN COLUMN Q. Mark X in each month.

	2014 **Chaka chatha**							**2015** **Chaka chino**							
Ranked Livelihood Activities from Q1.	**Dry Season** **Chilimwe**					**Wet Season** **Ndzinja/nthawi ya mvula**						**Dry Season**			
Please re-write…	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
1st____________															
2nd____________															
3rd____________															
4th ____________															

START OF SKIP QUESTIONS:

Q3 NOTE:

IF RESPONDANT <u>DID</u> SELECT <u>ANY OF 1-3</u> FROM Q1a, PROCEED TO <u>ASK Q3</u>.

IF NOT, <u>SKIP TO Q4.</u>

3.a. If you had the choice what would you prefer to farm? Please select one: farming crops […]; farming livestock (e.g. goats, ducks, pigs, etc. **<u>excl. chicken</u>**) […]; farming chicken […]; farming fish […].

Kodi ndi ulimi wuti womwe mungasangalatsidwe kupanga mutate musankhe?

3.b. Why have you selected this preferred farming option? Please tick all the apply: Cheaper to farm […] Higher yields […] Higher income from sale […] Preferred food consumption […] More nutritious […]Ease of practice […] Other please specify […]

Kodi ndichifukwa chani mwasankha ulimi umenewu?

Q4 NOTE:

IF RESPONDANT <u>DID</u> SELECT <u>3</u> FROM Q1a, PROCEED TO <u>ASK Q4</u>.

IF NOT, SKIP TO Q5.

4.a. How many ADULT members of your HH are involved in fish farming? Please also specify gender (male: M, or female: F).

Kodi ndi amuna kapena akazi angati (osachepera zaka 16) amene amapanga nawo za ulimi wa nsomba?

Fish farming [M:.......F:.......]

NOTE: PLEASE ALSO ADMINISTER PART TWO OF SURVEY.

4.b. What is the importance of fish farming related activities for your HH? Please tick all that apply: Income [.....] Food [.....] Other please specify [.....]

Kodi ntchito zosiyanasiyana zimene mumapanga za ulimi wa nsomba ndizofunikira bwanji pa khomo panu?

Q5 NOTE:

IF RESPONDANT DID NOT SELECT 3 FROM Q1a, PROCEED TO ASK Q5. IF NOT, SKIP TO Q6.

5.a.Would you consider becoming involved in fish farming? Yes [.....] No [.....]. **IF NO, SKIP TO Q6**.

Kodi mungafune kuyamba nawo ulimi wa nsomba?

5.b.**IF YES**, Are there any constraints that have stopped you partaking in fish farming? Yes [.....] No [.....] **IF NO, SKIP TO Q6.** Kodi pali zovuta zinazillizonse zimene zimakupangitsani kuti musapange nawo za ulimi wa nsomba?

5.c. **IF YES**, What are the constraints? Ndizovuta zanji?

Please tick all that apply: Financial up front cost of construction [.....] 2. Financial running costs [.....] 3. Skill [.....] 4. Availability of land [.....] 5. Customs [.....] Other (specify) [.....]

END OF SKIP QUESTIONS: TO CONTINUE TO ANSWER BELOW Qs:

6. If you had the choice to partake in any role in the fishery sector, what fisher income generating activity would you prefer? Please select one: No.3 Fish Farming […] No.4 Fishing […] No.5 Fish Processing […] No.6 Fish Trading […] No.7 Other fish related business [...]

Kodi ndi bizinesi yanji yomwe mungapange yokhuzana ndi nsomba mutasangalatsidwa kuyamba?

EXPENDITURE SECTION

7.a. Over the (SET PERIOD SPECIFIED BELOW) did you or other members in your HH purchase (item)?

Kodi ndalama zanu mu miyezi yoposera khumi ndi yiwiri yapitayi magwiritsa ntchito muzinthu ngati ziti?

PLEASE READ OUT LIST OF ITEMS. PLEASE TICK ALL THAT APPLY. IF NOT APPLY – INPUT ZERO. SPECIFY TOTAL COST IN MK.

7.a. Expenditure Details	**TICK**	**MK**	**7.a. Expenditure Details (cont.)**	**TICK**	**MK**

1 WEEK			**4 MONTHS**		
Charcoal Nkhuni			Clothes Zovala		
Paraffin Mafuta anyale			Gifts Mphatso		
Leisure/alcohol Zachisangalalo/mowa			Laundry, dry cleaning, tailoring fees		
Cigarettes or other tobacco			Kitchen Utensils (Bowls, glassware, plates, cookpots)		
Public Transport- Bicycle Taxi/ Bus/Minibus Mayendedwe			Cleaning utensils (brooms, brushes, etc.)		
1 MONTH			Torch / flashlight		
Milling fees, grain			Business Investments Bizinesi		
Personal beauty, cleaning products (soap, shampoo, toilet paper, hair products, clothes cleaning powder).			Equipment Investments Zipangizo		
Petrol or diesel			Loan repayments Kubwenza ngongole		
Motor vehicle service, repair, or parts			HH Education Maphunziro		
Bicycle service, repair, or parts			HH Health Care Thanzi/chipatala/matenda		
Wages paid to servants			Others: Zina ndi zina		
Mortgage - regular payment to purchase house					
Repairs & maintenance to dwelling					

Repairs to household & personal items radios, watches, etc., excl. battery purchases)					
Recharging batteries, cell phones					

8. What are your household's top 4 priority areas of expenditure?

kodi munjira zimene mwatchulazi ndi njira zinayi ziti zimene mumagwiritsa ntchito ndalama zanu kuposa zonse?

1st [..............................] 2nd [..............................] 3rd [..............................] 4th [..............................]

9. Does your HH have any savings of money? Yes [..........] No [..........]

Kodi muli ndi ndalama zosunga pakhomo pano?

SHOCKS/COPING STRATEGIES FOR HOUSEHOLD - ZINTHU ZOBWERA MWADZIZDIZDI ZIMENE ZINAKHUDZA PANJA LANU

10a. During the **last 12 months**, was your HH affected negatively by any of the following [SHOCKS]? Kodi mu miyezi khumi ndi iwiri yapitayi, nyumba yanu yakumanako ndi zinthu zobwera mwazadzidzi monga izi?		**10.b.** Please rank the three most significant shocks you experienced. Most Severe (1), 2nd Most Severe (2), 3rd (3). muzinthu mwatchulazi, ndiziti zomwe zinakukhudzani kuposa zonse?			**10.c**. As a result of this/these [SHOCKS], did your […] READ RESPONSES FOR EACH COLUMN: Increase.... 1 Decrease....2 Did Not Change…3				
READ OUT EACH SHOCK ONE BY ONE. Tick all that apply or INPUT ZERO.		PLEASE INPUT SHOCK NO.							
Shock Codes	Tick	1st	2nd	3rd	Income	Assets	Food Production	Food Stocks	Food Purchases
1. Drought/Poor Rains/Irregular Rains									
2. Floods/water logging									
3. Unusually High Level of Crop Pests or Disease									
4. Unusually High Level of Livestock Disease									
5. Unusually Low Level of Fish Availability									
6. Unusually Low Prices for Agricultural Output									
7. Unusually Low Prices for Fishing Output									
8. Unusually High Costs of Agricultural Inputs									
9. Unusually High Prices for Fishing Inputs									
10. Unusually High Prices for Food									
11. End of Regular Assistance/Aid/Remittances From Outside HH									
12. Reduction in the Earnings from Household (Non-Agricultural and non-fishing) (Not due to Illness or Accident)									
13. Serious Ilness or Accident of Household Member(s)									
14. Death of Household Member(s)									
15. Theft of Money/Valuables/Assets/Agricultural Output									
16. Other (Specify)									

F) FOOD CONSUMPTION

BEFORE PROCEEDING, PLEASE ASK THE PARTICIPANT IF THEY HAVE BEEN FASTING OVER THE PAST 7 DAYS DUE TO THE PERIOD OF RAMADAN YES (…………); (NO…………).

1.A		**1.B**	**1.C**	**1.D**	**1.E**	**1.F**	**1.G**	**1.H**
Over the past **7 days**, did you or others in your HH consume any [FOOD ITEM]? Kodi inuyo kapena anthu ena apakhomo panu munadya chakudya ngati izi musabata yangothayi? **PLEASE READ OUT EACH FOOD ITEM** **INPUT 1. Yes or 2. No** **PROBE Q – Please probe the respondent to ensure familiar with the last 7 day period.**		How **many days** over the past **7 days** did your HH consume that food item? Kodi ndi masiku angati mumadya chakudya sabata yangothayi?	How much of each [FOOD ITEM] came from the following; **1.C. Purchases** 1.D. Own production (crops/animals) 1.E. Food and game you collected / fished / hunted, 1.F Gifts, donations and 1.G Other sources. **PLEASE INPUT % FOR EACH.**					**If purchases were selected,** how much did you spend on purchases per item? **PLEASE SPECIFY MK FOR EACH ITEM SPECIFIED**
INCLUDE BOTH FOOD EATEN COLLECTIVELY IN THE HOUSEHOLD AND THE FOOD EATEN INDIVIDUALLY.	**1.Yes** **2.No**	**No. of Days (0-7)** **IF NOT CONSUMED RECORD ZERO.**	**1.C %**	1.D **%**	1.E **%**	1.F **%**	1.G%	**MK**
CEREALS;								
maize, rice, bread etc **Chimanga, mpunga, chingwa.**								
ROOT AND TUBERS;								
Sweet Potato								
Carrots								
Pumpkin								
Cocoyam (masimbi)								

All Other; e.g. Cassava, plantain, potato, etc. **Chinangwa, mbambata**								
PULSES/LEGUMES/NUTS;								
beans, pigeonpea, nuts etc **Nyemba, sawawa, mtedza**								
VEGETABLES;								
Cabbage								
Nkhwani								
Tanaposi/Rape								
Other cultivated green leafy vegetables								
Other Vegetables: onion, tomato								
FRESH FRUITS;								
Mango								
Papaya								
Other Fresh Fruits (e.g banana, orange, apples, pineapple, wild fruits).								
ANIMAL PROTEIN;								
Chicken								
Beef (cattle)								
Goat								
Other red meat (guinea fowl, small animals)								
Pork (ask about pork if <u>non-Muslim</u>)								

Fish? If yes ask for each specie below) **Nsomba ;**								
Fish 1? …………………								
Fish 2? …………………								
Fish 3? …………………								
Fish 4? …………………								
Eggs **Mazira**								
Milk and milk products; fresh, butter, cheese etc **Mkaka ndizina zochokera ku mkaka.**								
OTHER;								
Oil/fats **Mafuta**								
Sugar/honey **Shuga/uchi**								
Miscellaneous **Zina ndi zina**								

PAUSE – QUALITY CHECK – ENSURE THE TOTAL NUMBER OF DAYS DOES NOT EXCEED 7, AND TOTAL % DOES NOT EXCEED 100. IF NOT CORRECT – ASK RESPONDANT TO VERIFY.

2. How many meals per day, including breakfast, are taken on average over the **past 7 days** in your HH for each HH member? Kodi mumadya kangati patsiku pakhomo panu musabata yangothayi kuphatikiza kadzutsa?

Adult Male [……….] Adult Female [……….] Children Male [……….] Children Female [……….]

SKIP QS

IF FISH WAS SELECTED AS CONSUMED IN Q1, PROCEED TO ASK Q3 – IF NOT SKIP TO Q7.

3. What was the origin / source of each fish species that your HH consumed over the **past 7 days** as listed in Q1?	**4.**How was each fish that your HH consumed processed?

Kodi nsomba zimene munadya munazipeza kuti? INSERT ONE OF THE FOLLOWING NO.S AGAINST EACH FISH SPECIES; 1. FARMED 2. LAKE CHILWA 3. RIVER 4. LAKE MALAWI 5. OTHER (SPECIFY)		Kodi nsomba zimene munandya zidali zokonzedwa bwanji? INSERT ONE OF THE FOLLOWING NO.S AGAINST EACH FISH SPECIES; 1. FRESH 2. SUN-DRIED 3. SMOKED 4. ICED 5. OTHER (SPECIFY)
PLEASE LIST FISH SPECIES THAT WERE SELECTED AS EATEN FROM Q1.	NO. 1, 2, 3, 4 or 5	NO. 1, 2, 3, 4 or 5
Fish 1? …………………		
Fish 2? …………………		
Fish 3? …………………		
Fish 4? …………………		

5.A. Which members of the HH consumed EACH fish? **PLEASE TICK IN COLUMN A1-4 FOR EACH FISH SPECIES**.

Kodi ndi anthu angati amene anadya nawo nsomba ngati izi ?

IF A MEMBER GROUP DID NOT CONSUME, INPUT ZERO.

5.B. Which part of the fish was consumed? PLEASE SELECT **ALL** THAT APPLY **FROM B CODES** AND INPUT NUMBER INTO COLUMN B 1-4.

Kodi ndi mbali iti ya nsomba imene inadyedwa.?

Fish Species PLEASE LIST FISH SPECIES FROM Q5 ABOVE.	5A.1 Adult Male Amuna a akulu	5B.1	5A.2 Adult Female Akazi a akulu	5B.2	5A.3 Male Children Ana a amuna	5B.3	5A.4 Female Children Ana a akazi	5B.4	**5B. CODES** 1. Whole fish 2. Head of fish 3. Fillet / middle 4. Tail or fins 5. Skin 6. Eggs **7.** Bones
	Tick	No 1-7	Tick	No 1-7	Tick	No 1-7	Tick	No 1-7	
Fish 1? …………………									
Fish 2? …………………									
Fish 3? …………………									

Fish 4? …………………									

6. Do you feel the quantity of fish eaten in the **last 7 days** by your HH is enough? Please tick one.
   Kodi mulingo wa nsomba umene unadyedwa pa sabata yathayi unali okwanira? More than enough (___);
   Enough (___); Not enough (___).

END OF SKIP QS. CONTINUE WITH BELOW QS.

7.a. What fish species has your **HH consumed** in the last **12 months**? Ndi mtundu wanji wansomba umene mwadya pahomo pano kwa miyezi khumi ndi iwiri yapitayi ? List top 4 species most consumed.	**7.b.** How does your HH consumption of each fish species vary throughout the **last 12 months?** Kodi Kadyedwe kanu ka nsomba mwatchulazi kasintha bwanji pa miyezi khumi ndi iwirii yapitayi? Please mark the months when that fish species was eaten with **X**.													
PLEASE LIST FISH SPECIES BELOW.	**2014**							**2015**						
	Dry Season					**Wet Season**						**Dry Season**		
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Fish 1? ……………… …															
Fish 2? ……………… …															
Fish 3? ……………… …															

Fish 4? ……………… …															

8.a. What is your HH preferred choice of fish species to consume? Please specify one species from Q7a […………………………………….]

Kodi pakhomo pano mumakonda kudya mtundu wanji wa nsomba?

8.b. Why does your HH prefer to consume this fish species? Please tick all that apply:

Chifukwa chani mumakonda mtundu wasomba umenewu?

More nutritious […..] Ease of preparation [….] Good taste [….] Size of fish {………} Low price to buy [….] Available through own production/fished [….] Most available catch [….] Available at market [….] Other please specify […….]

9.a. Over the **<u>last 12 months</u>**, has your household faced any constraints with accessing fish for HH consumption?

Yes [……..]; No […….].

Kodi mu miyezi khumi ndi iwiri yapitayi, mwakumanako ndi zovuta zilizonse pakapezedwe kanu ka nsomba?

9.b. **IF YES,** what access constraints did your household face? Please tick all that apply:

Ndimavuto anji amene munakumana nawo? Low own production/catch of fish […….] Fish is too expensive to purchase […….] Fish is not available at market [……..]; Too expensive to travel to market […….] Other please specify […….]

10.a. If your household had the choice, what would your household prefer to eat from the following?: please tick one: Chicken […] Fish […] Chicken eggs […] Beef […] Goat […] Milk […] Other specify [……………………]

Kodi mumakonda zakudya zanji zanyama zomanga thupi?

10.b. What is the reason for this choice? Please tick all that apply: More nutritious […..] Ease of preparation [….] Good taste [….] Low price to buy [….] Available through own production/fished [….] Available at market [….] Other please specify […….

G) FOOD SECURITY

1. In the past **<u>7 days,</u>** did you worry that your HH would not have enough food? Yes […..] No [….]

Kodi mu sabata yathayi, munakhalako ndi khawa kuti panyumba panu simukhala ndi chakudya chokwanila?

2. In the past **<u>7 days,</u>** how many days have you or someone in your household had to: Kwasabata yathayi, kodi inu kapena aliyese wapakhomo pano **PLEASE READ A – E AND INPUT THE NUMBER OF DAYS. <u>IF NO DAYS, RECORD ZERO AND SKIP TO Q4.</u>** 3. How worried would you be to adopt each of the following behaviours?

Mungakhale okhudzidwa bwanji kutsatila njila zotsatilazi **PLEASE READ WORRY SCALE AND INPUT THE NUMBER: Not worried=1, A little worried=2, Very worried= 3.**						
	a. Eat less preferred and/or reply less expensive foods?	b. Limit portion size at mealtimes?	c. Borrow food or money to buy food, or rely on help from a friend or relative?	d. Restrict consumption by adults in order for small children to eat?	e. Reduce number of meals eaten in a day?	f. Going without food for whole days.
Q2. DAYS						
Q3. 1-3						

4. In the last **12 months,** have you been faced with a situation when you did not have enough food to feed the household? Kodi mu miyezi khumi ndi yiwiri yapitayi munayamba mwakhalapo ndi chakudya chosakwanira chodyetsa banja lanu pakhomo panu? Yes [……….] No [……….]

IF YES PROCEED TO Q5. IF NO, SKIP TO SECTION H; SOCIAL CAPITAL.

5. When did you experience this incident in the last **12 months**? Kodi ndi liti zimenezi zinachitika mumiyezi khumi ndi yiwiri yapitayi?

Mark X in each month from 12 months ago up to the current month of the interview.

2014 / Chaka chatha							**2015 / Chaka chino**							
Dry Season / Chilimwe					**Wet Season / Ndzinja/nthawi ya mvula**						**Dry Season / Chilimwe**			
Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug

6.How often has your HH experienced this over the **past 10 years**?

Mwakhala mukukumana ndizimenei mowilikiza bwanji kwa zaka khumu zapitazo?

Every year […] Every 2-3 year […] Every 4-5 year […] Don't Know […] Other please specify […]

7. When you did not have enough food or money to buy food, did your household have to;

Kodi munapanga chani nthawi imene munalibe chakudya chokwanila kapena ndalama zogulira chakudya cha pa khomo panu? **PLEASE READ EACH ITEM AND INPUT 1. YES OR 2. NO.**	
Coping Strategies	**1.Yes** **2.No**
1.Rely on less preferred and less expensive foods? Kudalira zakudya zotchipa komanso zosakondedwa	
2.Borrow food, or rely on help from a friend or relative? Kubweleka chakudya kapena kudalira chithandizo kuchoka kwa achibale	
3.Purchase food on credit? Kugula chakudya pa ngongole	
4.Gather wild food, hunt, or harvest immature crops? Kutolera zakudya kapena kusaka nyama zakutchire, kapenanso kukolora zolima zosakhwima	
5. Intensify fishing/fish processing/fish trading?	
6. Intensify fish farming?	
7. Fish during the closed season in lake or river?	
8. Fish using gears prohibited (e.g. seine nets)?	
9.Intensify other livelihood activities that are non-agriculture and non-fishing/fish farming to bring in extra income to buy food?	
10.Consume seed stock held for next season? Kudya mbewu zolimila chaka china nyengo ya dzinja	
11.Send household members to eat elsewhere? Kutumiza achibale kukadya kwina	
12.Send household members to beg? Kutumiza achibale kukapemphetsa	
13.Limit portion size at mealtimes? Kuchepetsa mulingo wa chakudya nthawi yakudya	
14.Restrict consumption by adults in order for small children to eat? Kuchepetsa chakudya cha anthu akuluakulu kuti ana adye	
15.Feed working members at the expense of non-working members?	

Kudyetsa anthu ogwira ntchito okha okha	
16.Reduce number of meals eaten in a day? Kuchepetsa chakudya chodyedwa pa tsiku	
17.Skip entire days without eating? Kudumphitsa matsiku osadya	
18. Did not do anything	

8.A. What would you consider to be the cause of the situation? Kodi zinapangitsa kuti musakhale ndi chakudya chosakwanira ndi chani?		**8.B.** Please list up to 3 reasons from 7.A. in order of importance. **PLEASE INPUT THE CAUSE NO. INTO 1ST 2ND & 3RD BELOW.**		
PLEASE READ EACH ITEM AND INPUT **1. YES OR 2. NO.**	**1.Yes** **2.No**	1st	2nd	3rd
1. Inadequate household stocks due to drought/ poor / irregular rains				
2. Inadequate household stocks due to floods / water logging				
3. Inadequate household food stocks due to crop pest damage				
4. Inadequate household food stocks due to livestock disease				
5. Inadequate household food stocks due to small land size				
6. Inadequate household food stocks due to lack of farm inputs				
7. Inadequate household food stocks due to closed fishing season				
8. Inadequate household food stocks due to theft				
9. Food in the market was too expensive				
10. Unable to reach the market due to high transportation costs				

11. No food available in markets				
12. Reduction in income from HH actiivties				
13. Other (specify)				

9. Which food groups were affected by these causes? Tick all that apply.
   Ndi gulu liti lazakudya limene linakhudzidwa chifukwa chavutoli?

Cereals; maize, rice, bread etc […] Vegetables […] Pulses / legumes / nuts […] Meat; beef, goat, chicken, guinea fowl, small animals […] Fish […] Fruit […]

H) SOCIAL CAPITAL

1. Do you have relatives? Yes [……….] No [……….]

Kodi muli ndi achibale?

2. Do you give or receive food to/from these relatives in the last 12 months? Give only [……….] Receive only [……….] Both; give and receive [……….] No [……….]

Kodi mu miyezi khumi ndi yiwiri yapitayi munapeleka kapena kulandira chakudya kwa achibalewa?

3. Do you give or receive cash to/from these relatives in the last 12 months?

Give only [……….] Receive only [……….] Both; give and receive [……….] No [……….]

Kodi mu miyezi khumi ndi yiwiri yapitayi munapeleka kapena kulandira ndalama kwa achibalewa?

4. Have these forms of mutual aid changed over the last 12 months? Increased [……….] Decreased [……….] Same [……….]

Kodi kuthandizanaku kunasintha bwanji mu miyezi khumi ndi yiwiri yapitayi?

5.a. Is any member of your household affiliated to a local institution/social group? Yes [……….] No [……….]

Kodi alipo wina aliyense munyumbamu amene amakhudzidwa ndi zamagulu m'mudzi muno?

IF YES, PROCEED TO Q5.B. IF <u>NO, SKIP TO END SURVEY</u>.

5.b. How many members of your HH are affiliated to a local institutions / social group? Kodi ndi anthu angati apakhomo panu amene ali ma membala a magululu osiyanasiyana a m'mudzi mwanu? **PLEASE READ OUT EACH GROUP AND INPUT NO. OF MEMBERS AFFILIATED INTO THE COLUMN.** **IF NONE INPUT ZERO.**	**5.c.** What benefits are received? Kodi mumapindula chani mumagulu amenewa? **Input all that apply**: 1=Get help in times of problems, 2=Satisfaction in helping others, 3=Recognition, 4= Security, 5=Economic benefits; 6=None, 7=Other specify.

Affiliation Type	No. of HH Members Affiliated IF NONE INPUT ZERO.	5.c. Benefits (Specify if select 7=other)
Affiliation with political party -Membala wa chipani		
Membership in community committees (school, church, specify)-Membala wa komiti (sukulu, tchalitchi)		
Membership in governance committees (Village Natural Resource Management Committee, Village Development Committee, Agricultural Development Committee, Beach Village Committee, River Village Committee etc) - specify Membership of church/mosque Membala wa ma komiti oyang'anira chitukuko cha m'midzi		
Membership in NGO supported groups (farmers club, irrigation, AIDS, Women Fish Processors Group etc.) specify -Membalaw wa ma gulu a mabungwe a zaulimi		
Participation in community festivals Kutenga nawo mbali mu zisangalalo za m'mudzi		
Other associations (specify)- Magulu ena		

PART ONE SURVEY END

IF THE HH WAS NOT A FISHER HH – END THE SURVEY AND PROCEED TO THE LAST PAGE 'END OF SURVEY' AND COMPLETE COMMENTS.

IF THE HH IS A FISHER HH – PROCEED TO ADMINISTER PART TWO TO THE FISHER YOU ARE CURRENTLY INTERVIEWING.

PART TWO – FISHING INDUSTRY SURVEY

CONDUCTED ONLY WITH FISHER HHS; THE LEADING FISHER.

To be administered ONLY TO FISHING HHS.

I) CHARACTERISTICS

1.A.What is your involvement in the fish farming industry?

Kodi mu nkhani zausodzi wa nsomba mumapanga chani?

Fish farm owner [..............] Run the fish farm [..............] Fish farm labourer (e.g. feeder, maintenance, canal/pond construction) [..............] Fish processing [..............] Fish trading [..............]; Other (please specify)________.

IF MORE THAN ONE WAS TICKED, PROCEED TO Q1B. IF NOT, SKIP TO Q2.

1B. Which is your major activity? […………].

2.How long have you been involved in your [major fisher activity]?

Mwakhala mukupanga [major fisher activity] kwanthawi yayitali bwanji? 0-1 years [...] 2-5 years [...] 6-10 years [...] 11-15 years [...] 16-20 years [...] More than 20 years [...]

3.A. Has there been any time when you stopped your [major fisher activity] for an entire year or more? Kodi nthawi inayake munasiyako (your role in the fish sector] kwa chaka chanthunthu kapena kupitilira apo? Yes [……….] No [……….]. **IF YES PROCEED TO Q3.B. IF NO SKIP TO Q4.**

3B. How often? Please tick one. A. Just once [……….] b. 2-3 times [……….] c. Many times [……….]
4.A. In the **last 12 months**, which are the months that you have partaken in your [major fisher activity]? Mumiyezi 12 yadutsayi, ndi miyezi iti imene mwapangako (your role in fish sector) Please mark an **X** in each month. **State n/a if not applicable.**
4.B. Of these months, are there **HIGH** season months and **LOW** season months for(…) when you partake in your role? Mumiyezi mwatchulayi, ndi miyezi yake iti imene ili yabwino kwambiri, ndi imene siyabwino kwenikweni? **State n/a if not applicable.**
Please INSERT **H** or **L** for the months marked with **X,** and input below in row B. If the respondent claims that there are no distinct HIGH VS. LOW season months, record **H** (HIGH) for months in which any time is spent partaken in the role. **State n/a if not applicable.**
PROBE QS: If there is difficulty in identifying months. Start discussion first on the last wet and dry season, then try and detail to the month.

	2014						**2015**						
	Dry Season				**Wet Season**						**Dry Season**		
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
A.Mark X													
B.Input H / L													

5.A. During the last HIGH season, what was your level of engagement in your [major fisher activity]? Mumiyezi yabwino yanchito yanuyi (imene yangodutsayi) , mumagwira nchito yanuyi kawiri kawiri bwanji? **State n/a if not applicable.**

Please tick ONE: 1. Full-time (engaged exclusively only in [major fisher activity]) [...] 2. Part-time (primarily engaged in non-fishing activities and spent some time in [major fisher activity]) [...] Other please specify [....................................]
5.B.How many weeks were you engaged in the last HIGH season? No. Weeks [.....]
Munagwira masabata angati? **State n/a if not applicable.**
5C. During those weeks, approximately how many <u>days per week</u> did you partake in your major fish role? No. Days / Week [.....] **State n/a if not applicable.**
Mumasabata amenewa, mumagwira nchito yanuyi kangati pa week?

6.A. During the last LOW season, what was your level of engagement in your [major fisher activity]? Please tick ONE: 1. Full-time (engaged exclusively) [...] 2. Part-time (primarily engaged in non-fishing activities and spent some time in [major fisher activity]) [...] Other please specify [....................................] **State n/a if not applicable.**
Nanga mu miyezi yobvuta ya nchito yanuyi (imene yangodutsayi), mumagwira nchito yanuyi kawiri kawiri bwanji?
6B. How many weeks were you engaged in the last LOW season? No. Weeks [.....]
Munagwira masabata angati? **State n/a if not applicable.**
6C. During those weeks, approximately how many <u>days per week</u> did you partake in your major fish role? No. Days / Week [.....] **State n/a if not applicable.**
Mumasabata amenewa, mumagwira nchito yanuyi kangati pa week?

7.How much do you earn on average per week during the last HIGH season? [.........kwacha] [……n/a]
Mumapeza ndalama zochuruka bwanji pa week (mumiyezi yabwino)?
8.How much do you earn on average per week during the last LOW season? [.........kwacha] [……n/a]
Mumapeza ndalama zochuruka bwanji pa week (mumiyezi yobvuta)?

9. What are your household's priority areas of expenditure from income generated from your involvement in the fisheries sector? Tick all that apply.

kodi munjira zimene mwatchulazi ndi njira zinayi ziti zimene mumagwiritsa ntchito ndalama zanu kuposa zonse?

HH Food [.............................] HH maintenance [.............................] HH health [.............................] HH education [.............................] Personal [.............................] Other, please specify [.............................]

J) START UP

1. What are the reasons you became involved in your [major fisher activity]? Choose all that apply: Kodi chinakupangitsani kuti muyambe [major fisher activity] ndichani?
   Custom/tradition; [...] For income; [...] For food; [...] Due to government project; [...] Due to NGO project; [...] Due to community project; [...] Other (please specify)................. .
2. Where did you acquire the information needed to participate in your [major fisher activity]? Kodi nanga upangiri otimuthe kumapanga nawo [major fisher activity] munaudziwira kuti?
   Choose all that apply: Information from NGOs [...] Information from local authorities [...] Information from other fishers [...] Information from family [...] Information from community groups [...] Radio/TV [...]/ Attend training courses [...] Read relevant literature [...] Other (please specify) [...]

3. Do you consider your [major fisher activity] to be a profitable business i.e. is the income generated is enough to meet you and your family's monthly monetary requirements? Kodi inuyo mumaona kuti [major fisher activity] imakupezetsani phindu lokwanira?

   Mwachitsanzo ndalama zomwe mumapeza zimakwaniritsa zimene inuyo ndi banja lanu

   limafuna? Yes [...] No [...] Other specify [……………………]

4. Would you recommend being involved in your [major fisher activity] to other members of the community who are not yet involved? Kodi inuyo mutha kuwalimbikitsa anthuena omwe sapanga nawo [major fisher activity] kuti ayambe? Yes [...] No [...] Don't know [….]

K) SHOCKS

<table>
<tr><td colspan="2">1a. During the <u>last 12 months</u>, was your [major fisher activity] affected by any of the following [SHOCKS]?
Mumiyezi 12 yadutsayi kodi nchito yanuyi yasokonezedwako ndi izi (zimene nditatchule apazi)?</td><td colspan="3">1.b. Please rank the three most significant shocks you experienced. Most Severe (1), Second Most Severe (2), Third (3).
Chomwe chinasokoneza nambala 1 ndi chiti? Chachiwiri? Chachitatu?</td><td colspan="5" rowspan="2">1.c. As a result of this/these [SHOCKS], did […] READ RESPONSES FOR EACH COLUMN:
Chifukwa cha zosokonezazi, eti [chakuti] china…?; (check column just below)
Increase.... 1 Decrease....2 Did Not Change…3Don't know …..4
Other (please specify)……………..5</td></tr>
<tr><td colspan="2">PLEASE READ OUT EACH SHOCK CODE ONE BY ONE. Tick all that apply. IF NOT APPLY, <u>INPUT ZERO.</u>
<u>IF NO TO ALL, SKIP TO SECTION L.</u></td><td colspan="3">PLEASE INPUT SHOCK NO.</td></tr>
<tr><td>Shock Codes</td><td>Tick</td><td>1st</td><td>2nd</td><td>3rd</td><td>Amount of fish caught/ harvested</td><td>Fish Related Income</td><td>Fish related Assets</td><td>Fish Consumption</td><td>Food Purchases</td></tr>
<tr><td>17. Drought/Poor Rains/Irregular Rains</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>18. Floods/water logging</td><td></td></tr>
<tr><td>19. Unusually Low Prices for Fishing Activity Output</td><td></td></tr>
<tr><td>20. Unusually High Prices for Fishing Inputs</td><td></td></tr>
<tr><td>21. Serious Illness or Accident</td><td></td></tr>
<tr><td>22. Disease of fish</td><td></td></tr>
<tr><td>23. Dangerous animals / predation</td><td></td></tr>
<tr><td>24. Theft of Fishing Equipment/ Fish</td><td></td></tr>
<tr><td>25. Conflict</td><td></td></tr>
<tr><td>26. Other (Specify)</td><td></td></tr>
</table>

2. Since you started partaking in your (major fisher activity), how often have you experienced (1st Ranked SHOCK)? Every Year [……] Every 2 years […….] Every 3- 5 years […….] Other […….] Don't know […….] N/A […….]

Chiyambileni nchito yanuyi, chosokoneza (cha nambala 1 chija) mwakumana nacho kawiri kawiri bwanji?

3. Since you started partaking in your (major fisher activity), how often have you experienced (2nd Ranked SHOCK)? Every Year [……] Every 2 years […….] Every 3- 5 years […….] Other […….] Don't know […….] N/A […….]

Nanga chosokoneza (chachiwiri chija) mwakumana nacho kawiri kawiri bwanji?

4. Since you started partaking in your (major fisher activity), how often have you experienced (3rd Ranked SHOCK)? Every Year [……] Every 2 years […….] Every 3- 5 years […….] Other […….] Don't know […….] N/A […….]

Nanga chachitatu chija, mwakumana nacho kawiri kawriri bwanji?

L) CHANGE AND PERCEPTIONS

1. A. Would you say your life has improved since you started partaking in your [major fisher activity]? Kodi mugati moyo wanu watukuka chiyambireni [your major activity] ?
   Yes [...] No [...] **IF YES PROCEED TO Q1.B. IF NO PROCEED TO Q2.**

1B. If yes, please state reasons (tick all that apply): Mungatiuze njira zimene umoyo wanu wasinthika? I have been able to take care of my family's finances [...] I can employ people [...] My health has improved [...] My family's health has improved [...] We are no longer worried about food insecurity [...] I have increased income [...] Other [...]

2. On a scale of 1-5, how important is your [major fisher activity] as a contribution to HH income, compared to other HH income activities?
   Kodi inuyo mungati mumabweretsa ndalama zambiri bwanji pa banja lanu kutengera ndi ntchito yanuyi[your major activity] **Please probe with LADDER scale 1-5 below & tick one:**
   1. Not very important […] 2. Somewhat important […] 3. Moderately important […]
   4. Important […] 5. Extremely Important […]
3. Has the importance to your HH income changed since the flood? Chisefukireni madzi pali kusintha kuli konse pa ku funikira? Increased [...] Decreased [...] Same [...] Don't know […..]N/A […….].

4. On average, how has the quantity of food that you are eating changed since you started partaking in your [major fisher activity]? Mongoyerekeza, kodi mulingo wachakudya chomwe mumadya chasintha chiyambireni kupanga [your major activity]? More food consumed [...] Same [...] Less [...] Don't know [...]
5. On a scale from 1-5, how important is your [major fisher activity] for your HH food? Kodi inuyo gawo limene mumatenga po pakapezedwe kachakudya pa banja lanu mukamapanga [your major activity] ndi kofunikira bwanji? **Please probe with LADDER scale 1-5 below & tick one:**
   1. Not very important […] 2. Somewhat important […] 3. Moderately important […]
   4. Important […] 5. Extremely Important […]
6. Has the importance to HH food changed since the flood? Kodi kufunira kwake kwa sintha chisefukira madzi? Increased [...] Decreased [...] Same [...] Don’t know […..].
7. Have you faced any constraints with partaking in your [major fisher activity]? Ndizovuta ziti zomwe mumakumana nazo [SANKHANI]? Monga Kukwera mtengo kwa zogwirira ntchito ndi ulimi onse? Kusowa kwa matumbi, Kupelewera mukupezeka kwa chakudya cha nsomba kuipa kwa madzi, Umbava Kupelewera ubwino kwa chakudya, Kusowekera kwa ukadaulo ndi chiziwitso choyenerera Kusowa kwa ngogole Kusowa kwa malo oyenelera; Kusowa kwa madzi okwanira; Reduced employment opportunities, Zina (tsindikizani) ....
8. What is the length of time that you consider yourself to continue to partake in [your major activity]? Kodi inuyo mukudziona mukupitiriza kupanga your [major fisher activity] kwanthawi yayitali bwanji? Please tick one: One more year […] 2-5 years […] Indefinitely […] Other – specify […………]Don’t know […..].
9. Has the number of people involved in the fishing sector changed since the flood? Kodi chiwerengero chaanthu omwe akupanga zimenezi chasintha chisefukireni cha madzi? More now [...] Less now [...] Same [...] Don’t know […..].
10. Has the number of people involved in the fishery sector changed over the past 10 years ago? Kodi chiwerengero cha anthu omwe akuchitanawo ntchito imeneyi chasintha bwanji m’zaka khumi zapitazo? More now [...] Less now [...] Same [...] Don’t know […..].

M) GOVERNANCE

1. Are you aware of any laws or restrictions governing fish farming in your area? Yes [...] No [...]. **IF NO PROCEED SKIP TO Q10. IF YES PROCEED TO Q2.** Kodi mukudziwa za malamulo ena alionse okhudzana ndi usodzi wa nsomba m’dera lanu lino??
2. What type of laws are in place in your area? Government [...] Traditional / village [...] Mixed [...] Other [...]Don’t know […..].kodi ndimalamulo ali m’dera lanu lino anakhazikitsidwa ndindani?
3. Are there any restrictions on which fish species you can culture/farm? Yes [...] No [...] IF YES, please specify which fish species […………………………………………]

   Pali malamulo oletsa nsomba zimene mungawete?

4. Are there any rules or regulations prohibiting the movement of farmed fish? Yes [...] No [...] IF YES, please specify [……………………………………………]

   Pali malalulo amene amaletsa kusuntha nsomba kwa nsoma zowetazi?
5. Are there any rules or regulations about fish disease control within ponds? Yes [...] No [...]IF YES, please specify [……………………………………………]

   Pali malamulo okhudzana ndi zamatenda a nsomba mu madamu?
6. Do you record any information about your fish farming ponds? Yes [...] No [...]
   Mumasunga kalembera wa zochitika mu madamu a nsomba anu?
7. A.On a scale of 0 to 5, to what extent do fishermen/fish farmers in your community comply with rules and regulations governing fishing/fish farming?
   Kodi asodzi amatsatira bwanji malamulo ndi ndondomeko zimene zilipo zokhudzana ndi usodzi wa nsomba?
   Please probe with LADDER scale description below.

No compliance					Full compliance
0	1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often	Always

Scale 0-5 [……….] Don't know [……...]

IF 5 WAS <u>NOT</u> SELECTED, PROCEED TO Q7.B. IF 5 or Don't know WAS SELECTED, SKIP TO Q8.

7.B. In your opinion, why do fishermen/fish farmers in your community not fully comply with the rules and regulations governing fishing/fish farming?

Tick all that apply. 1. Unaware of the regulations [...] 2. For income and food to meet HH needs [...] 3. Not agree with the regulations [...] 4. Don't know [...] 5. Other please specify [...]

Mmene mukuonera inuyo, ndi chifukwa chiyani asodzi/kapena oweta nsomba samatsatira malamulowa bwino bwino?

8. On a scale of 0 to 5, to what extent are the rules and regulations enforced in your community? Kodi malamulo ndi ndondomekozi zimkhazikitsidwa ndi kutsatidwa bwanji?

Please probe with LADDER scale description below.

No enforcement					Full enforcement
0	1	2	3	4	5
Never	Rarely	Sometimes	Often	Very Often	Always

Scale 0-5 […..] Don't know […..]

9. A. Have the regulations affected your [major fisher activity]? Yes [...] No [...] Kodi malamulo ndi ndondomekozi zakhuza kapena kusokoneza bwanji ntchito zanu? **IF YES PROCEED TO Q9.B. IF NO SKIP TO Q10.**
   B. How have the regulations affected the benefits obtained from the activity? Please tick. Enhanced […] Lowered […] Same […]. Nanga malamulo ndi ndondomekozi zakhuza kapena zasokoneza bwanji phindu ndi zina zomwe zimachokera ku ntchito zanu zokhudzana ndi usodzi wa nsomba?
   C. How have the regulations affected your household food security? Increase [...] Decrease [...] Same [...] Malamulowa akhudza bwanji kapezekedwe ka chakudya pakhomo panu pano?
   D. How have the regulations affected your household income? Increase [...] Decrease [...] Same [...] Malamulowa akhudza bwanji nkhani za chuma pakhomo panu pano?
10. Do the government/ local authorities and other stakeholders provide any support to fish farmers in the area? If so, what kind of support do they provide? Kodi alimi a nsomba amathandizidwa ndi boma kapena mabungwe ena apadera? Ngati chithandizo chikuperekedwa, ndi thandizo lanji lomwe alimi amalandira?

Organisations Mabugwe	**Do you have access to these organisations/individuals? Yes 1, No 2** Kodi muli ndi kuthekera kuthandizidwa ndi mabungwe awa? Eya 1, Ayi 2	**Frequency of Contact over past year (no of visits/month)** Mu chaka chapitacho, mwakumana nawo kangati? (kangati pa mwezi)	**Type of support received.** **1 Monetary (credit) 2 Technical advice 3 Marketing Assistance 4 Other** Chithandizo chomwe chinalandilidwa (munjira yanji) 1 Ndalama (ngongole) 2Ulangizi pa ukadaulo (Ntchito za alangizi) 3.Chinthandizo pa za malonda 4 Zina	**Satisfaction level about the quality of services** **1. Very satisfied; 2. Somewhat satisfied; 3. Neither satisfied nor unsatisfied; 4. Somewhat unsatisfied; 5. Very unsatisfied** Kakhutisidwe ndi nchito za alangizi 1. okhutitsidwa; 2. Okhutitsidwa pang'ono; 3. okhutitsidwa komanso osakhutitsidwa; 4. Osakhutitsidwa pang'ono; 5. Osakhutitsidwa
Government Extension Services Ntchito za ekisiteshoni				
NGOs/ Donor Organisations				

Mabungwe oti si aboma				
Research Institutes Malo a kafukufuku				
Other (specify) Zina				

END OF INTERVIEW

Thank you for your cooperation in participating in this study... **NOTE TIME ENDS:**

Zikomo kwambiri podzipereka ndi kutenganawo mbali pakafukufukuyu

INTERVIEWER REMARKS

Respondent's cooperation was: Very good Good Fair Poor

The quality of respondent's answers were: High quality Generally reliable Unreliable

What was the main reason for the questionable or unreliable quality of the interview? ……….………
………

Further comments:

………
…….

PART THREE

N) Production Trends and Characteristics

1. A. What is the total farm size (ha)? Kodi malo a ulimi ndi aakulu bwanji(ha)? .... N/A [………]
   1.b. What is the % of: crop land%............fish pond area%.................. homestead area%...................

   kodi ndi gawo lalikulu bwanji la: zolima za kumunda........... damu la nsomba.................. malo okhalapo...................

2. A. What are the tenure arrangements for the fish farms?
   Ndi ndondomeko yanji ilipo ya umwini wa malo opagangirapo ulimiwo? single owned […]; jointly owned […]; single leased […]; jointly lease […];

   Other (please specify).................

   a mwini m'modzi […]; a eni angapo […];obwerekedwa kwa m'modzi […];obwerekedwa kwa angapo […]; Zina (tsindikizani) […].................

   2.b. How was this tenure arrangement decided within the village?

   ……

   ……..

   ……

   ……

3. When did you start to lease/own your pond(s)? **PLEASE SPECIFY YEAR.** IF MORE THAN ONE, SPECIFY YEAR FOR EVERY POND OWNED:
   Pond 1 ………………….; Pond 2………………; Pond 3………… Pond 4………. Pond 5……………

4. Please describe the characteristics of the aquaculture operations **OVER THE PAST 12 MONTHS**
   Chonde fotokozani zokhuza machitachita a ulimi wanu wa pa madzi wa m'chaka chino (PAST 12 MONTHS)

   IF NOT APPLICABLE, SPECIFY N/A.

4.a	4.b	4.c	4.d	4.e	4.f	4.g
Mukuyendetsa madamu angati? Tsitsani m'musimu. How many ponds do you operate? **PLEASE NUMBER AND SPECIFY MAP NUMBER IN BRACKETS (E.G. 1. (MAP NO.8))**	Kodi damulo lidamangidwa litiro? (chaka) When was the pond constructed? **(year)**	Cholinga cha damu Mndanda [1] Popezera matumbi [2] posungira matumbi kufikira zitakula [3]Zina Purpose of pond **[1] Supplier of fingerlings [2] Farming fingerlings to maturity [3]other please specify**	Kukula kwa damu(ha/m) Pond Size **(ha/m)**	Kumila kwa damu (m) **Depth of Pond (m)**	Pakusungidwa mitundu yanji ya nsomba (ikani ma nambala a mitundu ya nsomba). What species are cultivated? **(No. species ID manual).**	Dziwe lanu ndi labwino bwanji? [1] sikugwiritsidwa ntchito [2] sili bwino kwenikweni [3] ndi yabwino kugwiritsa ntchito **[1] abandoned (not in use) [2] poor condition [3] good condition**
1.						
2.						

5. Please describe the production and harvesting information **<u>OVER THE PAST 12 MONTHS</u>**
Chonde fotokozani za malimidwe komanso zokhudza kukolora kwake mu chakachi(OVER THE PAST 12 MONTHS) **IF NOT APPLICABLE, SPECIFY N/A.**

POND NO.	**Kutalika kwa ulimi watunthu** kutalika (kuchoka mwezi wina kufika mwezi wina)	**Mitundu ya nsomba yowedzedwa Species Harvested**	**Mwezi womwe mwawedza Month of Harvest**	**Ndi zambiri bwanji zomwe mwawedza** [1] gawo chabe; [2] tunthu la kholora	**Kuchuluka pafupifupi kwa kholora yense pa kilo** (kg)	**Kuchuluka kwa nsomba zowezedwa Number of fish harvested**	**Kukula pafupifupi kwa nsomba poziwedza**	**Kuchuluka kwa zogulisidwa** (kg) **Quantity sold (kg)**	**Phindu la malonda onse Total Sales**	**Kuchuluka kwa zodyedwa**(kg) **Quantity Consumed** (kg)	**Muyeso wa padera**(kg) **Quantity Gifted** (kg)

	Production Cycle Duration (month-month)			Harvest amount [1] partial harvest; [2] full harvest	Average Total yield harvested (kg)		Average size of fish at harvest (cm)	PROBE, IF NOT USE %	Value (MKW)	PROBE, IF NOT USE %	PROBE, IF NOT USE %
	1st Cycle ………. To …….										
	2nd Cycle ……… to ……..										

6. Why did you select the specified species for cultivation? Chifukwa ninji munasakha mtundu wa nsomba umenewo? Please choose all that apply: Avail. of Fingerlings; Higher Growth; Good flavour/taste Better meat quality; Consumer preference; Higher market price; Ease of Cultivation; Traditional Practice; Other(please specify) ....
   Chonde sankhani zonse zikuyenera: kupezeka kwa matumbi; Kukula msanga; Makomedwe opambana Nyama yabwino; kukonda kwa Ogula; Kugulika pa mtengo wabwino pa msika; Kusavuta kusamala Machitidwe a chikhalidwe; Zina (Pelekani Chenicheni) ....
7. What is the pond water source? Kodi madzi a pa damu amachokera kuti? 1] Rainfall; [2] Rivers; [3] irrigation schemes [4] borehole [5] Lake; [6] Others ___ 1] Mvula; [2] Mitsinje; [3] ndondomeka za nthirira [4] pa mjigo [5] nyanja; [6] Zina ___
8. A. Have there been any problems with water availability over the past five years? Pakhalako mavuto ena aliwonse pa za kapezekedwe ka madzi mu zaka zisanu(5) zapitazi? 1] Yes; [2] No. **IF NO SKIP TO Q9.**

8.b. If yes, please select the following causes that apply: lack of available water due to drought;   lack of available water due to local access constraints; lack of available water due to conflicts with other users; lack of available water due to poor pond construction;   too much water due to flooding; other (please specify) .... Ngati eya, chonde sankhani mwa zifukwa izi zogwirizana nazo: kusowa kwa madzi chifukwa cha chilala;   kusowa kwa madzi chifukwa cha zoletsa za m'mudzi; kusowa kwa madzi chifukwa cha mikangano ndi a m'midzi ena; kusowa kwa madzi chifukwa cha mamangidwe osayenera a damu; kuchulukitsa kwa madzi chifukwa cha kusefukira kwa madzi; Zina (Chonde tchulani chenicheni) ....

9. Do you carry out water exchange practices on the pond? Kodi pali njira zosinthisira madzi a mu dziwe la nsomba? [1] Yes; [2] No………………………
10. How do you dispose of waste from your ponds? Kodi mumachotsa bwanji mnyasi mu damu mwanu? [1] Through the municipal waste system [2] Drain it into a nearby river/lake [3] Recycling solids and used as fertiliser on land [4] Other (please specify).................
    [1] Kudzera mwa ochotsa a boma [2] Kuthira mu nsinje kapena Nyanja za pa fupi. [3] kusinthanso zoti si za madzi ndi kuzigwilitsanso ngati manyowa

    [4] Zina (Tsindikizani).................
11. How do you set the price for the fish that you sell? Mitengo ya nsomba imapangidwa motani? malingana ndikukula; Malingana ndi mtundu wa nsomba; malingana ndi ubwino wa nsomba; malingana ndi mtengo pa msika pa nthawi imeneyoyo, ndiko kuti pali mtengo ogwirizana wa ogulisaKukambilana; Zina (Chonde tchulani) ……………… Not applicable ……………….
12. Who do you sell the fish to? Nsomba zanu mumakagulitsa kwa ndani? Local traders Local community members Family members directly to consumers at market Other (please specify) A malonda akuluakulu mdziko muno; anthu a m'mudzi mwathu; Achibale; Tokha kunsika kwa ogula; Zina (Chonde Tchulani) ……………….
13. What markets do you sell your fish at? **Please specify up to two or state N/A**. 1……………………………………………2…………………………………………………

14. Are there any constrains which would prevent you from increasing production from your pond or expanding the area under aquaculture if you wanted to? Please select those that apply. High Production Costs, Inadequate Supply Of Fingerlings, Inadequate Supply Of Feed Poor Water Quality, Theft, Poor Quality Of Feed/Seed, Lack Of Technical Knowledge And Skills, Lack Of Credit Facilities, Lack of suitable land; Lack of adequate water supply Other (please specify) ....

Kodi pali zobwenzerensa m'mbuyo zilizonse zomwe zikhonza kukulesani kukuza damu lanu kapena malo a ulimi wanu wa pa madzi mutafuna kutero? Chonde sankhani zokhazo zoyenerera Kudula kwa ulimi; Kusowa kwa matumbi; Kusowa kwa chakudya cha nsomba; Kuipa kwa madzi; Umbava; Kuperewera mu ubwino kwa chakudya/mbeu; kusowa kwa ukadaulo komanso chidziwitso choyenerera; Kusowa kwa ngongole; Kusowa kwa malo; kusowa kwa madzi okwanira; Zina (Chonde tchulani) ....

15. Please provide details of feeding information **OVER THE PAST 12 MONTHS**… Fotokozani bwino lomwe za zokudya za nsomba motere...

IF NOT APPLICABLE, SPECIFY N/A.

Mtundu wa chakudya chogwilitsidwa ntchito [1]zazomera; [2] manyowa a ziwetp; [3] zotsatila ku nyama ya ziweto; [4] zinyanyala za mkhonde Type of Feed Used **[1]Plant based; [2] Livestock manures; [3] Livestock by-products; [4] Kitchen wastes [5] Other please specify**	Gwero la chakudya Za m'mudzi m'momo; zotengedwa kutauni ina; ogulisa amalonda aakulu; za ekisteshoni; zapanyumba; Zina. Source of Feed **[1] homemade; [2] Extension services; [3] NGO project; [4] Commercial suppliers; [5] other please specify___**	Mungafotokoze bwanji kadaliridwe kwanu ka gwero ili mchaka chonse? How would you describe access to this source throughout the year? **[1] Very Easy; [2] Easy [3] neither easy nor difficult [4] Difficult; [5] Very Difficult.**	Mtengo wa chakudya (MWK/Kg) **Costs of Feed** **(MWK/Kg)** **OR OTHER UNIT**	Kadyesedwe % *total biomass/day or g/day* **Feeding Rate %** **total biomass/day or g/day** **IF THEY DO NOT FEED THE FISH DAILY, PLEASE SPECIFY FEEDING FREQUENCY AND VOLUME.**	Kakhutisidwe ndi ubwino wa chakudya chogwiritsidwa ntchito 1. Okhutisidwa kwambiri; 2. Pang'ono okhutisidwa; 3. Si okhutira, si osakhutira; 4. Pang'ono osakhutisidwa; 5. Osakhutisidwa kwambiri Satisfaction level about the quality of feed used **1. Very satisfied; 2. Somewhat satisfied; 3. Neither satisfied nor unsatisfied; 4. Somewhat unsatisfied; 5. Very unsatisfied**

16. Please provide details of stocking information **OVER THE PAST 12 MONTHS** Perekani zokhuza kaundula ndi kasungidwe kanu ka zithu mu chaka ichi

IF NOT APPLICABLE, SPECIFY N/A.

POND NO.	Dzina la mtundu wa nsomba Name of fingerling species stocked	Gwero* **Source of fingerlings* 1-5**	Mungafotokoze bwanji kadaliridwe kwanu ka gwero ili mchaka chonse? How would you describe access to this source throughout the year? **[1] Very Easy; [2] Easy [3] neither easy nor difficult [4] Difficult; [5] Very Difficult.**	Mwezi wa kaundula **Month of stocking**	Nambala la Gawo la ulimi. **Cycle No. (1st or 2nd)**	Nambala ya mitundu ya nsomba. **No. of Species stocked**	Kukula kwa pafupifupi **Av. Size of fingerlings CM/RULER GUIDE**	Malemeredwe (Kg) **Total Weight (Kg) OR OTHER UNIT**	Mphindu lake **Total Value/ Cost/kg**	Kakhutisidwe ndi ubwino wa matumbi omwe asungidwa 1. Okhutira kwambiri; 2.Pang'ono okhutisidwa; 3. Si okhutisidwa, si osakhutisidwa; 4.Pang'ono osakhutisidwa; 5.Osakhutisidwa kwambiri **Satisfaction level about the quality of fingerlings stocked** **1. Very satisfied; 2. Somewhat satisfied; 3. Neither satisfied nor unsatisfied; 4. Somewhat unsatisfied; 5. Very unsatisfied**

*Matanthauzo a Gwero: 1 = za ntchito za ekisiteshoni; 2 = pa nazale; 3 = Malo oswera nsomba a zamalonda; 4 = own produced; 5 = Other please specify
Source code: 1 = Extension Services; 2 = Public Hatchery (Department of Fisheries); 3 = Commercial Hatchery; 4 = Own produced; 5 = Other please specify

17. Please provide financial information regarding the operating and fixed costs of the aquaculture operations **OVER THE PAST 12 MONTHS** Perekani zokhuza ndalama zogwirira ntchito ya Ulimi wa nsomba ndi za ndalama zachikhazikike mu ntchito za pa munda wa pa madzi mu 2015 (**OVER THE PAST 12 MONTHS)**.

MAGAWO	**Mtengo** (MWK) **COST** (MWK)	**Mmene chuma chimayendera (kutengera Zaka)** **Economic Life** (Years)	**Ndalama yapachaka yachikhonzero** **Annual Repairing Cost**	**Gawo loyamba la ulimi** 1st **Production Cycle**		**Gawo lachiwiri la ulimi** 2nd **Production Cycle**	
SPECIFY N/A IF NOT APPLICABLE				Kuchuluka (Kg) Quantity (Kg)	Mtengo wa yuniti/Kg Unit Price/Kg	Kuchuluka (Kg) Quantity (Kg)	Mtengo wa yuniti/Kg Unit Price/Kg
Ndalama zokazikika / FIXED COSTS							
Mphindu pakubwereka Leased Value OR N/A							
Nsonkha wa pa malo Land Tax OR N/A							
Kukhonza ndi kubwenzeretsa Excavation/ Repairs							
Ukonde wa malire Seine Net							
Pampu ya mthirira. Irrigation Pump							
Mpanda Fencing OR N/A							

NDALAMA ZOGWIRIRA NTCHITO/ OPERATING COSTS							
Matabwa Wooden Material OR N/A							
Chingwe Rope							
Other specify__________							
ZOLOWA / INPUTS							
Manyowa Organic Fertiliser							
Feteleza Inorganic Fertiliser							

PLEASE PROBE RESPONDENT AND ASK WHETHER THEY HAVE INCURRED ANY COSTS WITH RUNNING THE FISH POND(S)

18. Please describe your aquaculture production practices in the last 5 years.
Chonde fotokozani za ulimi ndi kupindura kwanu mu ulimi wa pa madzi kwa zaka zisanu (5) zapitazi? **PROBE, BEGINNING WITH 2014. IF NOT APPLY, STATE N/A.**

18.a	18.b	18.c	18.d	18.e	18.f

Zaka 5 zapitazi	**Mitundu ya nsomba** (onani mlondola wa mitundu ya nsomba)	**Masamalilidwe** [1] za mtundu umodzi; [2]zamitundu yosiyanasiyana; [3].zonse, za ntundu umodzi ndi zamitundu yosiyanasiyana [1] mono-culture; [2] polyculture; [3] mono+polyculture	**Kuchuluka kwa ulimi omalizikira m'malonda.** **No of Production Cycles**	**Kupata kwa pafupipifupi(kg/ulimi uliwonse)** **Average total yield (kg/cycle)**	**Kukhutisidwa ndi mlingo ndi phindo la ulimi.** 1. Very satisfied; 2. Somewhat satisfied; 3. Neither satisfied nor unsatisfied; 4. Somewhat unsatisfied; 5. Very unsatisfied
2014					
2013					
2012					

19. Please provide details of the number of people who work or are associated with the aquaculture operation **<u>OVER THE PAST 12 MONTHS</u>**: Fotokonzani bwino lomwe zonse zofunika za anthu omwe akutenga nawo mbali pa ulimi wa nsomba:

<u>IF NOT APPLICABLE, END SURVEY.</u>

Mtundu wa nchito **Labour Type**	**Kuchuluka kwa a ntchito** **No of workers**		**N'thawi yaperekedwapo** **Time spent**			**Kuchuluka kwa antchito pa chaka** **Total labour day annually**	**Malipiro omwe amalandira (MWK pa mwezi)** **Salary Paid (MWK / month)**	**Malipiro operekedwa kale(MWK pa tsiku)** **Salary Paid (MWK/day)**
	Amuna Male	Aakazi Female	Maola pa Tsiku Hour/Day	Masiku Mwezi Day/Month	Miyezi pa Chaka Months/Year			
Olembedwa ntchito (Okhazikika) Hired Labour (Permanent)								
Olembedwa ndi ena.(Kukolola) Hired Labour (Harvesting)								
Olembedwa ntchito (pokonzetsera dziwe) Hired Labour (Pond preparation)								
Olembedwa ntchito (Zina) Hired Labour (Other type)								
Achibale akugwira nawo ntchito Family Labour								

20. Please provide details about the distribution of labour by gender associated with the aquaculture operation **<u>OVER THE PAST 12 MONTHS</u>**: Perekani zokhudza kagawidwe ka ntchito malingana ndi kusiyana pakati pa amuna ndi akazi kopezeka mu ulimi wa nsomba.

IF NOT APPLICABLE, END SURVEY.

	Ntchito ya anthu achibale family labour		Ntchito ya anthu ongolembedwa hired labour	
Ntchito zosankhidwa Selected activities	% Amuna Men	% Akazi Women	% Amuna Men	% Akazi Women
Kumanga dziwe la nsomba Pond excavation				
Kugula zofunikira (feteleza, nsomba zazing'ono ndi zina.) Buying of inputs (fertilizer, fingerling etc.)				
Kutsegulira matumbi Release of fingerling				
Kukhonza chakudya ndikudyesera Feed Preparation/Feeding				
Kuona za matenda Disease checking				
Kasamalidwe ka ubwino madzi Water quality management				
Kuwedza matumbi, kapena nsomba kumene. Harvesting of fingerling/fish				
Kugulisa matumbi kapena nsomba zimene. Selling of fingerling/fish				
Kutsatsa msomba zazing'ono ndi zazikulu zomwe.				

Marketing of fingerling/fish				
Kulondera Guarding				
Kulima mu migula Dike cropping				
Other please specify________________				

END OF INTERVIEW

Thank you for your cooperation in participating in this study... **NOTE TIME ENDS:**

Zikomo kwambiri podzipereka ndi kutenganawo mbali pakafukufukuyu

INTERVIEWER REMARKS

Respondent's cooperation was: Very good Good Fair Poor

The quality of respondent's answers were: High quality Generally reliable Unreliable

What was the main reason for the questionable or unreliable quality of the interview? ……...………………………………
……

Further comments:

……...……………………………………
……

Appendix H

Household Logsheet.

Questionnaire No.	Assistant	HH ID #	HH family name	Part 2 not complete-abandoned?	No of Ponds (to administer Part 3)	Map Serial No.	Date	Time Visit	Member of HH interviewed (Head of HH OR Fisher)	Interview Complete? Y/N	Consent? Y/N		# HH Fisher Members Interviewed	Unanswered Qu.? Y/N	Interview Refused? Y/N	House Vacant? Y/N	Revisit Required Y/N & Why?	Debrief Complete Y/N	Sign Off Y/N	Data Entry Complete? Y/N	Survey Scanned? Y/N	Consent Audio Saved? Y/N
											Written	Verb. Record										
1																						
2																						
3																						
4…																						

Appendix I

PCA Wealth Index.

The wealth index, developed by The DHS Program (Rutsein, and Johnson. 2004), is a composite measure of a household's cumulative living standard and is used as a proxy indicator of household level wealth. Table 1 below provides a summary of the variables included in the PCA that were considered relevant to the household assets, dwelling and sanitation characteristics that would be appropriate to explain the wealth of the household.

Table 1.1. Summary of variables included and excluded in the Principle Components Analysis.

Principle Components Analysis	**Productive assets**	**Non-productive assets**	**Households Dwelling & Water Source**	**Other**
Included:	Seine Nets Fish Pond	Radio Bicycle Phone Modern Furniture	Water supply (drinking) Flooring (Cement) Roof (Iron sheeting)	
Excluded:	*Treadle Pump* *Ox Cart* *Plough* *Fishing Boats* *Sewing Machine*	*TV* *Car/ Motorcyle*	*Electricity*	*Land ownership* Livestock: chicken *guinea fowls* ducks goats *pigs* *cattle*

Note: Items in italic/underlined were excluded from the PCA analysis due to representing <5% or >95% of all households. All livestock and land ownership variables were further excluded from the analysis as they depend on the livelihood activity of the household (Rutsein, and Johnson. 2004).

A total of ten items, representing household assets, dwelling characteristics and source of drinking water, were subjected to principal components analysis (PCA) using SPSS version 24. Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coeffcients of .3 and above. The Kaiser-Meyer-Olkin value was .649, exceeding the recommended value of .6 (Kaiser 1970, 1974) and Bartlett's

Test of Sphericity (Bartlett 1954) reached statistical significance, supporting the factorability of the correlation matrix. Principal components analysis revealed the presence of three components with eigenvalues exceeding 1, explaining 24%, 16% and 14% of the variance respectively. This was further supported by an inspection of the scree plot which revealed a clear break after the third component (figure 1.1.) A table summarising the unrotated loadings can be found in below (table 1.3). The three-component solution explained a total of 54% of the variance, with Component 1 contributing 24%, Component 2 contributing 16.0% and Component 3 contributing 14%. To aid in the interpretation of these three components, oblimin rotation was performed. The rotated solution revealed the presence of simple structure (Thurstone 1947), with all three components showing a number of strong loadings. A summary of the pattern and structure matrix for PCA is provided below in table 1.2. A bicycle, phone and radio items categorised as electronics and transport goods loaded strongly on component 1.

Table 1.2: Pattern and Structure Matrix for PCA with Oblimin Rotation of Three Factor Solution of Household Asset, Dwelling Characteristics and Source of Drinking Water Items.

Item	Pattern Coefficients			Structure Coefficients			Communalities
	PCA 1	PCA 2	PCA 3	PCA 1	PCA 2	PCA 3	
A bicyle	**.786**	-.045	-.061	**.772**	.030	.069	.601
A phone	**.756**	.024	.029	**.763**	.097	.155	.583
A radio	**.675**	.018	.185	**.707**	.084	.297	.534
Modern furniture	-.127	**.783**	.139	-.029	**.773**	.125	.626
Fishing nets	.001	**.730**	.111	.089	**.731**	.118	.546
Fishing ponds	**.324**	**.570**	-.346	.321	**.598**	-.287	.544
Iron sheet roofing	-.069	.087	**.803**	.073	.088	**.792**	.639
Cement flooring	.095	.202	**.650**	.222	.217	**.668**	.499
Source of drinking water	.231	-.177	**.451**	.288	-.151	**.487**	.313

Bold denotes high factor loading (>.3).

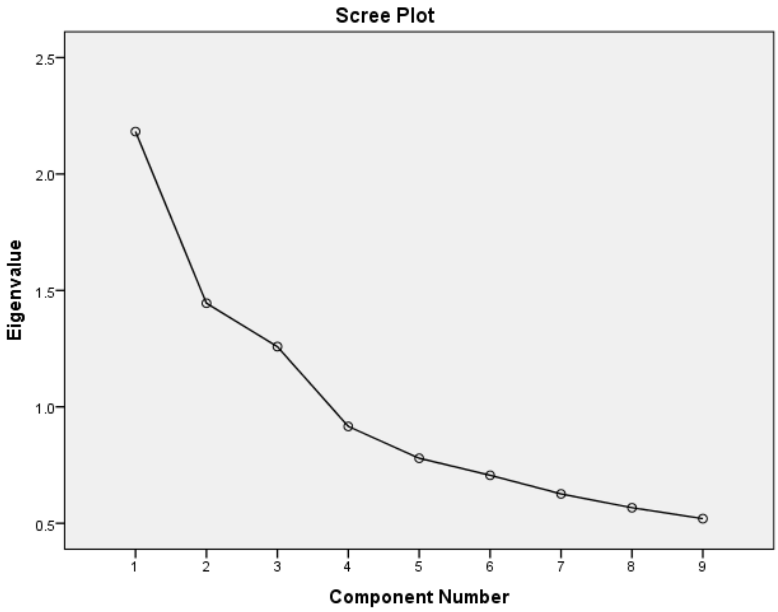

Figure 1.1. Principle Components Analysis Scree Plot Results.

Table 1.3. Principle Components Analysis Component Matrix Table.

Component Matrix[a]

	Component		
	1	2	3
A radio	.674	-.239	-.148
A phone	.660	-.226	-.310
A bicyle	.607	-.279	-.394
Cement flooring	.521	.014	.478
Source of drinking water	.362	-.328	.273
Modern furniture	.309	.716	.133
Fishing nets	.378	.633	.056
Fishing ponds	.331	.482	-.450
Iron sheet roofing	.417	-.069	.679

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

Appendix J

Statistical tests.

TABLE A Chi Square Test Results for Household Survey Data

Reference	Variable	Description of Test	Df (2)	N	X^2	P value	phi
	Gender HH Head	Difference between FH and NFH	1	137	1.390	0.238	-0.101
	Gender HH Head	Difference between Makawa and Malundu	1	137	8.414	0.004	-0.248
	Marital Status of HH Head	Difference between FH and NFH	3	136	7.484 *Likelihood Ratio	0.058	0.115 **Cramer's V
	Marital Status of HH Head	Difference between Makawa and Malundu	3	136	1.101 *Likelihood Ratio	0.777	0.090 **Cramer's V
	HH Education Level	Difference between FH and NFH	2	137	2.685	0.261	0.140 **Cramer's V
	HH Education Level	Difference between Makawa and Malundu	2	137	6.205	0.045	0.213 **Cramer's V
	HH Illness past 4 weeks	Difference between FH and NFH	1	137	4.337	0.037	0.178
	HH Illness past 4 weeks	Difference between Makawa and Malundu	1	137	0.441	0.507	0.057
	HH Ethnicity	Difference between FH and NFH	4	137	4.917 *Likelihood Ratio	0.296	0.181 **Cramer's V

	HH Ethnicity	Difference between Makawa and Malundu	4	137	117.038 *Likelihood Ratio	<0.001	0.833 **Cramer's V
	HH Religion	Difference between FH and NFH	4	137	9.383 *Likelihood Ratio	0.052	0.228 **Cramer's V
	HH Religion	Difference between Makawa and Malundu	4	137	41.135 *Likelihood Ratio	<0.001	0,532 **Cramer's V
	Primary Livelihood Activity	Difference between FH and NFH	11	134	21.893 *Likelihood Ratio	0.025	0.382 **Cramer's V
	Primary Livelihood Activity	Difference between Makawa and Malundu	11	134	38.867 *Likelihood Ratio	<0.001	0.472 **Cramer's V
	Land Ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	1.000	0.12
	Land Ownership	Difference between Makawa and Malundu	1	137	**Fishers Exact Test	1.000	0.909
	Land Use	Difference between FH and NFH	1	106	**Fishers Exact Test	0.507	0.119
	Land Use	Difference between Makawa and Malundu	1	106	**Fishers Exact Test	1.000	0.806
	Source of Drinking Water	Difference between FH and NFH	4	137	16.233	0.003	0.344
	Source of Drinking Water	Difference between Makawa and Malundu	4	137	50.287	<0.001	0.606
	Source of Washing Water	Difference between FH and NFH	5	137	21.004 *Likelihood Ratio	0.001	0.364 **Cramer's V
	Source of Washing Water	Difference between Makawa and Malundu	5	137	135.811 *Likelihood Ratio	<0.001	0.875 **Cramer's V
	Source of Domestic Water	Difference between FH and NFH	5	137	26.022 *Likelihood Ratio	<0.001	0.404 **Cramer's V

	Source of Domestic Water	Difference between Makawa and Malundu	5	137	88.722 *Likelihood Ratio	<0.001	0.729 **Cramer's V
	A car, motorcycle ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	1.000	-0.078
	A bicyle ownership	Difference between FH and NFH	1	137	3.285	0.070	0.155
	An ox cart ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	0.203	0.134
	A phone ownership	Difference between FH and NFH	1	137	0.760	0.383	0.074
	A radio ownership	Difference between FH and NFH	1	137	0.029	0.865	0.015
	Chickens ownership	Difference between FH and NFH	1	137	0.448	0.503	0.057
	Guinea fowls ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	0.203	0.134
	Ducks ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	0.486	0.086
	Goats ownership	Difference between FH and NFH	1	137	2.775	0.096	0.142
	Cattle ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	0.453	0.094
	Fishing boats ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	0.453	0.094
	Fishing nets ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	0.078	0.173
	Fishing ponds ownership	Difference between FH and NFH	1	137	28.329	<0.001	0.455
	Sewing maching ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	1.000	-0.36

	Treadle pump ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	0.090	0.165
	TV ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	0.328	0.104
	Iron sheet roofing ownership	Difference between FH and NFH	1	137	2.775	0.096	0.142
	Cement flooring ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	1.000	0.020
	Modern furniture ownership	Difference between FH and NFH	1	137	4.697	0.030	0.185
	Household have electricity ownership	Difference between FH and NFH	1	137	**Fishers Exact Test	1.000	-0.012
	Chickens ownership	Difference between Makawa and Malundu	1	137	13.104	<0.001	0.309
	Guinea fowls ownership	Difference between Makawa and Malundu	1	137	**Fishers Exact Test	0.500	0.112
	Ducks ownership	Difference between Makawa and Malundu	1	137	**Fishers Exact Test	1.000	-0.20
	Goats ownership	Difference between Makawa and Malundu	1	137	0.622	0.430	0.067
	Cattle ownership	Difference between Makawa and Malundu	1	137	**Fishers Exact Test	0.460	-0.93
	Farming Preference	Difference between FH and NFH	3	107	9.735	0.021	0.302
	Farming Preference	Difference between Makawa and Malundu	3	107	1.812	0.612	0.130
	Farming Preference Reason Manure	Difference between FH and NFH	1	106	**Fishers Exact Test	0.660	-0.61
	Farming Preference Reason Cheaper to Farm	Difference between FH and NFH	1	106	**Fishers Exact Test	0.211	-0.150

	Farming Preference Reason Higher Yields	Difference between FH and NFH	1	106	7.451	0.006	-0.265
	Farming Preference Reason Preferred Food Consumption	Difference between FH and NFH	1	106	0.601	0.438	0.075
	Farming Preference Reason More Nutritious	Difference between FH and NFH	1	106	0.082	0.774	-0.028
	Farming Preference Reason Ease of Practice	Difference between FH and NFH	1	106	**Fishers Exact Test	1.000	-0.010
	Farming Preference Reason Source of Food	Difference between FH and NFH	1	106	2.319	0.128	0.148
	Farming Preference Reason Other	Difference between FH and NFH	1	106	**Fishers Exact Test	0.213	0.145
			1	106	**Fishers Exact Test	1.000	0.044
	Non-Fish Farming Households Consideration for adopting fish farming	Difference between Makawa and Malundu	1	74	0.323	0.570	0.066
	Non-Fish Farming Households Perceived Constraints to adopting fish farming	Difference between Makawa and Malundu	10	41	24.331 *Likelihood Ratio	0.007	0.679 **Cramer's V
	Preferred type of fisheries sector role	Difference between FH and NFH	4	123	3.428	0.489	0.158
	Preferred type of fisheries sector role	Difference between Makawa and Malundu	4	123	22.029 *Likelihood Ratio	<0.001	0.385 **Cramer's V
	Top Ranked Area of Expenditure	Difference between FH and NFH	14	131	31.412 *Likelihood Ratio	0.005	0.441 **Cramer's V

	Top Ranked Area of Expenditure	Difference between Makawa and Malundu	14	131	39.012 *Likelihood Ratio	<0.001	0.483 **Cramer's V
	Second Ranked Area of Expenditure	Difference between FH and NFH	12	96	37.597 *Likelihood Ratio	<0.001	0.559 **Cramer's V
	Second Ranked Area of Expenditure	Difference between Makawa and Malundu	12	96	21.204 *Likelihood Ratio	0.047	0.418 **Cramer's V
	Third Ranked Area of Expenditure	Difference between FH and NFH	15	72	18.717 *Likelihood Ratio	0.227	0.442 **Cramer's V
	Third Ranked Area of Expenditure	Difference between Makawa and Malundu	15	72	25.465 *Likelihood Ratio	0.044	0.538 **Cramer's V
	Fourth Ranked Area of Expenditure	Difference between FH and NFH	14	64	19.482 *Likelihood Ratio	0.147	0.492 **Cramer's V
	Fourth Ranked Area of Expenditure	Difference between Makawa and Malundu	14	64	26.058 *Likelihood Ratio	0.025	0.567 **Cramer's V
	Top Ranked Area of Expenditure	Difference between gender groups	14	131	23.341	0.055	0.395
	Second Ranked Area of Expenditure	Difference between gender groups	12	96	25.110	0.014	0.469
	Third Ranked Area of Expenditure	Difference between gender groups	15	72	29.850	0.012	0.588
	Fourth Ranked Area of Expenditure	Difference between gender groups	14	64	27.907	0.015	0.592
	Savings	Difference between FH and NFH	1	112	2.609	0.106	-0.153
	Savings	Difference between Makawa and Malundu	1	112	3.613	0.057	-0.180
	Relatives give/receive food	Difference between FH and NFH	3	135	12.391 *Likelihood Ratio	0.006	0.299 **Cramer's V

	Relatives give/receive cash	Difference between FH and NFH	3	135	5.194	0.158	0.197
	Relatives mutual aid	Difference between FH and NFH	3	135	1.267 *Likelihood Ratio	0.531	0.084 **Cramer's V
	HH Affiliated to local group	Difference between FH and NFH	1	136	8.893	0.003	-0.256
	HH Membership of a Political Party	Difference between FH and NFH	1	100	Fishers exact	1.000	-0.28
	HH Membership of a Community Group	Difference between FH and NFH	1	100	3.107	0.078	0.176
	HH Membership of a Governance Committee	Difference between FH and NFH	1	102	0.531	0.466	-0.072
	HH Membership of a NGO Supported Group	Difference between FH and NFH	1	100	14.160	<0.001	-0.376
	HH Membership of a Participation in Festivals	Difference between FH and NFH	1	100	0.986	0.321	0.099
	HH Membership of a Other Associations	Difference between FH and NFH	1	100	4.825	0.028	0.220
	HH Membership of a Political Party	Difference between Makawa and Malundu	1	100	Fishers exact test	0.234	-0.159

	HH Membership of a Community Group	Difference between Makawa and Malundu	1	100	39.941	<0.001	-0.632
	HH Membership of a Governance Committee	Difference between Makawa and Malundu	1	102	2.087	0.149	-0.143
	HH Membership of a NGO Supported Group	Difference between Makawa and Malundu	1	100	0.261	0.609	-0.051
	HH Membership of a Participation in Festivals	Difference between Makawa and Malundu	1	100	0.001	0.977	-0.003
	HH Membership of a Other Associations	Difference between Makawa and Malundu	1	100	7.070	0.008	-0.266
	HH Experienced one or more shocks in past 12 months	Difference between FH and NFH	2	137	2.791 Likelihood Ratio	0.248	0.122 **Cramer's V
	HH Shock - Drought	Difference between FH and NFH	1	136	5.033	0.025	-0.192
	HH Shock - Flood	Difference between FH and NFH	1	136	6.611	0.010	0.220
	HH Shock - High level of crop pests or disease	Difference between FH and NFH	1	136	2.408	0.121	-0.133
	HH Shock - High level of livestock disease	Difference between FH and NFH	1	136	0.040	0.841	0.017

	HH Shock - Low level of fish availability	Difference between FH and NFH	1	136	20.547	<0.001	-0.389
	HH Shock - Low prices for agriculture output	Difference between FH and NFH	1	136	2.315	0.128	-0.130
	HH Shock - Low prices for fishing output	Difference between FH and NFH	1	136	16.264	<0.001	-0.346
	HH Shock - High prices of agricultural input	Difference between FH and NFH	1	136	1.020	0.313	-0.087
	HH Shock - High prices of fish input	Difference between FH and NFH	1	136	16.764	<0.001	-0.351
	HH Shock - High prices for food	Difference between FH and NFH	1	136	1.517	0.218	0.106
	HH Shock - End of regular assistance/aid/remittance from outside household	Difference between FH and NFH	1	136	0.349	0.555	0.051
	HH Shock - Reduction in earnings from household (non agriculture and fishing, and not due to illness or accident)	Difference between FH and NFH	1	136	2.107	0.147	-0.124
	HH Shock - Serious illness or accident of household member	Difference between FH and NFH	1	136	0.001	0.976	-0.003
	HH Shock - Death of household member	Difference between FH and NFH	1	136	1.153	0.283	0.092
	HH Shock - Theft of money, valuables, assets, agriculture output	Difference between FH and NFH	1	136	0.002	0.962	0.004

	HH Shock - Other	Difference between FH and NFH	1	136	0.337	0.562	0.050
	HH Top Ranked Shock	Difference between FH and NFH	11	134	19.874 Likelihood Ratio	0.047	0.355 **Cramer's V
	Shock impact- income	Difference between FH and NFH	1	134	2.026	0.155	-0.123
	Shock impact- assets	Difference between FH and NFH	1	134	2.027	0.155	-0.123
	Shock impact- food production	Difference between FH and NFH	1	134	Fishers exact test	0.092	0.166
	Shock impact- food stocks	Difference between FH and NFH	2	134	8.102 Likelihood Ratio	0.017	0.215 **Cramer's V
	Shock impact- food purchases	Difference between FH and NFH	2	134	6.521	0.038	0.221
	Food Consumption Groups	Difference between FH and NFH	2	137	6.247	0.044	0.214
	Food Consumption Groups	Difference between Makawa and Malundu	2	137	8.978	0.011	0.256
	Preferred Fish Species to Consume	Difference between FH and NFH	10	135	13.856 Likelihood Ratio	0.180	0.287 **Cramer's V
	Preferred Fish Species to Consume	Difference between Makawa and Malundu	10	135	39.663 Likelihood Ratio	<0.001	0.496 **Cramer's V
	Constraints to access fish for consumption	Difference between FH and NFH	6	108	4.947 Likelihood Ratio	0.551	0.205 **Cramer's V
	Constraints to access fish for consumption	Difference between Makawa and Malundu	6	108	26.415 Likelihood Ratio	0.001	0.463 **Cramer's V
	Animal Protein Preference	Difference between FH and NFH	6	137	6.217	0.399	0.206

	Animal Protein Preference	Difference between Makawa and Malundu	6	137	11.024	0.088	0.277

TABLE B Independent Samples T-Test Results for Household Survey Data

Reference	Description	Mean	SE	Df (2)	T-Statistic	P value	Mean Difference	95% CI
	HH Size FH NFH	4.65 4.90	2.030 1.790	135	-0.756	0.451	-0.250	-0.901 to 0.404
	HH Size Makawa Malundu	63 74	4.78 4.76	135	0.064	0.949	0.21	-0.633 to 0.675
	Fish Gift FH NFH	9.62 0.00	4.128 0.00	93	2.116	0.037	9.615	0.592-18.638
	Fish Purchased FH NFH	86.54 86.28	4.779 5.047	93	0.037	0.970	0.259	-13.597-14.116
	Fish Own Production/Hunted FH NFH	3.85 13.49	2.693 5.024	93	-1.772	0.080	-9.642	-20.447-1.163

TABLE C Non Parametric Mann-Whitney U Test Results for Household Survey Data

Reference	Description of Test	N	Mean Rank	U	P value	Z
	HH Age FH NFH	62 72	69.73 65.58	2094.000	0.538	-0.616
	HH Age Makawa Malundu	62 72	63.27 71.14	1970.000	0.242	-1.170
	No. Children FH NFH	75 62	70.88 66.73	2184.000	0.535	-0.621
	No. Children Makawa Malundu	63 74	68.11 69.76	2275	0.806	-0.246
	No. Adults FH NFH	62 75	79.84 60.04	1653.000	0.002	-3.170
	No. Adults Makawa Malundu	63 74	70.54 67.69	22234.000	0.648	-0.457
	No. HH Members Literate FH NFH	61 74	73.07 63.82	1948.000	0.158	-1.413

	No. HH Members Literate Makawa Malundu	61 74	56.88 77.17	1578.500	0.002	-3.102
	No. Livelihood Activities FH NFH	62 75	81.97 58.28	1521.000	<0.001	-3.702
	No. Livelihood Activities Makawa Malundu	63 74	68.12 69.75	2275.500	0.799	-0.255
	Total Land Size (ha) FH NFH	61 74	75.70 61.65	1787.000	0.033	-2.127
	Total Land Size (ha) Makawa Malundu	62 73	59.54 75.18	1738.500	0.018	-2.371
	Frequency of consumption – Cereals FH NFH	62 75	68.40 69.50	2287	0.271	-1.100
	Frequency of consumption – Pulses FH	62 75	70.18 68.03	2252.00	0.670	-0.426

	NFH					
	Frequency of consumption – Vegetables FH NFH	62 75	76.91 62.46	1834.500	0.032	=2.147
	Frequency of consumption – Fruit FH NFH	62 75	71.94 66.57	2143.000	0.370	-0.896
	Frequency of consumption – Milk FH NFH	62 75	69.33 68.73	2304.500	0.803	=0.250
	Frequency of consumption – Sugar FH NFH	62 75	75.90 63.77	1897.500	0.038	-0.250
	Frequency of consumption – Condiments FH NFH	62 75	68.70 69.25	2306.500	0.892	-0.136
	Frequency of consumption – Fish	62 75	65.65 71.77	2117.000	0.206	-1.265

	FH NFH					
	Frequency of consumption – Protein FH NFH	62 75	74.76 64.24	1968.000	0.118	-1.565
	Frequency of consumption - Meat, Fish and Eggs FH NFH	62 75	74.40 64.54	1990.500	0.143	-1.464
	Frequency of consumption - Vitamin A FH NFH	62 75	69.00 69.00	2325.000	1.000	0.000
	Frequency of consumption - Oils FH NFH	62 75	75.33 63.77	1932.500	0.078	-1.760
	Food Consumption Score FH NFH	62 75	77.58 61.91	1793.000	0.021	-2.301

	Food Consumption Score Makawa Malundu	63 74	57.10 79.14	1581.000	0.001	-3.240
	Food Coping Strategies Index FH NFH	48 67	53.24 61.41	1379.500	0.195	-1.297
	Food Coping Strategies Index Makawa Malundu	58 57	66.30 49.55	1171.500	0.007	-2.696

Appendix K

Further presentation of results.

Table 7.10. Percentage of Household Expenditure by Item for Household Type and Village.

			Type of Household		Village		
			Non Fish Farming	Fish Farming	Makawa	Malundu	Total
HH Expenditure Item	Paraffin (1month)	Count	2	1	0	3	3
		%	1.5%	0.7%	0.0%	2.2%	2.2%
	Leisure Alcohol (1mo)	Count	1	3	2	2	4
		%	0.7%	2.2%	1.5%	1.5%	2.9%
	Tobacco (1mo)	Count	3	1	4	0	4
		%	2.2%	0.7%	2.9%	0.0%	2.9%
	Public transport (1mo)	Count	10	20	9	21	30
		%	7.4%	14.7%	6.6%	15.4%	22.1%
	Milling fees (1mo)	Count	70	57	60	67	127
		%	51.5%	41.9%	44.1%	49.3%	93.4%
	Personal beauty (1mo)	Count	65	54	54	65	119
		%	47.8%	39.7%	39.7%	47.8%	87.5%
	Petrol (1mo)	Count	1	0	1	0	1
		%	0.7%	0.0%	0.7%	0.0%	0.7%
	Bicycle service (1mo)	Count	19	19	16	22	38
		%	14.0%	14.0%	11.8%	16.2%	27.9%
	Servant Wages (1mo)	Count	7	2	1	8	9
		%	5.1%	1.5%	0.7%	5.9%	6.6%
	Dwelling repairs & maintenance (1mo)	Count	5	5	5	5	10
		%	3.7%	3.7%	3.7%	3.7%	7.4%
	Repairs to HH & personal items (1mo)	Count	0	4	0	4	4
		%	0.0%	2.9%	0.0%	2.9%	2.9%
	Recharging batteries phones (1mo)	Count	12	15	7	20	27
		%	8.8%	11.0%	5.1%	14.7%	19.9%
	Clothes (4mo)	Count	40	41	38	43	81
		%	29.4%	30.1%	27.9%	31.6%	59.6%
	Gift (4mo)	Count	27	19	23	23	46
		%	19.9%	14.0%	16.9%	16.9%	33.8%
	Laundry (4mo)	Count	15	15	14	16	30
		%	11.0%	11.0%	10.3%	11.8%	22.1%
	Kitchen utensils (4mo)	Count	19	19	13	25	38
		%	14.0%	14.0%	9.6%	18.4%	27.9%
	Cleaning utensils (4mo)	Count	11	3	7	7	14
		%	8.1%	2.2%	5.1%	5.1%	10.3%
	Torch (4mo)	Count	17	8	6	19	25
		%	12.5%	5.9%	4.4%	14.0%	18.4%
	Business invest. (4mo)	Count	8	14	8	14	22
		%	5.9%	10.3%	5.9%	10.3%	16.2%

Equipment invest. (4mo)	Count	5	3	2	6	8
	%	3.7%	2.2%	1.5%	4.4%	5.9%
Loan repayments (4mo)	Count	25	25	16	34	50
	%	18.4%	18.4%	11.8%	25.0%	36.8%
HH education (4mo)	Count	37	25	24	38	62
	%	27.2%	18.4%	17.6%	27.9%	45.6%
HH healthcare (4mo)	Count	48	31	40	39	79
	%	35.3%	22.8%	29.4%	28.7%	58.1%
Other (4mo)	Count	10	4	4	10	14
	%	7.4%	2.9%	2.9%	7.4%	10.3%
Total	Count	74	62	63	73	136
	% Total	54.4%	45.6%	46.3%	53.7%	100.0%

Percentages and totals are based on respondents.
a. Dichotomy group tabulated at value 1.

Figure 7.11 The percentage of household expenditure by item according to household type.

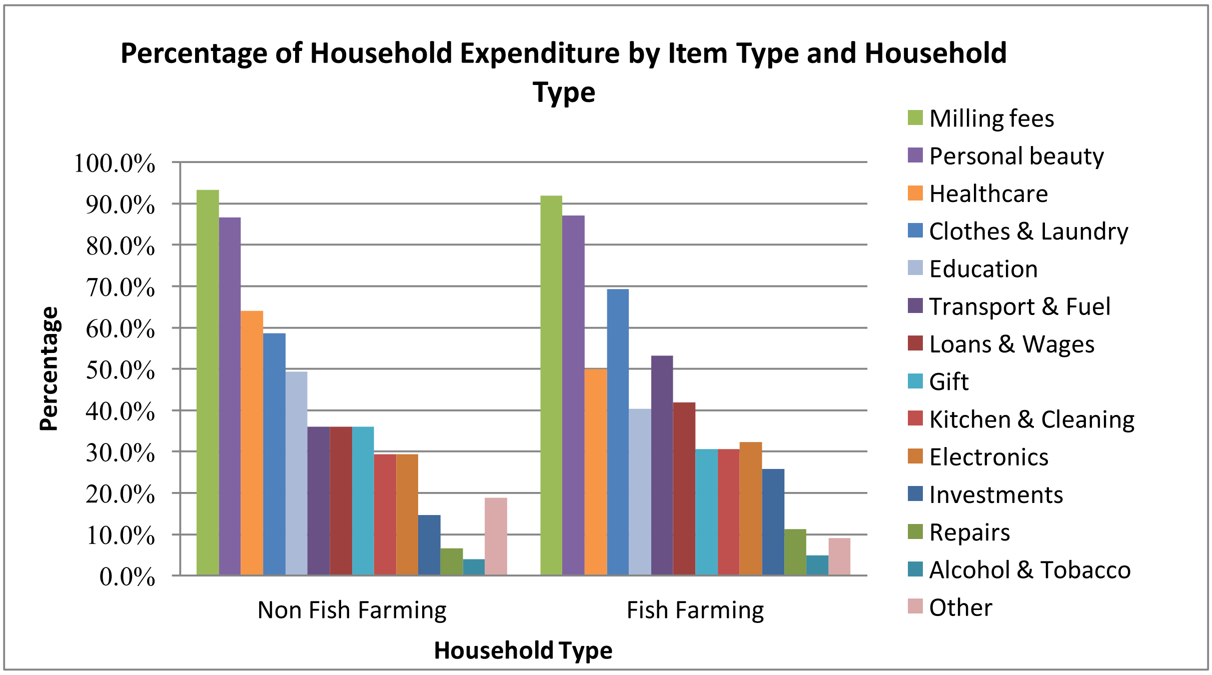

Table 7.11. Households who had given/received food in the past 12 month by household type and village.

			Type of Household		Village	
			Non-Fish Farming	Fish Farming	Makawa	Malundu
Give/receive food	Give only	Count	4	14	4	14
		%	3.00%	10.40%	3.00%	10.40%
	Receive only	Count	3	4	2	5
		%	2.20%	3.00%	1.50%	3.70%
	Both	Count	60	35	48	47
		%	44.40%	25.90%	35.60%	34.80%
	No	Count	6	9	8	7
		%	4.40%	6.70%	5.90%	5.20%
Give/receive cash	Give only	Count	9	10	5	14
		%	6.70%	7.50%	3.70%	10.40%
	Receive only	Count	6	5	4	7
		%	4.50%	3.70%	3.00%	5.20%
	Both	Count	18	24	26	16
		%	13.40%	17.90%	19.40%	11.90%
	No	Count	40	22	26	36
		%	29.90%	16.40%	19.40%	26.90%
Changes in mutual aid	Increased	Count	1	0	1	0
		%	0.80%	0.00%	0.80%	0.00%
	Decreased	Count	27	21	20	28
		%	21.30%	16.50%	15.70%	22.00%
	Stayed same	Count	42	36	35	43
		%	33.10%	28.30%	27.60%	33.90%

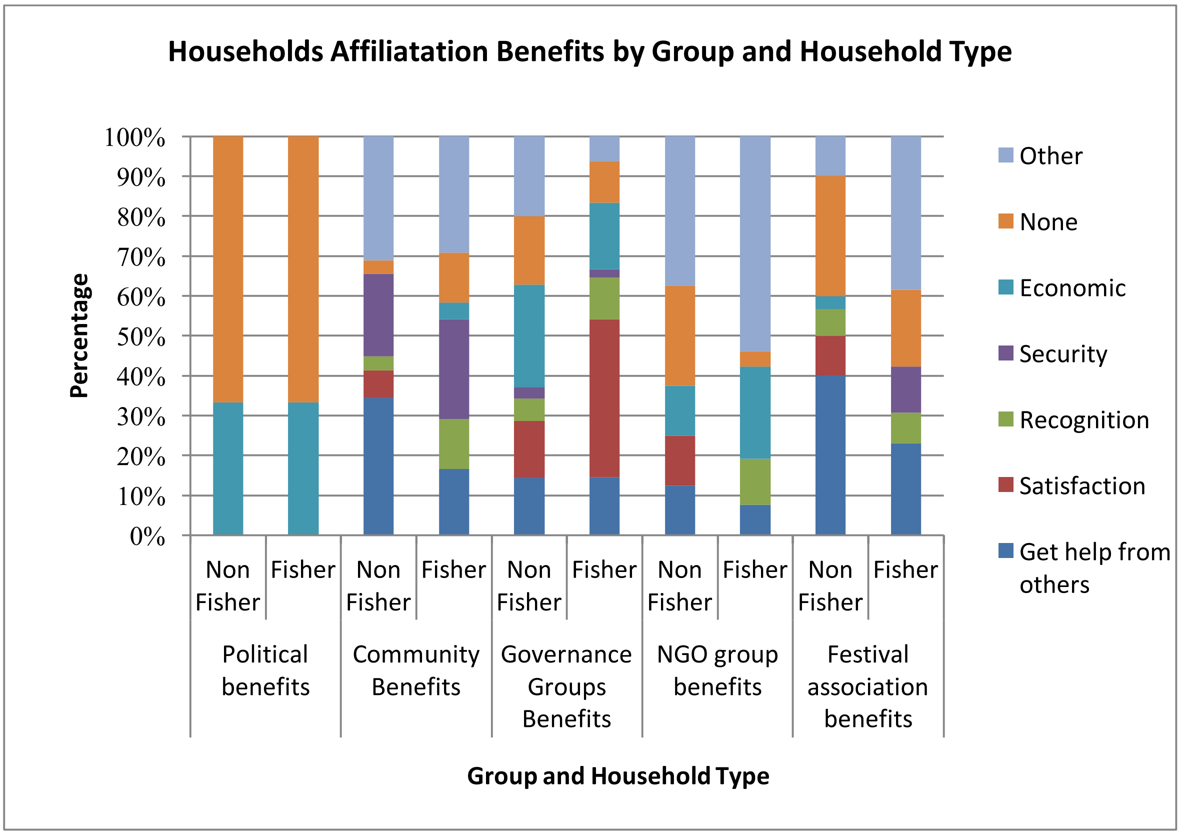

Figure 7.12. Household Affiliation benefits by group and household type.

Table 7.12. Farming Preference Reason by all households.

		Responses		Percent of
		N	Percent	Cases
HH Farming Preference Reason[a]	Farming Preference Reason Cheaper to Farm	2	1.3%	1.9%
	Farming Preference Reason Higher Yields	17	10.8%	16.0%
	Farming Preference Reason Higher Income	69	43.9%	65.1%
	Farming Preference Reason Preferred Food Consumption	31	19.7%	29.2%
	Farming Preference Reason More Nutritious	2	1.3%	1.9%
	Farming Preference Reason Ease of Practice	22	14.0%	20.8%
	Farming Preference Reason Source of Food	6	3.8%	5.7%

	Farming Preference Reason Source of Manure	5	3.2%	4.7%
	Farming Preference Reason Other	3	1.9%	2.8%
Total		157	100.0%	148.1%

a. Dichotomy group tabulated at value 1.

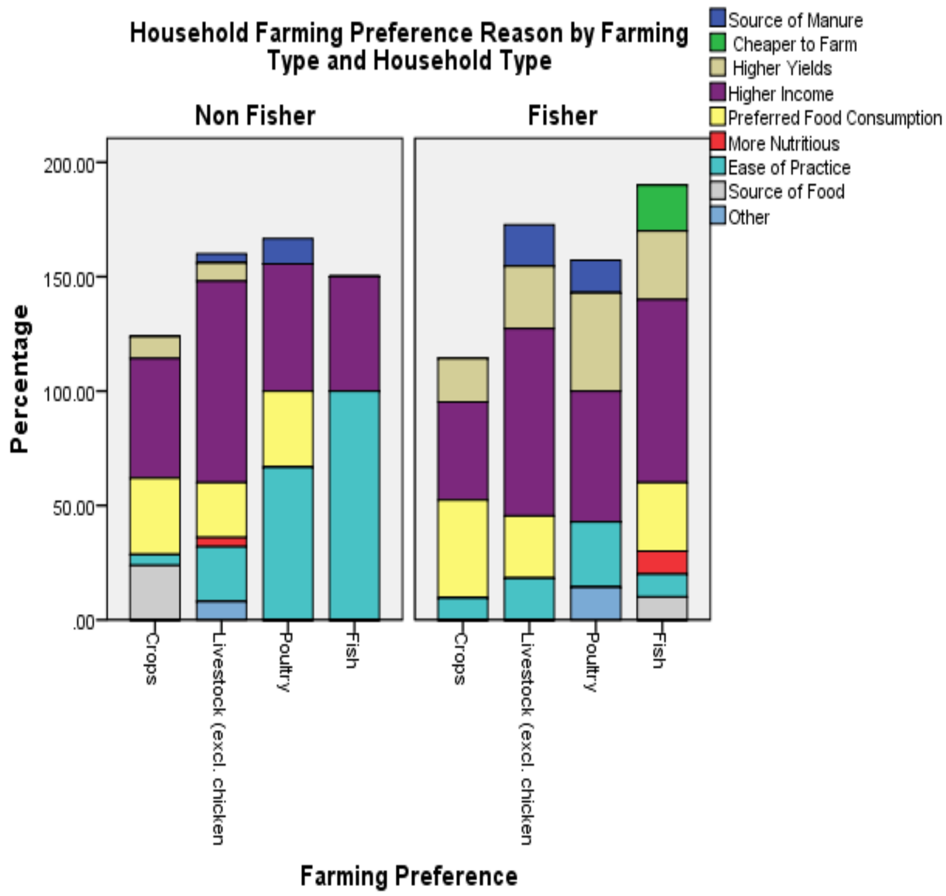

Figure 7.13 Farming Preference by farming type between fish farming and non-fish farming households.

Table. 7.13. Preferred type of fisheries sector role by household type and village.

			Type of Household		Village		Total
			Non Fish Farming	Fish Farming	Makawa	Malundu	
Preference for any fish sector role	1 Fish farming	Count	43	37	35	45	80
		% of Total	35%	30%	28.50%	36.60%	65.00%
	2 Capture Fisheries	Count	7	2	0	9	9
		% of Total	6%	2%	0.00%	7.20%	7.20%
	3 Fish processing and Trading	Count	17	17	25	9	34
		% of Total	14%	14%	20.30%	7.20%	29.20%
		Total	67	56	60	63	123

Table 7.14. Perceived Importance of Fish Farming by Household Type and Village.

			Household Type		Village	
			Non- Fish Farming Household	Fish Farming Household	Makawa	Malundu
Importance of Fish Farming to HH	HH income source	Count	1	15	1	15
		%	3%	48%	3.2%	48%
	HH food source	Count	0	16	0	16
		%	0%	52%	0.%	52%
	Wider community and No importance to HH	Count	0	14	14	0
		%	0%	36%	36%	0%
Total		Count	1	30	15	16

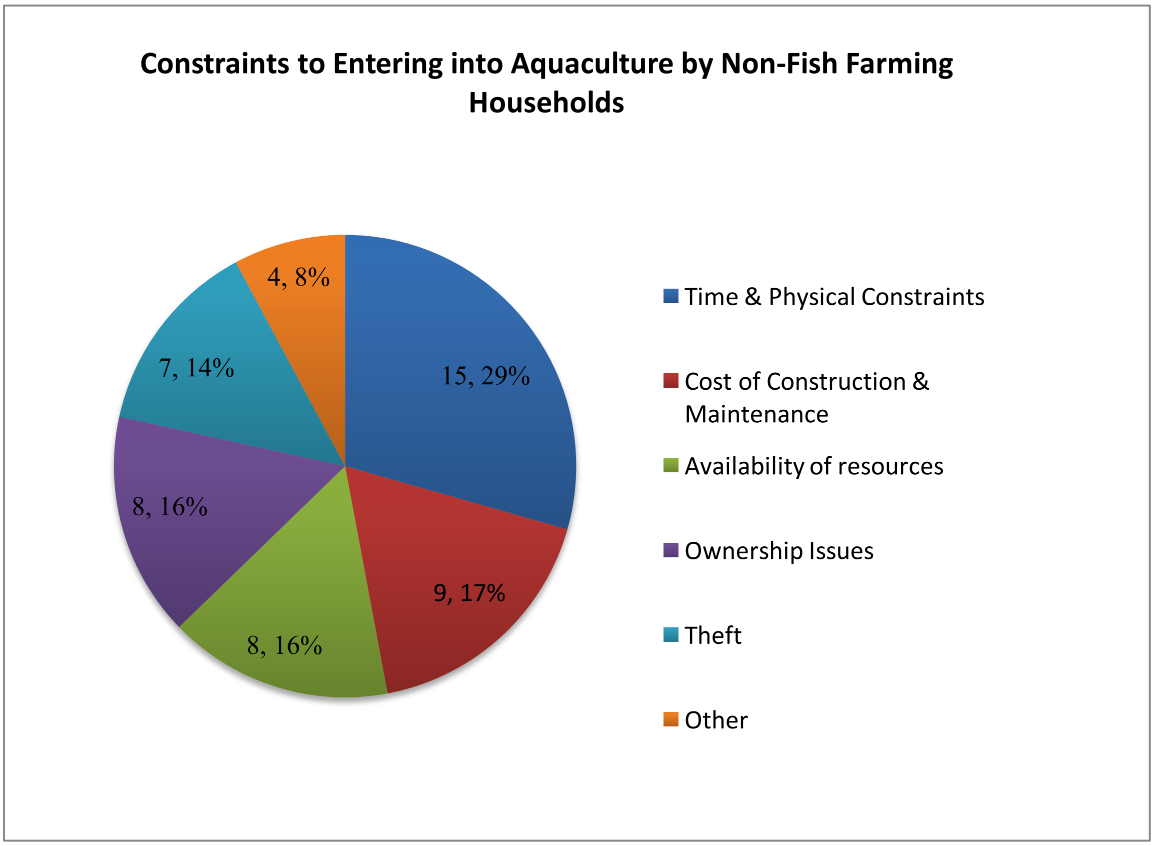

Figure 7.14 Constraints to joining fish farming by non-fish farming households- (Category Availability includes: availability of land, water, feed and seed).

Table 7.15. Percentage of Top Ranked Shocks (Most Severe) by Household Type.

			Type of Household		Total
			1 Non Fisher	2 Fisher	
Ranked shocks. Top most severe	1 drought	Count	3	5	8
		% within Type of Household	4.1%	8.2%	6.0%
		% of Total	2.2%	3.7%	6.0%
	2 flood	Count	35	31	66
		% within Type of Household	47.9%	50.8%	49.3%
		% of Total	26.1%	23.1%	49.3%
	3 crop disease	Count	0	3	3
		% within Type of Household	0.0%	4.9%	2.2%
		% of Total	0.0%	2.2%	2.2%
	6 low price agriculture	Count	1	2	3
		% within Type of Household	1.4%	3.3%	2.2%
		% of Total	0.7%	1.5%	2.2%
	8 high costs agriculture output	Count	1	5	6
		% within Type of Household	1.4%	8.2%	4.5%
		% of Total	0.7%	3.7%	4.5%
	9 high cost fish input	Count	0	1	1
		Expected Count	0.5	0.5	1.0
		% within Type of Household	0.0%	1.6%	0.7%
		% of Total	0.0%	0.7%	0.7%
	10 high price food	Count	11	7	18
		% within Type of Household	15.1%	11.5%	13.4%
		% of Total	8.2%	5.2%	13.4%
	12 reduction earnings	Count	2	0	2
		% within Type of Household	2.7%	0.0%	1.5%
		% of Total	1.5%	0.0%	1.5%
	13 serious illness or accident	Count	7	3	10
		% within Type of Household	9.6%	4.9%	7.5%
		% of Total	5.2%	2.2%	7.5%
	14 death	Count	6	1	7
		% within Type of Household	8.2%	1.6%	5.2%
		% of Total	4.5%	0.7%	5.2%
	15 theft	Count	4	1	5
		% within Type of Household	5.5%	1.6%	3.7%
		% of Total	3.0%	0.7%	3.7%
	16 other	Count	3	2	5
		% within Type of Household	4.1%	3.3%	3.7%
		% of Total	2.2%	1.5%	3.7%
Total		Count	73	61	134
		% of Total	54.5%	45.5%	100.0%

Table 7.16. Impact of shocks to income, assets, food production, food stocks and food purchases by household type.

		Type of Household					
		1 Non Fisher		2 Fisher		Total	
		Count	Column N %	Count	Column N %	Count	Column N %
How shocks affect income	increase	0	0.0%	0	0.0%	0	0.0%
	decrease	55	75.3%	52	85.2%	107	79.9%
	not change	18	24.7%	9	14.8%	27	20.1%
	Total	73	100.0%	61	100.0%	134	100.0%
How shocks affect assets	1 increase	0	0.0%	0	0.0%	0	0.0%
	2 decrease	39	53.4%	40	65.6%	79	59.0%
	3 not change	34	46.6%	21	34.4%	55	41.0%
	Total	73	100.0%	61	100.0%	134	100.0%
How shocks affect food production	1 increase	0	0.0%	0	0.0%	0	0.0%
	2 decrease	73	100.0%	58	95.1%	131	97.8%
	3 not change	0	0.0%	3	4.9%	3	2.2%
	Total	73	100.0%	61	100.0%	134	100.0%
How shocks affect food stocks	1 increase	0	0.0%	1	1.6%	1	0.7%
	2 decrease	73	100.0%	56	91.8%	129	96.3%
	3 not change	0	0.0%	4	6.6%	4	3.0%
	Total	73	100.0%	61	100.0%	134	100.0%
How shocks affect food purchases	1 increase	29	39.7%	33	54.1%	62	46.3%
	2 decrease	36	49.3%	17	27.9%	53	39.6%
	3 not change	8	11.0%	11	18.0%	19	14.2%
	Total	73	100.0%	61	100.0%	134	100.0%

Table 7.17. Average Number of Meals per Day by Household Member and Village.

			How many meals per day for male adult	How many meals per day for female adult	How many meals per day for male children	How many meals per day for female children
Household Type	Non Fish Farming	N	75	75	75	75
		Mean (SE)	1.55 (.123)	1.91 (.097)	1.56 (.122)	1.51 (.132)
	Fish Farming	N	62	62	62	62
		Mean (SE)	1.73 (.115)	1.98 (.096)	1.40 (.133)	1.44 (.145)
Village	Makawa	N	63	63	63	63
		Mean (SE)	1.73 (.107)	1.79 (.099)	1.24 (.123)	1.41 (.137)
	Malundu	N	74	74	74	74
		Mean (SE)	1.54 (.129)	2.07 (.093)	1.70 (.124)	1.53 (.138)
	Total	N	137	137	137	137
		Mean (SE)	1.63 (.085)	1.94 (.069)	1.49 (.090)	1.47 (.097

Table 7.18. Fish Consumption by Species and Household and Village Type.

			Type of Household			Village		
			Non Fish Farming	**Fish Farming**	**Total**	**Makawa**	**Malundu**	**Total**
Fish Species Consumed in Past 7 Days[a]	**Chambo**	Count	5	13	18	12	6	18
		% within TypeHH	9.4%	27.1%		29.3%	10.0%	
		% of Total	5.0%	12.9%	17.8%	11.9%	5.9%	17.8%
	Bonya	Count	6	0	6	0	6	6
		% within TypeHH	11.3%	0.0%		0.0%	10.0%	
		% of Total	5.9%	0.0%	5.9%	0.0%	5.9%	5.9%
	Dondolo	Count	1	1	2	0	2	2
		% within TypeHH	1.9%	2.1%		0.0%	3.3%	
		% of Total	1.0%	1.0%	2.0%	0.0%	2.0%	2.0%

Makumba	Count	1	0	1	0	1	1
	% within TypeHH	1.9%	0.0%		0.0%	1.7%	
	% of Total	1.0%	0.0%	1.0%	0.0%	1.0%	1.0%
Matemba	Count	27	24	51	25	26	51
	% within TypeHH	50.9%	50.0%		61.0%	43.3%	
	% of Total	26.7%	23.8%	50.5%	24.8%	25.7%	50.5%
Mbaba	Count	1	2	3	0	3	3
	% within TypeHH	1.9%	4.2%		0.0%	5.0%	
	% of Total	1.0%	2.0%	3.0%	0.0%	3.0%	3.0%
Ncheni	Count	0	2	2	0	2	2
	% within TypeHH	0.0%	4.2%		0.0%	3.3%	
	% of Total	0.0%	2.0%	2.0%	0.0%	2.0%	2.0%
Mlamba	Count	11	15	26	13	13	26
	% within TypeHH	20.8%	31.3%		31.7%	21.7%	
	% of Total	10.9%	14.9%	25.7%	12.9%	12.9%	25.7%
Mputa	Count	1	0	1	0	1	1
	% within TypeHH	1.9%	0.0%		0.0%	1.7%	
	% of Total	1.0%	0.0%	1.0%	0.0%	1.0%	1.0%
Njole	Count	1	0	1	0	1	1
	% within TypeHH	1.9%	0.0%		0.0%	1.7%	
	% of Total	1.0%	0.0%	1.0%	0.0%	1.0%	1.0%
Usipa	Count	7	9	16	2	14	16
	% within TypeHH	13.2%	18.8%		4.9%	23.3%	
	% of Total	6.9%	8.9%	15.8%	2.0%	13.9%	15.8%
Utaka	Count	3	3	6	0	6	6
	% within TypeHH	5.7%	6.3%		0.0%	10.0%	
	% of Total	3.0%	3.0%	5.9%	0.0%	5.9%	5.9%
Makakana	Count	1	0	1	0	1	1
	% within TypeHH	1.9%	0.0%		0.0%	1.7%	
	% of Total	1.0%	0.0%	1.0%	0.0%	1.0%	1.0%
Njolinjo	Count	0	1	1	0	1	1
	% within TypeHH	0.0%	2.1%		0.0%	1.7%	
	% of Total	0.0%	1.0%	1.0%	0.0%	1.0%	1.0%
Nthibidi	Count	1	0	1	0	1	1

	% within TypeHH	1.9%	0.0%		0.0%	1.7%	
	% of Total	1.0%	0.0%	1.0%	0.0%	1.0%	1.0%
Total	Count	53	48	101	41	60	101
	% of Total	52.5%	47.5%	100.0%	40.6%	59.4%	100.0%

Percentages and totals are based on respondents.

a. Dichotomy group tabulated at value 1.

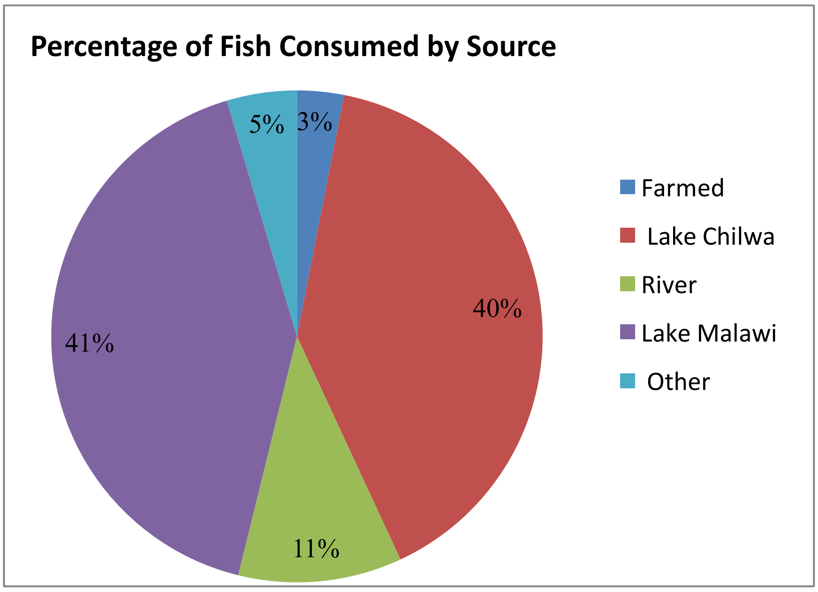

Figure 7.15. Household Fish Consumption by Source.

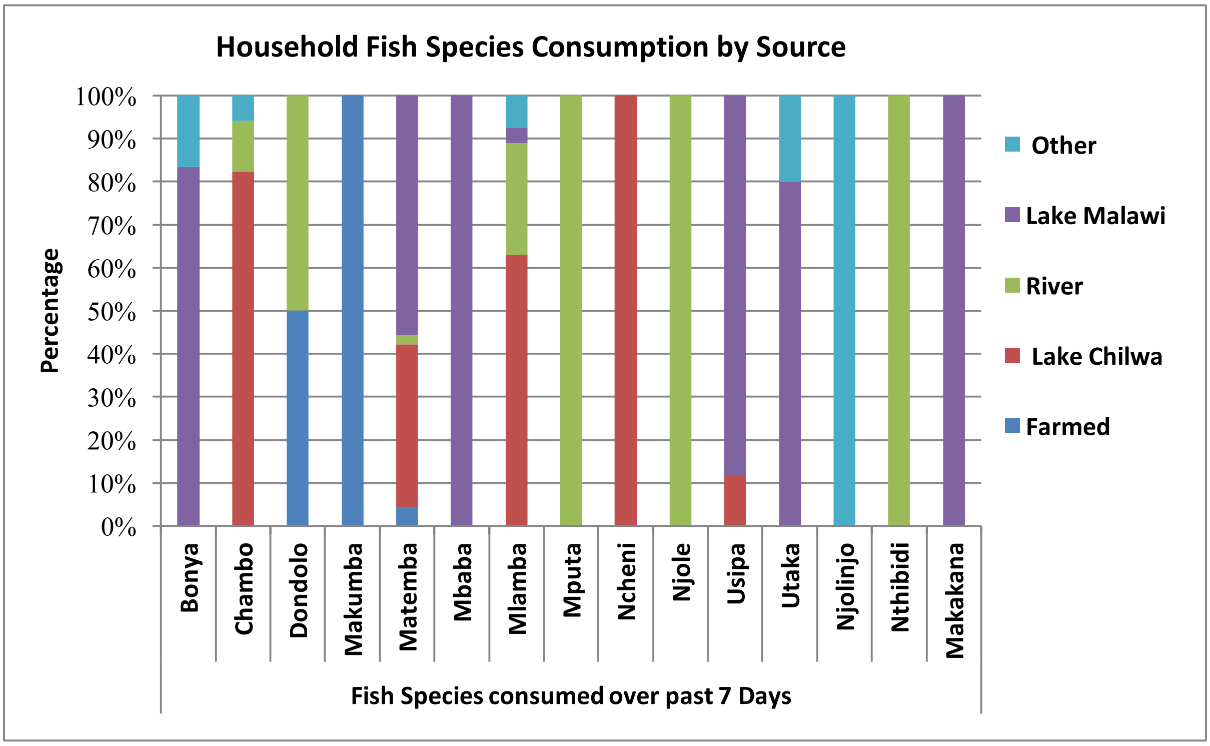

Figure 7.16. Fish Consumption by Species and Source.

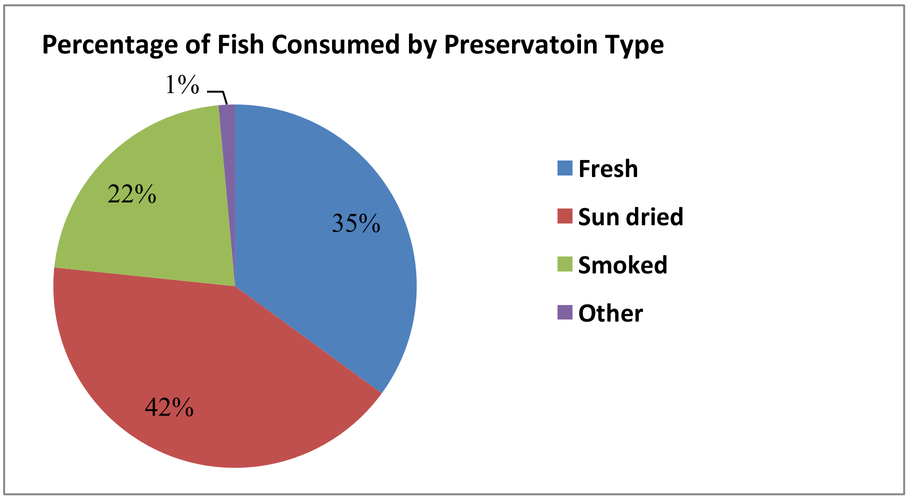

Figure 7.17. Household Fish Consumption by Fish Preservation Type.

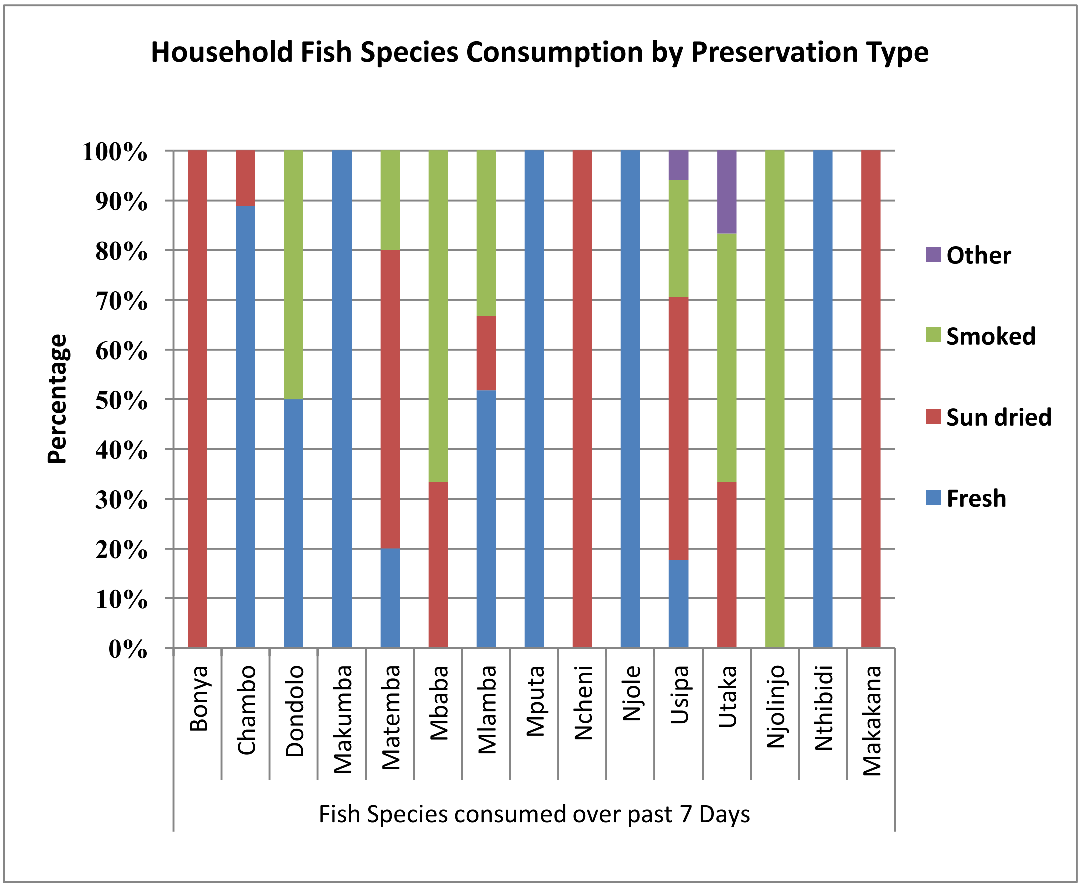

Figure 7.18. Household Fish Species Consumption by Preservation Type.

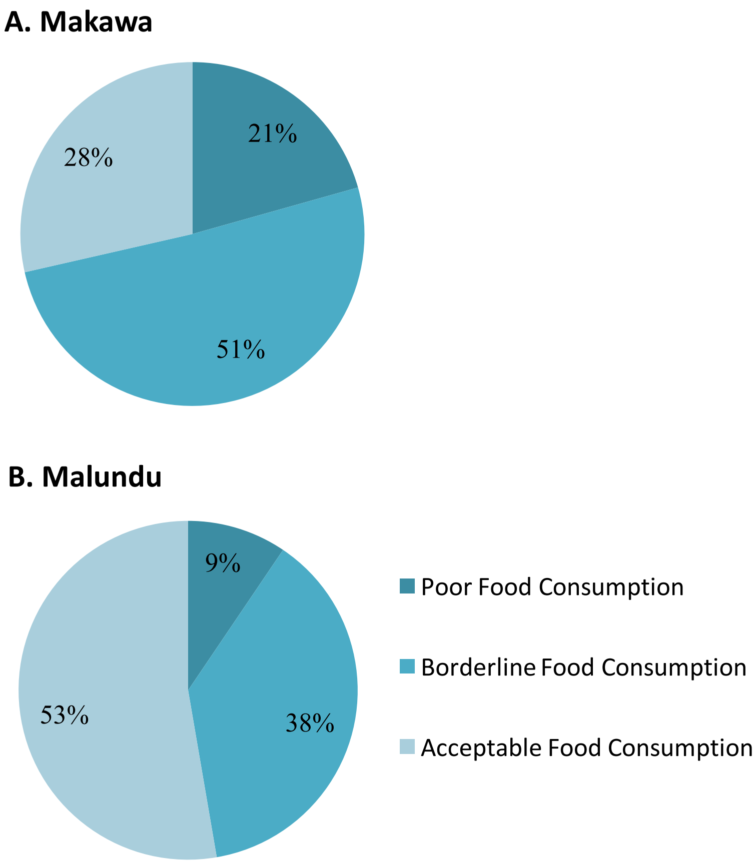

Figure 7.19. Food Consumption Scores according to Food Consumption Groups (a) households from Makawa; and (b) households from Malundu.

Table 7.19. Household Fish Species Consumption Preference by Household Type and Village

			Type of Household			Village		
			Non Fish Farming	Fish Farming	Total	Makawa	Malundu	Total
Household preferred fish to eat	Chambo	Count	22	23	45	30	15	45
		% within Type of Household	29.7%	37.7%	33.3%	49.2%	20.3%	33.3%
		% of Total	16.3%	17.0%	33.3%	22.2%	11.1%	33.3%
	Matemba	Count	11	14	25	17	8	25
		% within Type of Household	14.9%	23.0%	18.5%	27.9%	10.8%	18.5%
		% of Total	8.1%	10.4%	18.5%	12.6%	5.9%	18.5%
	Mbaba	Count	0	1	1	0	1	1
		% within Type of Household	0.0%	1.6%	0.7%	0.0%	1.4%	0.7%
		% of Total	0.0%	0.7%	0.7%	0.0%	0.7%	0.7%
	Mlamba	Count	25	15	40	11	29	40
		% within Type of Household	33.8%	24.6%	29.6%	18.0%	39.2%	29.6%
		% of Total	18.5%	11.1%	29.6%	8.1%	21.5%	29.6%
	Mputa	Count	1	0	1	0	1	1
		% within Type of Household	1.4%	0.0%	0.7%	0.0%	1.4%	0.7%
		% of Total	0.7%	0.0%	0.7%	0.0%	0.7%	0.7%
	Bonya	Count	3	1	4	0	4	4
		% within Type of Household	4.1%	1.6%	3.0%	0.0%	5.4%	3.0%
		% of Total	2.2%	0.7%	3.0%	0.0%	3.0%	3.0%
	Njole	Count	2	0	2	0	2	2

		% within Type of Household	2.7%	0.0%	1.5%	0.0%	2.7%	1.5%
		% of Total	1.5%	0.0%	1.5%	0.0%	1.5%	1.5%
	Usipa	Count	3	2	5	1	4	5
		% within Type of Household	4.1%	3.3%	3.7%	1.6%	5.4%	3.7%
		% of Total	2.2%	1.5%	3.7%	0.7%	3.0%	3.7%
	Utaka	Count	3	2	5	0	5	5
		% within Type of Household	4.1%	3.3%	3.7%	0.0%	6.8%	3.7%
		% of Total	2.2%	1.5%	3.7%	0.0%	3.7%	3.7%
	Dondolo	Count	3	0	3	0	3	3
		% within Type of Household	4.1%	0.0%	2.2%	0.0%	4.1%	2.2%
		% of Total	2.2%	0.0%	2.2%	0.0%	2.2%	2.2%
	Other	Count	1	3	4	2	2	4
		% within Type of Household	1.4%	4.9%	3.0%	3.3%	2.7%	3.0%
		% of Total	0.7%	2.2%	3.0%	1.5%	1.5%	3.0%
Total		Count	74	61	135	61	74	135
		% within Type of Household	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	54.8%	45.2%	100.0%	45.2%	54.8%	100.0%

Table 7.20 Household Constraints to Accessing Fish for Consumption by Household Type and Village.

			Type of Household			Village		
			Non Fish Farming	Fish Farming	Total	Makawa	Malundu	Total
Household faced any constraints with accessing fish past 12 months reason	Low production / catch	Count	1	2	3	2	1	3
		% within Type of Household	1.7%	4.2%	2.8%	3.5%	2.0%	2.8%
		% of Total	0.9%	1.9%	2.8%	1.9%	0.9%	2.8%
	Fish too expensive to buy	Count	35	26	61	37	24	61
		% within Type of Household	58.3%	54.2%	56.5%	64.9%	47.1%	56.5%
		% of Total	32.4%	24.1%	56.5%	34.3%	22.2%	56.5%
	Fish not available at market	Count	4	3	7	4	3	7
		% within Type of Household	6.7%	6.3%	6.5%	7.0%	5.9%	6.5%
		% of Total	3.7%	2.8%	6.5%	3.7%	2.8%	6.5%
	Too expensive to travel to market	Count	14	9	23	3	20	23
		% within Type of Household	23.3%	18.8%	21.3%	5.3%	39.2%	21.3%
		% of Total	13.0%	8.3%	21.3%	2.8%	18.5%	21.3%
	No money to purchase fish	Count	3	7	10	8	2	10
		% within Type of Household	5.0%	14.6%	9.3%	14.0%	3.9%	9.3%
		% of Total	2.8%	6.5%	9.3%	7.4%	1.9%	9.3%
	No access to Lake (closed/dry)	Count	2	1	3	3	0	3
		% within Type of Household	3.3%	2.1%	2.8%	5.3%	0.0%	2.8%
		% of Total	1.9%	0.9%	2.8%	2.8%	0.0%	2.8%
	Other	Count	1	0	1	0	1	1

	% within Type of Household	1.7%	0.0%	0.9%	0.0%	2.0%	0.9%
	% of Total	0.9%	0.0%	0.9%	0.0%	0.9%	0.9%
Total	Count	60	48	108	57	51	108
	% within Type of Household	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	55.6%	44.4%	100.0%	52.8%	47.2%	100.0%

Table. 7.21. Household Food Insecurity Coping Strategies Employed over the Past 12 Months by Household Type and Village.

			Type of Household		Village		
			Non Fisher	Fisher	Makawa	Malundu	Total
Food Insecurity Coping Strategies[a]	HH rely on less preferred/expensive foods	Count	49	34	43	40	83
		% of Total	54.4%	37.8%	47.8%	44.4%	92.2%
	HH borrow or rely on help	Count	39	28	36	31	67
		% of Total	43.3%	31.1%	40.0%	34.4%	74.4%
	HH purchase food on credit	Count	25	13	23	15	38
		% of Total	27.8%	14.4%	25.6%	16.7%	42.2%
	HH gather, hunt or harvest food	Count	29	24	32	21	53
		% of Total	32.2%	26.7%	35.6%	23.3%	58.9%
	HH intensify fishing, processing, trading	Count	6	1	3	4	7
		% of Total	6.7%	1.1%	3.3%	4.4%	7.8%
	HH intensify fish farming	Count	0	3	1	2	3
		% of Total	0.0%	3.3%	1.1%	2.2%	3.3%
	HH fish during closed seasons	Count	0	1	0	1	1
		% of Total	0.0%	1.1%	0.0%	1.1%	1.1%
	HH intensify other livelihood activities	Count	18	22	30	10	40
		% of Total	20.0%	24.4%	33.3%	11.1%	44.4%
	HH consume seed stock	Count	33	25	31	27	58

		% of Total	36.7%	27.8%	34.4%	30.0%	64.4%
	HH send members to eat elsewhere	Count	23	7	15	15	30
		% of Total	25.6%	7.8%	16.7%	16.7%	33.3%
	HH send members to beg	Count	15	4	8	11	19
		% of Total	16.7%	4.4%	8.9%	12.2%	21.1%
	HH limit portion sizes at mealtimes	Count	48	30	42	36	78
		% of Total	53.3%	33.3%	46.7%	40.0%	86.7%
	HH restrict consumption by adults for children to eat	Count	34	27	36	25	61
		% of Total	37.8%	30.0%	40.0%	27.8%	67.8%
	HH feed working members only	Count	6	6	7	5	12
		% of Total	6.7%	6.7%	7.8%	5.6%	13.3%
	HH reduce no of meals eaten in a day	Count	41	34	40	35	75
		% of Total	45.6%	37.8%	44.4%	38.9%	83.3%
	HH skip days without eating	Count	23	13	19	17	36
		% of Total	25.6%	14.4%	21.1%	18.9%	40.0%
	HH do nothing	Count	1	0	1	0	1
		% of Total	1.1%	0.0%	1.1%	0.0%	1.1%
Total		Count	52	38	47	43	90
		% of Total	57.8%	42.2%	52.2%	47.8%	100.0%

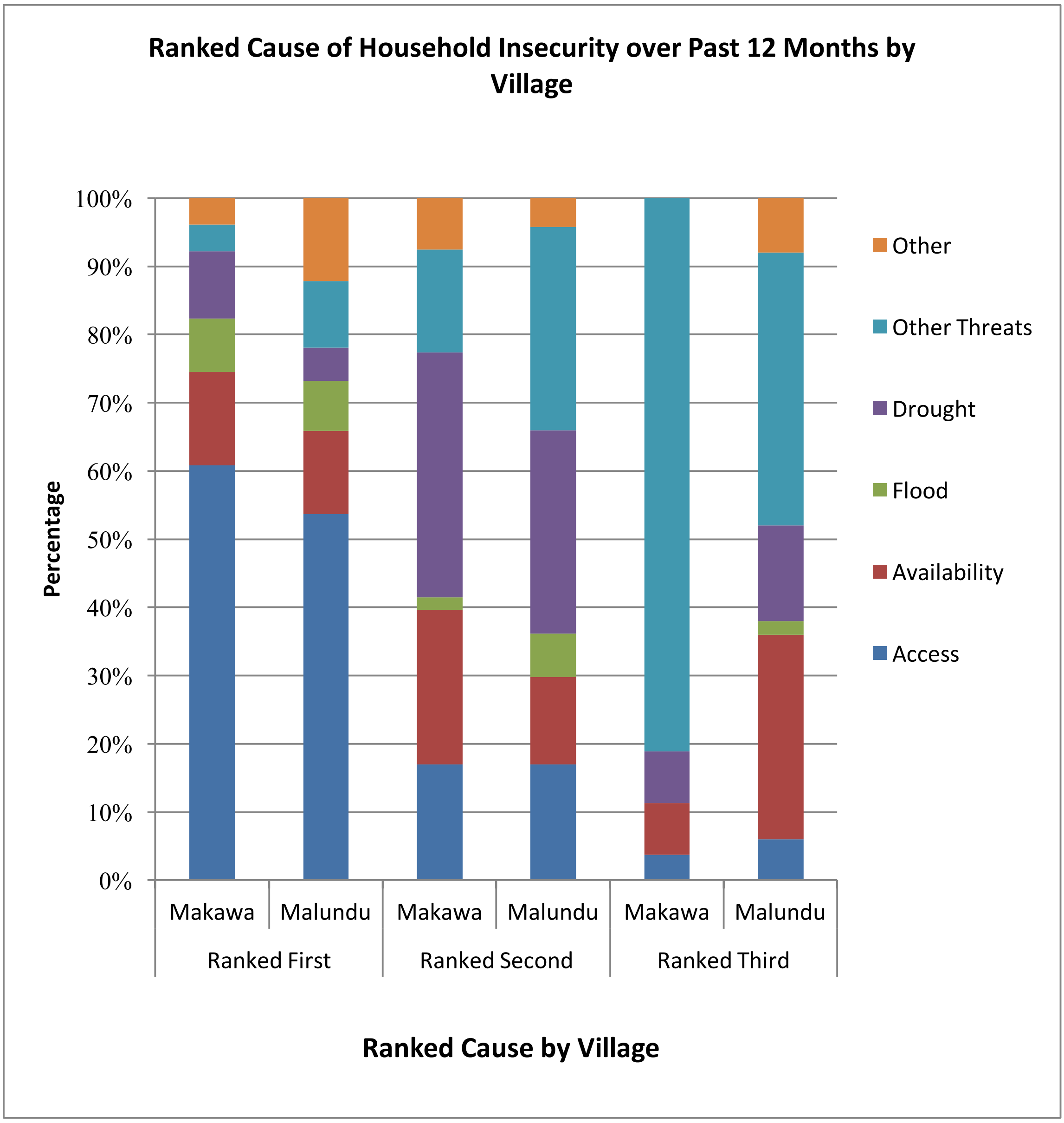

Figure 7.20. Ranked Causes of Household Food Insecurity over the Past 12 Months by Village- (Category 'Access' includes: reduction in income, market transport cost, food at the market too expensive, closed season; Category 'Availability' includes: not available at market, too small land, lack of farm inputs; Category 'Other Threats' includes: livestock disease, crop pest damage, theft).

Table. 7.22**. Food Groups Affected by Causes of Household Food Insecurity over the Past 12 Months by Household Type and Village.**

			Type of Household		Village		
			Non Fisher	Fisher	Makawa	Malundu	Total
Food Groups Impacts[a]	Vegetables	Count	2	1	2	1	3
		% within TypeHH	3.6%	2.8%	4.1%	2.3%	
		% of Total	2.2%	1.1%	2.2%	1.1%	3.3%
	Pulses	Count	14	16	12	18	30
		% within TypeHH	25.0%	44.4%	24.5%	41.9%	
		% of Total	15.2%	17.4%	13.0%	19.6%	32.6%
	Cereals	Count	55	36	48	43	91
		% within TypeHH	98.2%	100.0%	98.0%	100.0%	
		% of Total	59.8%	39.1%	52.2%	46.7%	98.9%
Total		Count	56	36	49	43	92
		% of Total	60.9%	39.1%	53.3%	46.7%	100.0%

Appendix L

Fish species in Malawi.

Local Name	Family	Scientific Name	Source(s)
Chambo (called Kasawala when very small)	Cichlidae	*Oreochromis karongae Oreochromis squamipinnis Oreochromis lidole*	Lake Chilwa River Shire Lake Malawi Aquaculture
Dondolo	Cichlidae	*Docimodus spp.*	Lake Malawi Upper Shire
Makakana	Cichlidae	*Oreochromis mossambicus Oreochromis placidas*	Lower Shire Aquaculture
Makumba	Cichlidae	*Oreochromis shiranus chilwae Oreochromis shiranus shiranus*	Lake Chilwa Aquaculture
Matemba	Cyprinidae	*Barbus paludinosus*	Lake Chilwa Aquaculture
Mbaba	Cichlidae	*Buccochromis spp.*	Lake Malawi
Mlamba	Clariidae	*Clarias spp.*	Lake Chilwa Aquaculture Lake Malawi
Mputa	Mormyridae	*Petrocephalus spp. (catostoma)*	

			Lake Malawi River Shire
Ncheni	Cichlidae	*Rhamphochromis spp.*	Lake Malawi
Njole	Cyprinidae	*Labeo altivelis*	Lake Malawi River Shire
Njolingo	Unknown	*Unknown*	Unknown
Nthibidi	Unknown	*Unknown*	Unknown
Usipa (also Bonya)	Cypranidae	*Engraulicypris sardella*	Lake Malawi
Utaka	Cichlidae	*Copadichromis spp.*	Lake Malawi

Appendix M

Comparison of published weightings of six food coping behaviours

Table 8.12. Comparison of published weightings of six food coping behaviours from sub-Saharan Africa with perceived severity as reported by surveyed households within this report.

Coping behaviour	Maxwell 1996, 3-point scale[a]	Darling 2014, 3-point scale[b]	This Study's Findings, 3-point scale[c]
Eating less preferred foods	1	2.07 (0.80)	2.74 (0.64)
Limiting portion sizes	1	1.95 (0.77)	2.77 (0.59)
Borrowing food or money to buy food	2	2.23 (0.86)	2.86 (0.48)
Preparing food only for the children	2	2.21 (0.81)	2.83 (0.53)
Skipping meals	2	1.97 (0.83)	2.86 (0.49)
Going without food for whole days	3	2.71 (0.55)	3.00

[a]1 is least severe and 3 is most severe

[b]Mean (standard deviation) of 113 responses on a 3-point scale

[c]Mean (standard deviation) of 137 responses on a 3-point scale

Appendix N

A Summary of major conferences and activities carried out during the course of the PhD to share research.

- Presentation and panel member at the inaugural Global Conference on Inland Fisheries, Freshwater, Fish and the Future, organised by FAO and Michigan State University (MSU), in January 2015. Attendees including fisheries and aquaculture stakeholders world-wide.
- Development and sharing of the YouTube Video 'Malawi's Fisheries Sector' (https://www.youtube.com/watch?v=vJgngY4TRH8) online and at several international conferences, including the Global Conference on Inland Fisheries, the World Universities Network (WUN) Annual Meeting, the World Aquaculture Society (WAS) inaugural conference in Cape Town, Africa.
- Presentation at the ESPA Fisheries Working Group, London, UK, February 2017. Attendees including fisheries and aquaculture stakeholders.
- Presentation at the World Aquaculture Society (WAS) inaugural conference in Cape Town, Africa, June 2017. Attendees including fisheries and aquaculture stakeholders from Africa and international.
- Presentation at the UN Oceans Conference (SDG 14), New York, USA, June 2017.
- Presentation at the ESPA ASSETS project workshop, Malawi, July, 2017. Attendees including fisheries and aquaculture stakeholders from Malawi and international.
- Presentation at the Resilience 2017 Conference, Stockholm Sweden, August, 2017. Attendees including fisheries and aquaculture stakeholders from Malawi and international.

Appendix O

SSEGM ETHICS SUB-COMMITTEE APPLICATION FORM

1. Name(s): Alison Simmance

2. Current Position Post Graduate Researcher

3. Contact Details:

Division/School Social Statistics and Demography

Email as42g08@soton.ac.uk

4. Is your study being conducted as part of an education qualification?

✓ **Yes** ☐ **No** ☐

5. If Yes, please give the name of your supervisor

Professor Nyovani Madise

6. Title of your project:

Sustainable Livelihoods: the value of small-scale aquaculture in Southern Malawi to food and nutritional security

7. Briefly describe the rationale, study aims and the relevant research questions of your study

The purpose of this project is to understand the role of small-scale aquaculture in the context of sustainable livelihoods of rural populations in the Southern District of Zomba, Malawi.

This is a 4 year interdisciplinary PhD project under the ESRC pathway 'Energy, Environment and Resilience'. Given that the sustainable development of aquaculture is dependent upon the political, economic, social and environmental parameters contextualizing the sector, this PhD is guided by interdisciplinary perspectives from both natural and social sciences. A brief summary of the project is provided as follows:

Malawi's rural population faces increasing livelihood pressures from the accumulative impacts of food insecurity, unemployment, environmental degradation, HIV/AIDS and increased climate variability. As the shortage of arable land limits agricultural expansion and due to the absence of livelihood alternatives in urban areas, the best hope for improving rural Malawian livelihoods comes from increasing the productivity of existing rural land and water resources. Of particular importance is the need for greater availability of fish as a source of protein and high quality micro-nutrients.

With the decline of capture fisheries supplies and population growth, the government is promoting investment in aquaculture in order to help increase the supply of fish nationwide. Over the past 30 years, a variety of donor investments in smallholder aquaculture in Malawi has resulted in an increase in production of farmed fish from est. 800t in 2006 to 3,000t in 2012. Although increasing evidence reveals that the introduction of smallholder aquaculture has had a substantial impact on food security and nutrition of participating households, there are limited empirical studies that measure the long-term impacts of aquaculture, particularly in relation to the last decade of rapid growth and policy change.

The project will be guided by the conceptual Sustainable Livelihoods Framework. The project aims to understand the relationship between aquaculture and food and nutritional security which will be investigated via the following research objectives and questions:

1. To determine and characterise the current status and challenges of the aquaculture sector in Malawi.
    - 1.a. What is the current status of and challenges faced by the aquaculture sector?
2. To understand and describe production trends, shocks, seasonality and management characteristics of aquaculture systems.
    - 2.a. What are the production trends, shocks, seasonal characteristics and constraints experienced by fish farmers involved in both cluster and single aquaculture systems?
    - 2.b. What is the role of gender in aquaculture and do differences exist between men and women in relation to perceived benefits and challenges experienced from aquaculture?
3. To determine the impact of aquaculture on the livelihoods of fish farmers and the extent to which it contributes to household food and nutritional security.
    - 3.a. What is the livelihood status of those households involved in fish farming and non-fishing farming households?
    - 3.b. What is the role of farmed fish to household food security and food consumption patterns?
4. To understand organisational and institutional factors relating to aquaculture and assess how they influence livelihood outcomes arising from aquaculture?

- 4.a. What are the current policies and regulations governing the aquaculture sub-sector and how effective are they?
- 4.b. What institutional processes and organisations do fish farmers have access to and do they influence outcomes arising from aquaculture?

5. To understand the sustainability of active aquaculture systems via assessing suitable spatial environmental and social factors. The assessment will draw on spatial analysis using GIS.
   - 5.a. What environmental, social and economic factors affect the long-term viability of small scale aquaculture?
   - 5.b. Is the current distribution/zonation of aquaculture operations in Zomba located in favourable sites as determined by social-environmental factors?

8. Describe the design of your study

This application refers to the second and final phase of field work of this project.

Building on phase I of this study (completed in July, 2014) which used Key Informant Interviews and secondary data to address objective 1, this phase of the study will use a mixed methods approach to address objectives 2-4.

The study will take place in Zomba district in Southern Malawi, where the University of Southampton are conducting a 4-year study on Ecosystem Services and Food security (the ASSETS project) (PI Guy Poppy, Co-I, N Madise). Two case study villages, Mawilra (TA Mlumbe, Chingale Area) and Lobeni (TA Kuntumanje), have been purposively selected, based on their intensity of aquaculture operation which is measured by the number of aquaculture ponds in the homestead (low intensity= <5 single ponds; high intensity= >5 single ponds known as cluster fish farms), age of aquaculture operation (>5 years old) and distance from Lake Chilwa. Two other villages, Kuyikanga (TA Mlumbe) and Kalino (TA Kuntumanje), have been selected as reserves. Finalization of village selection will be undertaken in the field with further confirmation from the District Officer and local Fisheries Officer that the villages will still meet the criteria after the floods in January and February, and with acceptance of the Village Headman for two villages.

Methods will include:

a) Quantitative surveys- household and fisher farmer surveys to address objective 2, 3, 4; and
b) Qualitative methods- the Photo-Voice methodology. To address objective 2.

The mixed methods approach will allow triangulation in that the weaknesses of one will be supported by the strengths of another. Adopting an interdisciplinary and mixed methods approach is widely viewed as an effective approach when investigating the relationships between aquaculture and livelihoods.

Quantitative House Hold Surveys: the aim of the household questionnaire is to address objective 3 (questions 3a, b). I intend to sample a total of 160 households from my two case study fish farming villages to investigate the role of fish to household food security and livelihoods of fish farmers and non-fish farmer's households located in the district of Zomba.

Selection of HHs: I will first of all do a listing of households in my selected case study villages and will use a short filter questionnaire with a key village informant to identify households involved in fish farming and those not. The listing of households will be drawn from key informants in the village. Typical villages in Zomba are between 20 – 200 households. Then I will stratify the households by involvement in fish farming (yes or no). From the fish farming group, I will aim to select 50 households. I will select these households using a random number generator. Similarly from the non-fish farming group I will select 50 households using random number generator. I intend to sample a total 100 households from the high intensity cluster fish farming village Mawilra. Within the low intensity case study fish farming village (Lobeni), it is highly likely that only a few households may be involved in fish farming. For this reason, a lower sample of a total 60 households will be selected from Lobeni. Data obtained from the ASSETS project will be used as additional sources of data to supplement the data gathered for this study.

Household Members Targeted: As stated above, households will be stratified by involvement in fish farming (yes or no). From the fish farming group, the adult member of the household involved in fish farming will be targeted. From the non-fish farming group, the head of household will be targeted.

The household surveys will be mostly closed questions, giving opinion, ranking the statements and multiple choice options where applicable. A limited number of open-ended questions will be included, for example if participants need to specify options outside those given in the question. The questionnaire will be carried out in the two case study fish farming villages located in the district of Zomba. Households will be sampled according to participation in fish farming. The questionnaire is comprised of 11 sections, designed in accordance with the Sustainable Livelihoods Framework.

Quantitative fish farmer surveys: the aim of the fish farmer questionnaire is to address objective 2 (question 2a) and 4 (question 4b). The fish farmer questionnaire will be administered to all households involved in fish farming (as an additional module to the HHS).

A pilot test will be carried out in the field to ensure that both the Household and Fish Farmer questionnaires will be conducted smoothly, with a set time, that questions are easily understood and response categories appropriate.

The translator will lead in administering the quantitative survey and I will observe. After introductions to the purpose of the survey and the team, participants will be asked if it is ok for me to attend the interviewers. If they say no, I will leave, but from the experience of other Southampton PhD students who are doing research in the same locality, this is unlikely to be a problem.

A modified Photo-Voice methodology will be used as a qualitative tool to access the views and experiences of women and men involved in the fish farming through the use of photography and voice. The target group will be adult women and men involved in fish farming who will be purposively selected from each of the two case study villages. A small group of women and men- approx. 5- will be selected and each participant will be given a disposable camera to capture their experiences of their involvement in aquaculture and values of the fish farm to their livelihood. An interview will then be carried out separately with men and women participants to develop a narrative behind the photos and gather an in-depth understanding about the participant's views and experiences.

For the Photo-Voice methodology, I will lead with the aid of the translator who will a) translate my questions into Chichewa to the participant; and b) relay back the response from Chichewa to English to me. The Photo-Voice interview will be recorded with the use of a Dictaphone and later transcribed into English.

I plan to spend approximately one month working with each village. By spending time within each community, it is hoped that a level of confidence and trust will be earnt by the researcher so that community members will feel confident with discussing characteristics of the fish farm, their livelihoods and perceptions of organizational and institutional factors.

The data obtained from this study will be analyzed quantitatively and qualitatively. The software- SPSS and NVivo- will be used to analyze the data obtained.

Please note that the surveys and tools attached are to be finalized after piloting in the field.

Summary of total numbers of study participants: 160 households will be sampled for the purpose of administering the quantitative questionnaire (100 in one village, 60 in the second village). In addition, approx. 10 participants will be sampled for the purpose of administering the Photo-Voice methodology (5 participants in each of the two villages). Total estimated number of participants is 170.

9. Who are the research participants?

The proposed samples will be adult members (above 16 years) of fish farming communties and adults who are involved in aquaculture operations.

10. If you are going to analyse secondary data, from where are you obtaining it?

Secondary will be obtained from the existing collaborator- the WorldFish Centre- as well as from the Department of Fisheries.

11. If you are collecting primary data, how will you identify and approach the participants to recruit them to your study?

Please upload a copy of the information sheet if you are using one – or if you are not using one please explain why.

Case study fish farming villages will be purposively selected and identified with assistance from experts from the WorldFish office, Malawi (an existing collaborator to this project). Once two villages have been selected based on technical and logistic criteria, participants will be approached through traditional community leaders who will be approached with the assistance from local authority extension workers. If recruitment is insufficient, alternative village case studies will be found. A letter of invitation for members of the community to participate in this project, accompanied by a summary of this project, will be provided to the traditional community leaders. Communication will also be assisted by experts from the WorldFish office in Malawi who have direct experience of working with a diverse range of local fishers and stakeholders in this field. As a researcher with a professional background in fisheries management, I have a good track record of success using this approach.

An information sheet will be provided to participants from each community and will also be covered verbally with the participants at the outset of the interview/survey. This information is scripted and is included in the Participant Information Sheet document.

12. Will participants be taking part in your study without their knowledge and consent at the time (e.g. covert observation of people)? If yes, please explain why this is necessary.

No

13. If you answered 'no' to question 13, how will you obtain the consent of participants?

Please upload a copy of the consent form if you are using one – or if you are not using one please explain why.

Participants will be briefed verbally regarding the nature of the study and what the interview or survey will involve when they are recruited, and this will be reiterated more fully at the start of the interview. A written information sheet and consent form will be used as part of the consent process. Consent will be obtained in either written or recorded verbally form according to the preferences/illiteracy of the participant, and the consent form will be constructed such that it can provide a script to this oral consent where this is appropriate.

14. Is there any reason to believe participants may not be able to give full informed consent? If yes, what steps do you propose to take to safeguard their interests?

When interviewing or carrying out the survey it is likely that the interviews will be conducted with the participation of an interpreter, which may affect the clarity of communication regarding consent. Attempts will be made to recruit an interviewer with experience of research, and the interpreter will be interviewed at the outset of the process which will help to establish the importance of consent through their own experience.

15. If participants are under the responsibility or care of others (such as parents/carers, teachers or medical staff) what plans do you have to obtain permission to approach the participants to take part in the study?

N/a.

16. Describe what participation in your study will involve for study participants. Please attach copies of any questionnaires and/or interview schedules and/or observation topic list to be used

Participants will be approached, either by the researcher and translator, or a community member (who has been asked to recruit participants) and will be informed of the research process (including what the research is about, time needed to participate and payment given) and asked if they would like to participate.

Consent will be given (see above) and the research will commence. Depending on the type of research, participants will be asked to give between 1.5 hours and half a day of their time. In line with other projects happening in the area and guidance from the University of Malawi Ethics Review Committee, participants will be given a small token of appreciation for their time (equivalent to the daily minimum wage). This approach has been adopted based on guidance given to the ASSETS project. The researcher will ask questions to the participants, which will be translated by the translator. The translator will then translate the resonses back to the researcher.

Participants will be asked to be interviewed individually or as part of a small group of approx. 5 people. The participatory nature of the Photo-Voice method will allow participants to discuss topics amongst themselves and with the researcher. During the HHS, participants will be asked more structured questions. The attached surveys and Photo-Voice schedule, will be used as a guide for the researcher in implementing the two methods- Photo-Voice and quantitative surveys. All methods be conducted with the aid of an interpreter, and the Photo-Voice discussions will be audio recorded.

Once the session is complete, the researcher will summarise the points made by participants, ask if participants have any questions or further items they wish to discuss, and then the researcher will thank the participants for their time, and make any payments necessary.

17. How will you make it clear to participants that they may withdraw consent to participate at any point during the research without penalty?

This will be made clear during the provision of information at the outset of the surveys/Photo-Voice as part of the consent process. It will be stated that the participants can withdraw their participation at any time while answering the questionnaire/Photo-Voice guided questions and there will not be any follow-up communication. At the conclusion of the surveys/Photo-Voice interviews, the participant will be informed that it has been completed and asked whether they are still happy for the conversation to be used as part of the research. Full personal contact details will be established for the individual to contact if they decide at a later date that they would prefer to withdraw their consent. In addition, details of a local point of contact kindly provided by my collaborator- the WorldFish Centre- will be provided so that this opportunity is accessible to them and the researcher can be informed.

18. Detail any possible distress, discomfort, inconvenience or other adverse effects the participants may experience, including after the study, and you will deal with this.

I do not expect any of the questions posed in my study to give distress. The questions that I will use have been used successfully many times by the Malawi National Statistical Office and other surveys.

19. How will you maintain participant anonymity and confidentiality in collecting, analysing and writing up your data?

Should participants wish to endorse anonymity and confidentiality with respect to their views expressed in the interviews/questionnaires, then pseudonyms will be used for all individuals' referred to in transcripts and all other research output so that the views of these individuals cannot be identified. Audio recordings, transcripts and other documents will be stored electronically and password protected. In any materials released (such as reports or articles) to the fishing community in Malawi or other interested parties external to an academic context, any quotes will be careful to not only use pseudonyms but also either avoid using or change any other identifying information such as dates, locations. The focus will be on the meaning attached to experiences and views rather than the historical content of these which could be linked back to the participant.

Translators participating in the study will sign a confidentiality agreement and be fully briefed prior to and following interviews, which will include clarifying confidentiality requirements of the study.

20. How will you store your data securely during and after the study?

> *The University of Southampton has a Research Data Management Policy, including for data retention. The Policy can be consulted at http://www.calendar.soton.ac.uk/sectionIV/research-data-management.html*

Data stored electronically will be password protected and stored on a laptop and backed up on a secure online location and in a hard drive for ten years (in accordance with section 5 of the Research Data Management Policy). The password will only be known to the researcher and supervisor. The laptop will be either in the direct supervision of the researcher or locked up at all times during the study.

Paper records will be kept to a minimum during the study, and will be kept in a locked location when not in use or while being transported. Personal information will only be included on printed information where it is essential (e.g. consent forms or interview schedules) and this will be either scanned for secure electronic storage and destroyed, or placed in locked storage, immediately after use.

After the study only electronic records of personal data will be retained and stored securely as above.

21. Describe any plans you have for feeding back the findings of the study to participants.

Participants will be offered the opportunity to receive a summary of the findings following the research, which may be provided by email or telephone.

22. What are the main ethical issues raised by your research and how do you intend to manage these?

Matters around subject area-

There may be particular ethical sensitivities that arise when reflecting on livelihood and fishing activity experiences. Some of the questions will be asking for the participants' opinions and reflection on livelihood and fishing activity experiences as well as personal details. Participants may feel un-easy to answer these questions. However, the voluntary nature of the methods will enable the participant to stop or move on within the interview/survey questions. For this reason, the process of endorsing confidentiality will be transparent.

Matters around participants-

English and Chichewa are the Malawi's two official languages. It is anticipated that the majority of participants will speak Chichewa. As a result, interviews and surveys will be carried out with a translator, scripts will be translated into Chichewa and visual aids will be provided to guide all methods. This study will choose an effective translator with research experience and will brief the translator in advance to ensure all questions and an explanation of the project is understood.

Location of participation-

There are potential issues that might arise when working in a developing country like Malawi. Malawi is a tropical country where there is a relatively high instance of food, water and insect borne diseases and higher prevalence of HIV than in the UK. Water bodies in Malawi also have a high prevalence of the water borne disease – bilharzia – and as such there is a heightened risk of exposure to this disease due to the nature of the research involving visits to aquatic resources. To minimise these risks, comprehensive travel insurance will be in place and immunisation/anti-malarial programmes will be followed (as detailed in the attached risk assessment and international risk assessment forms).

In accordance with FCO advice, sensitivity to local traditions, cultures, laws and religions will be maintained at all times which include covering legs and shoulders to avoid offending local sensitivities. In the post-election environment all large gatherings will avoided and I will monitor the local media as advised by the FCO. A very low risk of threat is expected as highlighted by the recent FCO advice.

Positively, it is hoped that this second and final phase of the project will provide in-depth understanding of the role of fisheries to livelihoods in the context of food and nutritional security. The rich and interdisciplinary information obtained will provide valuable knowledge to address the objectives of this PhD study.

23. Please outline any other information you feel may be relevant to this submission.

In the context of much international work, personal relationships and in the field contacts are paramount in the success of any project. This PhD study is linked with the University of Southampton led ASSETS project which involves collaborators with two organisations in Malawi- the WorldFish Centre and LEAD. This project is fortunate to have gained the support of both organisations with the lead collaborator being Joseph Nagoli from the WorldFish Centre. My colleague Joseph Nagoli has been engaged in this project right from the beginning and has kindly provided support in the selection of villages and in securing arrangements, such as office space, in the field.

I carried out the first phase of data collection in Malawi last year. Having visited the field site and successfully completing the objectives of phase I, I feel confident and have strong competencies to carry the proposed methods of this final phase.

In addition, I have undertaken professional and voluntary work in Kenya and Madagascar within the same field of research, and am accustomed to the logistical complications, safety precautions and cultural awareness that are essential to operating in a sub-Saharan African environment. I also have a successful track record of working with different organisations and diverse teams through my experience in Madagascar and Kenya.

It is possible that my gender and role as a PhD student may affect the willingness of stakeholders to participate in my research as well as my relationship with research participants. Nevertheless, in this study I will respect local customs and translate my research aims effectively.

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