

**Forging pathways to sustainable food systems and rural poverty
reduction: Insights from a social and economic value chain analysis
of aquaculture in the Bolivian Amazon**

by

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M.R.D., Brandon University, 2012
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**A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree of**

Doctor of Philosophy

in the Department of Geography

University of Victoria

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Abstract

Increasing the social, economic, and environmental sustainability of food systems while making them productive enough to feed a future global population of 9 billion is one of the most significant challenges facing humanity. Aquaculture is touted as a food system that can make a profound contribution to this challenge, but much more research is needed to understand how it can develop sustainably. In central Bolivia, an aquaculture system is emerging that is generating opportunities for empowerment, food security, and poverty reduction. However, pathways that lead to the capture of these opportunities while avoiding challenges are not well defined. It is also unclear how the trajectory of growth can be supported so that aquaculture in the region can sustainably contribute to rural development. The purpose of this study, therefore, was to determine how rural small-scale aquaculture systems can contribute to food production while also being environmentally, socially, and economically sustainable. To do so, a new holistic value chain analysis that incorporates horizontal linkages (gender, food security, poverty analysis, and socio-political context) was developed and utilized. It included semi-structured interviews with 40 central Bolivian aquaculture producers, 40 farmers who did not produce aquaculture fish, 26 people employed in the aquaculture value chain, and 18 aquaculture system key informants.

The study found that aquaculture in central Bolivia tends to have a positive effect on system participants and has a low environmental impact. It also identified improvements that the system could make to improve its productivity and sustainability. Beyond the central Bolivian aquaculture system specifically, the research makes an important and valuable contribution to knowledge by identifying and explaining the linkages between local and regional food systems in the global South, and sustainable development outcomes. This research provides insight for development researchers and practitioners looking to improve the productivity and sustainability of aquaculture systems. This research also improves our understanding of how food system development can generate empowerment, food security, and poverty reduction more broadly.

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Acronyms

BOB – Bolivianos (name of Bolivian currency)

CBAVC – Central Bolivian aquaculture value chain

ELCSA – Escala Latino Americana y Caribina de Seguridad Alimentara

FAO – Food and Agricultural Organization

HDDS – Household Dietary Diversity Score

INE - Instituto Nacional de Estadísticas (Bolivian National Institute of Statistics)

IPD PACU - Institucion Publica Desconcentrada de Pesca y Acuicultura
(Decentralized Public Institution of Fisheries and Aquaculture)

LFS – local food system

MAS – Movimiento a Socialismo

PPV – Peces Para la Vida (first project name, 2012-2015)

PPVII – Peces Para la Vida II (in English *Amazon Fish for Food*, 2015-2018)

ROI – return on investment

SME – small/medium enterprise

USAID – United States Agency for International Development

USD – United States Dollars

UN – United Nations

Acknowledgements

Although at first glance this dissertation may seem to be just words on paper, on closer inspection you will see that it is in fact made up of the ideas, passion, time, and collaboration of dozens of people near and far. I owe a great debt to this tremendous group, and could not have done this work without them.

I would first like to thank my supervisor, Mark. Without his guidance, insight, backing, occasional kick in the ass, and most importantly his friendship, this work would have been over before it had begun. A great mentor does not simply provide you a path to follow; they give you the confidence and inspiration to forge your own.

My committee members, Aleck and Yogi, were likewise indispensable. Their support and feedback throughout made this research much better than it would have been without them. I would also like to thank my external examiner John for his thoughts and time.

I owe much to the Peces Para la Vida 2 project partners and collaborators. The support and friendship of Alvaro and Luis of IMG, Ahmed and Santiago of CIDRE, Paul and Fernando of Faunagua, Widen, Veronica, and Giovanni of CEPAC, Alison and Monica of UVic/WFT, my travelling companion Steve, and of the extended PPV2 team is deeply appreciated. A special thanks is needed for Tiffany, who was always a compass when I began to feel lost in the jungle. Perhaps the most important person to the success of the field research was Juan. I am grateful and still in awe of his dedication, ability to relate to people, and his camaraderie, which made long drives and hectic days in the Bolivian outback a pleasure. I also want to thank the people of Yapacani, Puerto Villaroel, and Entre Rios, and especially the farmers, workers, and business owners of the region who are involved in aquaculture. Their willingness, and often enthusiasm, to participate in this research speaks volumes of their interest in seeing their local aquaculture system succeed.

The International Development Research Centre (IDRC) and Global Affairs Canada financed the PPV2 project and this dissertation. Therefore, I owe a great deal to these organizations for their support. By extension, and though it may sound a bit odd, I also owe a great deal to the people of Canada, since they are the ones with the compassion and foresight to support organizations that carry out such important and impactful projects around the world.

I would like to thank my entire family, especially my brother Ryan, sister Erica, and my mother Kim. Such an undertaking is made easier when you know there are people who believe whole-heartedly in you and your abilities. My mother in particular has never waived in her support or confidence, and that bred in me an ambition to take on only the most challenging and interesting endeavors in life. I also owe an incredible debt to my father, who left us not long ago. He was the one who encouraged me to pursue my PhD. In the face of a life defining decision, he

encouraged me to forego the safe option and choose the road less travelled. He believed that living a fascinating and dynamic life while doing ones best to help others was the path to meaning and happiness. His philosophy, which he lived everyday of his life, will always be my driving force and inspiration.

Last, I would like to thank my wife Michelle. On the road to my PhD, we moved across half the country, got married, made a home, and fell in love with each other over and over again. We realized that with each other there is nothing we cannot do. Her contribution to this work, through her unwavering love and support, is immeasurable. Now that this adventure has come to a close, I can't wait to see what life has in store for us next.

For Michelle, My Ocean

Chapter 1: Introduction

“It has been estimated by the Food and Agriculture Organization of the United Nations that to meet the demand of increasing population by 2050, we need to increase food production by 60 percent globally and by 90 percent to 100 percent in developing countries. The enormity of the situation can be further gauged from the fact that more food has to be produced in the next 35 years than what was produced in the last 8,000 years.”

- Dr. M. Vijay Gupta, pioneer of aquaculture for the poor and World Food Prize and Sunhak Peace Prize winner.

1.1 Nature of the Problem

One of the most important and pressing challenges facing humanity is finding ways to feed an expected global population of 9 billion people by 2050 while simultaneously eliminating rural poverty and preserving the environment (FAO, 2009; Godfray *et al.*, 2010; WRI, 2014). The way to overcoming this “triple challenge” is to improve both global and local food systems – the complex set of actors, processes, and infrastructure involved in the production, distribution, and consumption of food – by making them more inclusive, equitable, and sustainable (Akram-Lodhi, 2013; Clapp, 2013; Clapp & Cohen, 2009; Fraser & Rimas, 2010; Patel, 2012; Weis, 2007). Aquaculture systems are in particular need of such improvement (Brummet, 2013; Bush *et al.*, 2013; Hall *et al.*, 2013; World Bank, 2014). Aquaculture has recently surpassed fisheries as the primary source of fish for human consumption and is the fastest growing food sector on the planet (FAO, 2016a). The majority of this growth is happening in rural areas of developing countries where aquaculture systems are directly supporting the livelihoods of more than 18 million people, most of who are small-scale producers (*ibid.*). It also provides food security by supplying much needed protein and micronutrients to over 1.5 billion people globally (Bene, *et al.*, 2015; FAO, 2016a; 2016b). Many

analysts and institutions therefore see small-scale rural aquaculture as having considerable potential to support local food production and alleviate rural poverty (Allison, 2011; Bene *et al.*, 2015; FAO, 2016).

Despite this, some analysts have come to question aquaculture's potential to address elements of the triple challenge. They refer to issues with its environmental impact (Naylor *et al.*, 2000; 2001; Troell *et al.*, 2014), social outcomes (Gammage *et al.*, 2006; Nuruzzaman, 2012), and inconsistent effect on poverty (Belton *et al.*, 2012). However, the problem with many of these arguments is that they are based on a small number of production systems that are located in only a few regions. The social, economic, and environmental effects of the rapid growth of new aquaculture systems in regions such as Africa and Latin America, remain largely unknown (Belton & Little, 2011; 2012; Bene *et al.*, 2016). It is also unclear how to shape the growth and development of these systems so that they contribute to addressing the food-poverty-environment triple challenge. Therefore, it is imperative to develop new insight and knowledge about how small-scale rural producer driven aquaculture systems can become more productive, profitable, environmentally friendly, and beneficial to society.

Investigating a food system is notoriously difficult given the complex and dynamic interaction of actors, governance structures, and institutions. One method that has emerged in recent years is value chain analysis (Kaplinsky & Morris, 2001; Riisgaard, 2008). A value chain is a metaphor for understanding how the different activities of actors and firms interact to add value to a product as it travels through sequential stages, from conception to consumption. According to this approach, value chains are the engines that drive food systems (FAO, 2014). However, value chain analysis, despite its increasing popularity amongst development researchers and practitioners, fixates on the economic and governance dimensions of the product in question. Most value chain studies overlook the horizontal linkages that mediate chain functioning and outcomes, specifically the social, economic, and natural environments of chain actors (Bolwig *et al.*, 2010; Spoor, 2015). Conventional value chain analysis, therefore, requires the incorporation of these

horizontal linkages to more effectively investigate the sustainability of food systems (FAO, 2014; Riisgaard *et al.*, 2010).

It is widely recognized by analysts and institutions that developing food systems capable of addressing the triple challenge will require the improvement of both global and local food systems and the value chains that drive them (Akram-Lodhi, 2013; Cribb, 2010; WRI, 2014; World Bank, 2008). Yet, there is a lack of research on precisely how to do so, particularly for local food systems in the developing world (Spoor, 2015). Local food systems are ubiquitous in rural regions of developing countries where semi-subsistence and small-scale commercial farmers are common. However, despite their prevalence, such systems are virtually absent from agriculture, aquaculture, value chains, and development literatures. This is a significant knowledge gap considering there are signals that local food systems supported by small-scale farmers are as important as global food systems for increasing the food supply and reducing the environmental impacts of food systems (FAO, 2012; Pretty *et al.*, 2005; Spoor, 2015). Furthermore, small-scale farmer driven local food systems in developing countries may be more important than global systems for rural poverty reduction (Anríquez & Stamoulis, 2007; Hazell, 2005; Mellor & Malik, 2017; IFAD, 2014).

Small-scale aquaculture systems similarly suffer from this lack of research. The majority of studies on small-scale aquaculture tend to be exclusively technical or economic while overlooking social factors and questions of sustainability. According to Belton & Little (2011), “detailed intellectually satisfying analyses of small-scale aquaculture and its implications with respect to poverty, livelihoods, food security and gender relations have been notable by their absence (p.152).” They also tend to either implicitly or explicitly favour or focus on outcomes of global engagement (Belton & Bush, 2013). The few that do investigate the impacts of local aquaculture tend to do so from one actor group’s point of view, usually the producer’s, and do not take a systems approach. Thus, the broader social, economic, and environmental effects of local aquaculture systems remain uninvestigated and unknown.

Perhaps the largest gap in knowledge about aquaculture systems is geographical. Most research has been in Asia, likely because this region accounts for more than 80% of global aquaculture production (FAO, 2016a). However, aquaculture systems are emerging throughout the world, and the regions with the fastest rates of growth are Africa and Latin America (ibid.). It is vital to better understand the diverse aquaculture systems on these two continents and their implications for development, poverty reduction, and sustainability. While Africa has lately received increased research attention, Latin America continues to be largely ignored despite extensive opportunities for aquaculture development (Hernández-Rodríguez, 2001; Roubach *et al.*, 2003). For small-scale producers in South America, economic growth, widespread land ownership, and increasing domestic and international demand for fish present opportunities to improve incomes. Aquaculture in Latin America and the Caribbean directly employs 3.5 million people and generates multiplier effects that accrue benefits to many more (FAO, 2016a). For consumers, increased availability of fish expands access to valuable nutrients and helps fight the growing problems of obesity and diet related disease (Bene *et al.*, 2015; FAO, 2016a). But, potential impacts of aquaculture in Latin America are largely unknown, and growth is rudderless. Thus, there is a considerable need for research on pathways to sustainable aquaculture value chains that drive sustainable food systems for Latin America.

In Bolivia, small-scale family-based aquaculture is being promoted by NGOs and government agencies as a vehicle for rural poverty reduction. A governmental department called the Decentralized Public Agency for Fisheries and Aquaculture (Institución Pública Desconcentrada de Pesca y Acuicultura – IPD PACU) has been established to grow aquaculture in the country and meet the government’s remarkable goal of increasing annual national fish consumption from an average of 1.8kg to 6kg over the next few years (Los Tiempos, 2015). Two pathways to the poverty reduction and consumption goals are envisioned. The first is the adoption of aquaculture by smallholder farmers to generate increased income through sales and to improve food security through increased consumption of fish at home. The second is the increased availability of fish for the general population, which

provides a high quality source of protein and nutrients and therefore improves nutrition and overall food security (IPD PACU, 2015). Currently neither pathway is well developed. Historically, aquaculture has seen slow growth in Bolivia. Farmers have not been quick to adopt aquaculture into their livelihood portfolios and, when they did, it was often due to NGO support and funding (FAO, 2005; Van Damme *et al.*, 2014).

However, quite recently a surge in interest from both farmers and consumers has occurred. New input supply businesses are entering the aquaculture system, new farmers are adopting aquaculture, and existing aquaculturists are expanding their operations. Consumption businesses such as markets and restaurants are also starting and expanding to meet consumer demand. The overall aquaculture value chain has grown quickly, but its effects and consequences remain largely unknown. It has also been unclear how best to steer the value chain down a path of sustainable development. The situation presents important questions about the implications of small-scale aquaculture value chains and local food systems for addressing the food system triple challenge.

The locus of aquaculture activity in Bolivia is the central lowland region of the country that forms the southern edge of the Amazon rain forest. It is a highly artisanal system that is comprised of approximately three hundred and fifty producers of indigenous origin, over a hundred service workers, and a small number of input supply businesses principally located in the nearby city of Santa Cruz (Bolivia's largest) (FAO, 2005). Markets for fish produced through aquaculture exist throughout the country but are relatively larger and more active near the production region and in Santa Cruz. This makes the Central Bolivian aquaculture value chain predominantly local and, to a lesser extent, regional. These producers and chain actors face a number of endogenous challenges related to their socioeconomic condition and the institutional framework in which they operate. They tend to be poor, have little capital, and have historically received inconsistent regional and state government support (Canal-Beeby, 2012; FAO, 2005). However, opportunities are also present. For example, financial tools explicitly for aquaculturists are being developed and disseminated, government interest in

aquaculture has become formalized in a department dedicated to the activity, and new localized outlets for aquaculture products in the form of restaurants are experiencing rapid growth and demand (IPD PACU, 2015).

Despite extensive natural and cultural resources, and significant economic advances in recent years, Bolivia remains the poorest and most food insecure country in South America (EIU, 2015; World Bank, 2015). Bolivia's history is fraught with social conflict, inequality, and exploitation, in part due to, first, colonization, and then, foreign corporations (Farthing & Kohl, 2014). In 2005 the populist party Movement Towards Socialism (MAS) was elected with a mandate to re-orient the economy to accrue benefits to Bolivians more evenly, and particularly for the historically marginalized indigenous population (Farthing & Kohl, 2014). They did so by adopting "21st century socialism" and undertaking an agenda of neoliberal and colonial deconstruction in the country (Kennemore & Weeks, 2011). As part of this agenda, and as a means to address rural poverty and the challenges that emanate from the global food system, Bolivia explicitly wrote food sovereignty into its constitution (Arce, 2011; Bolivian Constitution, 2009: Articles 255, 309, 405 & 407).

The concept of food sovereignty emerged in response to the marginalizing effect the current food system tends to have on small-scale farmers (Wittman *et al.*, 2010). Founded by a peasant movement, it refers to "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture system," (Nyéléni, 2007)². Although not exclusionary, the model concentrates on small-scale producers, typically of the global South³, and aims to make agriculture simultaneously sustainable, productive, and socially just. Rather than a manifesto for improvements to the current food system, it positions itself as an outright alternative. Its supporters see food sovereignty as an essential component of poverty alleviation as it rejects the globalized and corporatized food system and replaces it with a framework that explicitly addresses small-scale farmer welfare,

² Also see La Via Campesina (1996) for an earlier iteration.

³ Although the concept has also been growing in the global North. See Brent *et al.* (2015), Desmarais & Wittman (2014), Roman-Alcala (2015), and Wittman *et al.* (2010).

thereby striking at the source of much of the world's poverty (Desmarais, 2012). The concept of food sovereignty has also continued to expand over the years and has been associated with positions on a number of social and environmental issues such as agricultural patents (against), use of genetically modified organisms (against), agrarian reform (for), and gender equality (for) (La Via Campesina, 1996; Nyéleáni, 2007). For many social organizations and NGOs the concept has evolved into a global movement and has been incorporated into their discourses. More importantly, the concept of food sovereignty has been receiving attention from international institutions and national policy makers (Desmarais, 2008). The FAO and United Nations Human Rights Council (UNHRC) have begun to examine the concept for its development potential (see FAO, 2008; UNHRC, 2008; 2010)⁴, and eight countries, including Bolivia, have given it some form of legal status, and are exploring ways to move forward with implementation (Beauregard, 2009).

In Bolivia, food sovereignty is an influential idea in national political discourse. It has been incorporated into the constitution and various pieces of legislation, and is a guiding principle in the government's approach to rural development⁵. It is also influential in the government's plans to develop the aquaculture sector through supporting small-scale producers. However, Bolivia's food sovereignty approach has been inconsistent across agriculture sectors and contexts (Beasley, 2014; Cockburn, 2013; Lambie, 2012; Lynge & Meersohn, 2013). It therefore remains to be seen how and to what extent it manifests in Bolivia, what affect it is having and can have for aquaculture producers, and whether it is or can be an effective framework for addressing the food system triple challenge.

There is a clear need for research that utilizes value chain analysis imbued with social, poverty, and environmental indicators to determine how local aquaculture food systems can be more productive, equitable, profitable, and sustainable. For this reason, this study developed a holistic method for analyzing

⁴ A search of the WTO, IMF, and World Bank websites showed no institutionally sanctioned documents dealing with food sovereignty, but revealed many discussion and research papers, as well as presentations and opinion pieces discussing food sovereignty.

⁵ See Bolivian Constitution, Title 3: Comprehensive Sustainable Rural Development, Articles 405 & 407.

value chains by adding horizontal dimensions of the chain to the established economic and value adding verticality of the chain. In Bolivia, aquaculture has been touted as a means to improve social and economic conditions in rural areas but its development is being tempered by social, political, and cultural realities. It is therefore important to uncover how the context may be navigated and lead to poverty reduction and social equity for the sake of actors and overall rural development. This dissertation contributes to filling these gaps by investigating the central Bolivian aquaculture value chain, the political, and cultural factors that mediate its function, and the social and economic impact it has on its actors. It also outlines the pathways that Bolivian, and other small-scale aquaculture systems, can take that contribute to solving the food system triple challenge. Such research is critical for both Bolivian, and international policy makers to make informed decisions about food system and aquaculture development investments and policies. It is also valuable for NGOs looking to bolster rural development through farm based livelihoods that are resilient to challenges that emanate from food systems. Perhaps most importantly, this research helps small-scale aquaculture producers and chain actors, both in Bolivia and beyond, by unpacking aquaculture's potential as a pathway towards sustainable incomes, food security, and social equality.

1.2 Purpose of the Study

The purpose of this study is to determine how rural small-scale aquaculture systems can contribute to food production while also being environmentally, socially, and economically sustainable. The specific objectives are to:

1. Conduct a value chain analysis of the smallholder aquaculture system of Central Bolivia.

2. Investigate the aquaculture system's impact on the environment, and its effect on the income, food security, and gender equality of system participants.
3. Identify opportunities and barriers to aquaculture value chain entrance for potential chain actors and improved participation for current chain actors.
4. Investigate how food sovereignty and the localized nature of the aquaculture system mediate development outcomes.
5. Identify interventions and policies that would support sustainable and inclusive scaling-up of small-scale aquaculture in Bolivia.

1.3 Thesis Outline

This thesis has seven chapters. Chapter 2 presents the background to the problems, broadly, with food systems. It then outlines the ideas of locality and food sovereignty as spaces in which food system problems may be addressed. This is followed by an overview of the opportunities and challenges of aquaculture systems in relation to sustainability and their ability to influence rural development. Finally, it then outlines how improving value chains can drive development outcomes. Chapter 3 presents Bolivia's complex socio-political history, and how it has, and continues to, shape development in the country. It also outlines the emergence of aquaculture in the study region and how it is situated within the broader food system. Chapter 4 outlines the methods used in this research. Chapter 5 presents the results of field research conducted with aquaculture chain actors in central Bolivia. Chapter 6 discusses the insights generated from the findings in chapter 5 and outlines recommendations for improvements to the central Bolivian aquaculture value chain, and for the development of small-scale aquaculture value chains in other regions. Chapter 7 summarizes the findings and key insights of the research.

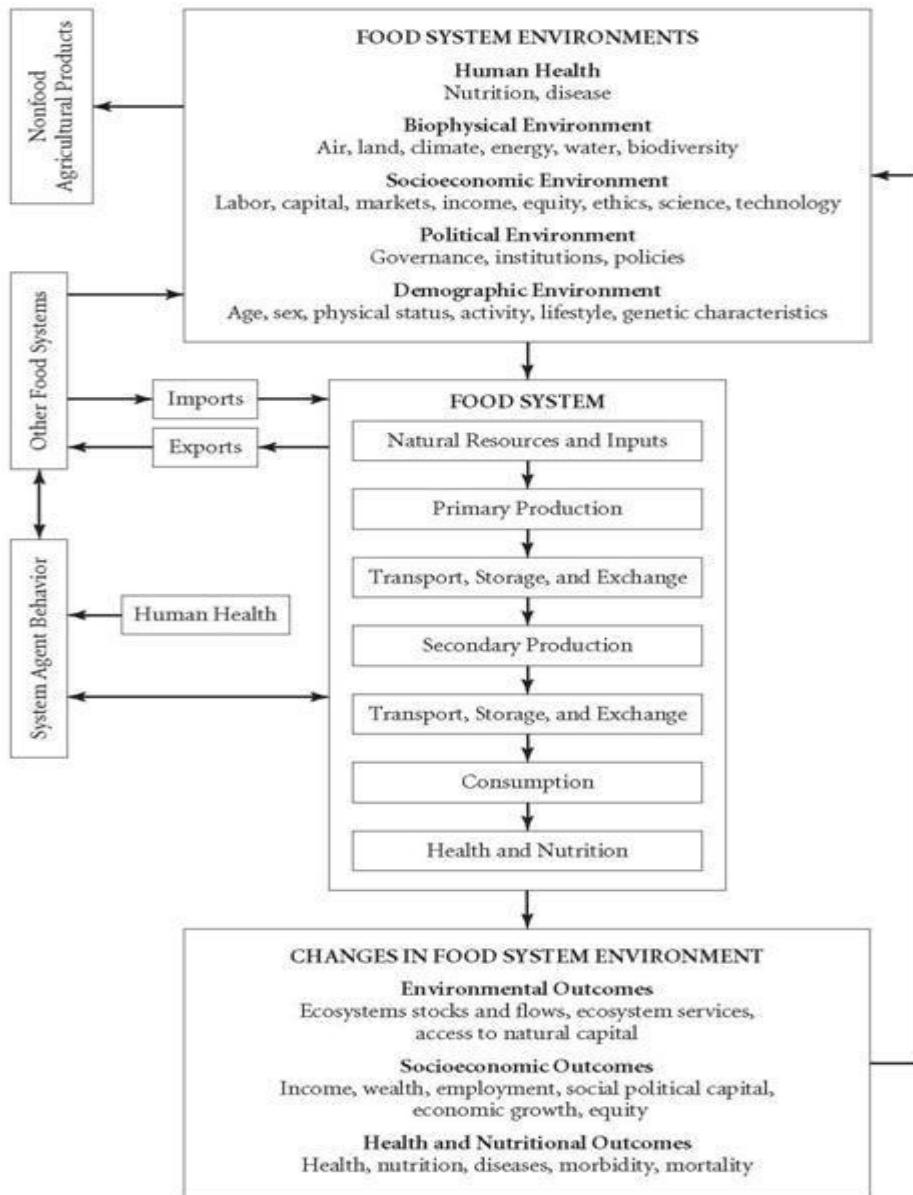
Chapter 2: Background

This chapter begins by examining the nature of current food systems. It then explores local food systems and food sovereignty as mediators of food system improvement. In the second section, the opportunities and challenges for aquaculture to drive rural development are discussed. The third section reviews the use of value chains as a means to better understand food systems, and the importance of holistic value chain analysis.

2.1 Food Systems

The term “food system” is used to describe all the actors, activities, and infrastructure involved in feeding a population. This includes production, processing, transport, and consumption of food, as well as its governance, and effects on society, culture, population health, the economy, and the environment (OMS, 2017). Food systems can manifest at different scales and be based on different products. There can be multiple food systems embedded within a larger food system. They may also be confined to a certain locality, or may exist across local, regional, and global scales. Often there are elements of both geographically fixed, and national or global processes and actors. The boundaries of food systems, whether they are delineated based on scale or sector, may also blur into one another, or overlap (Ericksen, 2008). A food system is a way of conceptualizing the complexity involved in the human interaction with food. Pinstrup-Andersen & Watson, 2011 provide a useful figure for framing how a food system can be conceptualized (figure 2.1).

Figure 2.1: A conceptual framework of a food system



Source: Pinstrup-Andersen & Watson (2011), p7.

For most of human history, food systems have been small and localized. Most people lived rurally and were subsistence farmers, only selling or trading surpluses with other members of the community for basic goods and services.

However, after the onset of the industrial revolution, the nature of food systems began to shift dramatically (ibid.). International trade in foodstuffs drove a commercial revolution that increased food consumption and diversified diets, which in turn increased the health of many populations (ibid.). Population health was further bolstered by technological innovation, scientific discovery, and increased incomes. Together these developments helped to set off a global explosion in population. Between the beginning of the 19th century and 1974, the global population quadrupled from one to four billion people.

Rapid population growth gave rise to concerns that humans would eventually outstrip the earth's capacity to produce food. This was most (in)famously expressed by Thomas Malthus as early as 1798 (Malthus, 1798). However, despite an explosion in the global population, aggregate agricultural production during the 18th and 19th century kept pace largely due to land expansion through colonization. During this period food systems, particularly in the global South, underwent a massive transformation. Many subsistence farmers and their land was re-purposed for colonial agriculture where priority was placed on export oriented luxury foods such as fruits and coffee for European and North American consumers. This gave rise to food distribution networks that spanned the globe and led to the formation of single commodity economies in many tropical countries, more recently dubbed "banana republics" (Striffler & Moberg, 2003).

Food production was also spurred by technological innovation. During the industrial revolution new machines increased efficiencies, but food became the subject of focused technological innovation starting in the inter-war period. This started in North America and was spurred by new discoveries in chemicals and machinery, as well as the need to address widespread crop failures in the Midwest (America's breadbasket) during the 1930s (the dust-bowl era). In the 1940s and 50s, this basket of innovations was exported to developing countries as a means to address the fallout of colonial agricultural policies. The emphasis on luxury crops rather than staple crops for the local population, as well as rapid population growth, had begun to generate widespread food shortages. As a means to combat this

problem, the “Green Revolution” was undertaken, and it fundamentally transformed the food system. According to Farmer (1986):

“The term 'Green Revolution' came into use in the late 1960s to cover 'the new technology' and its then-predicted consequences. This technology comprised new, high-yielding varieties (HYVs) of cereals, especially dwarf wheats and rices, in association with chemical fertilizers and agro-chemicals, and with controlled water-supply (usually involving irrigation) and new methods of cultivation, including mechanization. All of these together were seen as a 'package of practices' to supersede 'traditional' technology and to be adopted as a whole.”

This modernization and technology came to define the global food system. It was highly praised for doubling the amount of cereals produced per unit of land and is credited with saving over a billion lives, primarily in South Asia (IFPRI, 2002). It was also the catalyst for fundamental changes in local and global food systems. Thanks to the Green Revolution, food production became heavily mechanized, focused on monocultures, and dependent on chemical inputs (Cribb, 2010). The rise of this agro-industrial model of production caused a shift in the food system away from farmers and towards multinational corporations as they had the capacity to make necessary investments in research and development (Clapp, 2016). While this shift was more profound in the developed world, the corporatization of food systems also had ripple effects throughout food systems in the developing world. Power over food production, and eventually distribution, and even consumption, became concentrated in the hands of a small number of companies. Thus, the purpose of food systems became even more concentrated towards profit generation (Clapp, 2013; 2016).

This trend toward corporatization, commercialization, and industrialization of the food system was further spurred during the latter half of the 20th century by economic growth and globalization. Consumers in developed countries with greater disposable income began to demand food that could only be produced in foreign countries, was healthy, safe, and available year round (Gardner, 2013; Fraser & Rimas, 2010). It also increased the food system’s reliance on fossil fuels to achieve large-scale production and to move products thousands of miles from producer to

consumer (Weis, 2007). The effect of this transformation on the environment and societies of the Global South was often detrimental. Much unrest in developing nations had roots in land and resource conflicts. The rise of large monoculture crops led to the introduction and overuse of various chemicals that had adverse impacts on human health (Brockett, 1990). But, the effect on food security and health of consumers in the developed world was initially quite positive (Clapp, 2016). New and often cheaper products with wider availability diversified diets and supplied more vitamins and nutrients to consumers than ever before. However, increased incomes and consumerism, and especially agricultural corporation driven marketing and nutritionist advice, also drove changes in consumption patterns (Ostry, 2006). Demand for higher value foods, particularly proteins such as beef, pork, chicken, and seafood, increased substantially. Such types of food production tend to place a heavy burden on natural resources such as land and water (Herrero *et al.*, 2013; Weis, 2007; 2010). Consumers also began to demand convenience in food, which led to the widespread popularity of fast food restaurants and pre-packaged meals, all of which became dependent on processed foods. Diets therefore suffered as foods increasingly became high in calories but low in nutritional value, thus driving an epidemic of obesity and diet related illnesses that continues to grow today (Clapp & Cohen, 2009; Patel, 2012).

The problems that were created by the modern food system have generally been allowed to grow unchecked. Industrial food systems today are significant producers of greenhouse gas emissions and consumers of fresh water (Foley *et al.*, 2005; Gerber *et al.*, 2013). This environmental footprint is particularly heavy for meat products such as beef, pork, and chicken (Herrero *et al.*, 2013). Food system reliance on chemical inputs such as fertilizer, herbicides, and pesticides are compounding problems of eutrophication and biodiversity loss (Foley *et al.*, 2011). Large-scale monocropping has also been criticized for exacerbating these problems as well as causing deforestation and watershed manipulation that has led to droughts and/or floods in many regions (Altieri, 2009; Tilman, 1999). In some places food production is being shifted away from consumption and towards biofuel production, which can be an inefficient way to produce fuel and is viewed as

unsustainable by many (Altieri, 2009; Bindraban *et al.*, 2009; Gomiero *et al.*, 2010). The rise of biofuels, and the corporatization of food systems, has also been attributed to food price volatility, which in turn has sparked riots in some countries and can severely debilitate the food security of the poor (Dauvergne & Neville, 2010; McMichael, 2009).

These problems are posing a significant challenge to the food system's capacity to feed the global population today, but are also being exacerbated by emerging economic trends. Not only will there be a 30% larger population to feed in the future, but that population is expected to be, on average, the wealthiest in human history. The trend of rapid economic growth in many developing countries, particularly China and India, is expected to continue and lead to the emergence of a much larger global middle class. This economic growth is also expected to continue contributing to the trend towards urbanization. These changes will drive increased food demand, both in quantity and quality (Pingali, 2007). Demand for cereals is expected to increase by almost a third (from 2.1 billion tonnes today to 3 billion in 2050), but could be even more depending on the future trends in biofuel production (FAO, 2009). Demand for higher value products such as beef and seafood is expected to increase even more, 2.35 times by the FAO's estimate (*ibid.*). These needs will undoubtedly exacerbate the already significant pressures on the food system.

Compounding the problems with the food system, and its capacity to feed the world in the future, is rural poverty in developing countries. There are approximately 750 million people living in poverty (less than \$2USD/day), many of whom live rurally and are simultaneously, and paradoxically, small-scale farmers and fishers who suffer from hunger (Anriquez & Stamoulis, 2007; Ellis, 2000; FAO, 2012; IFAD, 2014). For many small-scale farmers, globalization and corporatization of the food system has had a marginalizing effect, either by eroding their returns on labour and investment, or by excluding them from participation altogether, thus perpetuating insecure and vulnerable livelihoods (Akram-Lodhi, 2013; Fraser & Rimas, 2010). These trends have also created a negative feedback loop. The increasing control of the food system by international firms erodes farmer

livelihoods, which leads governments to believe that agricultural investment is wasteful and therefore should be cut, which in turn further erodes farmer livelihoods. This is problematic since evidence indicates that agricultural growth, on average, is twice as effective at reducing poverty than growth in other sectors (World Bank, 2008). It is also becoming increasingly apparent that rather than being burdens on food systems, small-scale farmers may play a critical role in firming up local food security, reducing local poverty, and reducing the environmental impact of food systems (FAO, 2012; Mellor & Malik, 2017; Spoor, 2015; WRI, 2014). Furthermore, due to the combination of economic and population growth, the majority of new demand for food will be in the global South. Increases in food production will be disproportionality needed there, and it is becoming clear that small-scale farmers will be critical to meeting this need (FAO, 2009).

Many fishers and aquaculturists face similar food system challenges. The globalization and mechanization of fishing has pushed many fishers to the periphery, and has also pushed stocks to a breaking point in many regions (Bene & Friend, 2011; Pauly & Zeller, 2016). Gephart *et al.* (2017) have shown that fish harvesting and producing livelihoods are highly vulnerable to economic and environmental shocks, particularly in the developing world. Golden *et al.* (2016) have found that these factors will result in a considerable threat to human health, not only for fishers but also for those who depend on fish for food and nutrition. All of this is exacerbated by an under-appreciation on the part of multilateral donors of the economic and health benefits of fish (Bene *et al.*, 2015).

Analysts have advocated for a variety of pathways to address the triple challenge, but they generally fall into one of two broad categories (Garnett & Godfray, 2012). The first category can be termed the “modification” approach. It seeks to address food system problems by making specific changes without overhauling the system. It retains the notion of food as a commodity to be traded, rather than as a human right and a necessity of life. It continues to value people as “consumers” rather than “eaters” (Clapp, 2016). It maintains the orbit of power and governance in food systems around large firms rather than producers. It continues

to rely on technology and innovation as the primary means to overcome environmental problems and production limitations. The justification for this system is rooted in past success, food preferences, and wealth generation. The green revolution demonstrated innovation's capacity to overcome food shortages. Although it generated new problems, it also succeeded in averting famine and loss of life. Consumer food preferences for diversity and convenience are also generally well served by the current food system. The freedom of choice that the system provides has led to a wide variety of public health problems and has in some cases homogenized food tastes. However, it can also be credited with making both unhealthy and healthy foods widely and regularly available (Patel, 2010). Finally, consumerization and financialization of the food system has been a generator of wealth. While much of it tends to be concentrated amongst an elite few, particularly in the Global North, the lengthening of food chains to national and international scales has opened up more points for participation and thus created a wide variety of food system employment opportunities. While this too has disproportionately benefited workers of developed countries, employment generation in some developing countries has also taken place, and in some cases the opportunities are superior to available alternatives (Ashley & Maxwell, 2001; Byerlee *et al.*, 2009; Wiggins, 2016).

However, some analysts have pointed out endemic problems with the global food system, and have questioned the capacity of the modification approach to adequately address the triple challenge. On the production front, growth in yields has been slowing and most land suitable for cultivation is already in use (FAO, 2009). On the environmental front, modern agriculture continues to be highly problematic. Although new technology and techniques are regularly being developed to reduce the environmental impact of the global food system, it continues to be one of the most significant sources of both local and global scale environmental degradation (FAO, 2009; Foley, 2011; 2015). On the poverty reduction front, skeptics argue that as long as the profit motive remains central to food systems, they will remain dominated by large firms at the expense of small-scale producers (Akram-Lodhi, 2013). They also argue that if food systems remain

tailored for consumers who can afford food, the poor will continue to suffer food insecurity (Clapp, 2016). For these reasons, some advocates have begun to argue for alternative food systems.

The second category of pathways to addressing the food-poverty-environment challenge can be termed “alternative” approaches. These emerged from disillusionment with the traditional food system and the perceived lack of capacity, or interest, of its actors to improve the socioeconomic and environmental effects. While analysts and stakeholders have proposed several alternatives, and even more iterations, this study focuses on two that are highly relevant to Bolivia and its aquaculture system. The first is local food systems. This system receives focus because many food value chains in developing countries, the central Bolivian aquaculture value chain included, are highly localized. Understanding the opportunities and challenges inherent in localized systems will yield understanding of food system development that is more capable of contributing to addressing the triple challenge. The second alternative food system explored is food sovereignty. This system receives focus because the Bolivian government has integrated the concept into its constitution for the purpose of guiding the country’s agricultural development. How it is affecting the Bolivian food system, however, remains poorly understood.

The debates on how to address the problems that emanate from the food system, and how to improve it going forward, tend to fall into one of the two camps outlined above. However, it is becoming increasingly acknowledged that there is a need for elements of both approaches (see, for example, Cribb, 2010; Spoor, 2015; FAO, 2014; 2016a; 2016c; Rosin *et al.*, 2012; Wiggins, 2016; WRI, 2014). This is being driven by an emerging consensus that regardless of approach, food systems will need to become more productive, and socially, economically, and environmentally sustainable, both at the global and local level.

2.1.1 Local Food Systems

This study looks at local food systems because they might serve as a pathway for rural agricultural development in the global South that helps address the triple challenge. There are essentially two types of LFS. The first is LFS as many alternative food system scholars, farmers, and NGO workers present them. These LFS are thought of through a normative lens by idealizing certain relationships between actors in the food system (Martinez, 2010). They are according to Allen (2010), “a reaction to the destructive, disempowering and alienating effects of large-scale political economic forces (p.296),” and are thus envisioned as an alternative food system. Typically, they constitute farmers who have made a conscious decision to reject traditional value chains for their products, and instead sell directly to consumers. These producers tend to de-value the profit motive and prefer to focus on aspects of environmental and social justice (Macias, 2008). Such systems in turn depend on consumers (usually urban) who choose to pay higher prices and acquire their food less conveniently in return for food that is seemingly healthier and more sustainable (Hinrichs, 2003; Maye, *et al.*, 2007; Winter, 2003). A key characteristic of these LFS is that they have been explicitly created, fostered, patronized, researched, and argued for almost exclusively in, and by, people in Western Countries.

The second type of LFS are those that are common in developing countries. These systems can be conceptualized in the positivist sense: a space in which a food system functions. These systems tend to form organically out of local people’s need to trade with one another. Thus, unlike the conceptualization of LFS in the Global North, those in the Global South are not explicitly created nor are they imbued with political value. Markets in both urban and rural areas are typical manifestations of such LFS, but outlets such as restaurants and street vendors, and input businesses, labourers, and traders, also occupy space in such systems. They are spaces of economic activity that tend to have little formal regulation. Such LFS usually manifest not out of preference (like those in the North), but out of necessity and tradition. Farmers who participate in these systems are local, and tend to have

diversified farm production. While they may have a primary commodity that they sell to national or international markets, surplus of that commodity, along with the various other secondary products they produce, are usually funneled into the LFS. The riskiness of specialization and the volatility of national and international markets make them wary or incapable of fully integrating into larger scale food systems, which perpetuates their reliance on LFS. They are also often handicapped by the transport costs, production standards, and low price margins associated with more sophisticated markets (Humphrey, 2008; Michelson *et al.*, 2012). For consumers, LFS are also important. They provide lower priced food (although potentially less safe), which is critical to poorer families. They also provide better access to food since outlets of national and international food systems are frequently supermarkets that are located in dense urban areas. LFS are thus critical for food dispersion to rural and urban-fringe families.

There is some degree of overlap between the two types of LFS. The first is geographical; they both emphasize the “local” (broadly defined) as the point of activity. They also both tend to be driven by small-scale producers (although what defines small-scale would differ considerably between the two given their global north and global south orientations). They are also both important spaces of social activity, albeit in different ways. In the Global North attending a local food market is a conscious act of favouring local products, the people who produce them, and a rejection of the banality of acquiring food from a traditional supermarket (Allen, 2010). In the Global South, local markets are often patronized as the primary point of access to food, not as an alternative. As such, they are frequented by the vast majority of community members, and generate and perpetuate strong social and economic relationships. They are spaces where people gather and share information, making them important as a space of communication and sociopolitical development.

LFS are nested in larger food systems, may they be regional, national, or international. The value chains of various food products drive them, and these too tend to be largely local. However, the local nature of LFS is complex. Hinrichs (2003), analyzing the politics of a local food system in Iowa, USA, points out that

most understanding of LFS rests on a local-global binary, but that in fact the lines of delineation are quite blurred. This is the same with LFS in the global South, except that in Iowa the local nature of the food system is contested and debated because it has been intentionally created. In Bolivia and other developing countries, it tends to be taken as a fact of the economy since the LFS there manifest from the bottom up. LFS in developing countries have elements derived from a variety of scales. Specifically, these food systems tend to provide many high value foods such as meat, vegetables, and fruits from local value chains. Foods with higher production costs and complexity, for example milk, can be derived from regional or national value chains, and processed and branded foods come from global value chains (Pinstrup-Andersen & Watson, 2011). Even the local value chains that contribute to a LFS may have national or international elements, for example beef production meant for local consumption may use on occasion inputs such as antibiotics that are sourced from other countries. The point is that LFS are dynamic and often blend with food systems at other scales. The important aspect to understand is that despite this blending they remain a relatively distinct entity. As such, their local nature affects social, environmental, and economic outcomes for participants.

There are several reasons that it is important to understand LFS. First, they are ubiquitous in developing countries. Informal markets exist in nearly every village, town, and city, and are largely supplied by local producers, who in turn are supported by local input suppliers, processors, and labourers. They are economically dynamic and important for understanding broader economic trends (Benediktsson, 1998). In the words of Krause *et al.* (2015) “95% of the global food economy is domestic and just 5% is trade, with the result that what happens in urban markets and in urban–rural supply chains is by far the most important market force affecting farmers,” (p45; Belton & Bush, 2013; Reardon & Timmer, 2014). Gomez *et al.* (2011) point out that “food value chains in developing countries are primarily oriented to domestic markets. Developing country food exports account for only 1.9% and 8.4% of domestic production in raw tonnage and value, respectively,” (p1154). This situation is equally relevant to aquaculture. Belton & Bush (2013) argue that aquaculture research has taken on an “export bias” despite

the majority of aquaculture being destined for domestic markets, and thus LFS are likely to be the greatest effectors of development. Therefore, “agrarian and social-ecological changes accompanying the rapid spatial expansion, commoditisation and shifting material conditions of production of ... numerous aquatic organisms produced mainly for domestic or intra-regional markets remain almost entirely uncharted. Rather than static, ‘backward’ or ‘traditional’, many of these crop production systems are highly innovative, rapidly evolving and support dynamic value chains even when based on variations around basic extensive or semi-intensive blueprints,” (Belton & Bush, 2013, p7).

Second, LFS may benefit the poor and small-scale producers. Minten & Reardon (2008) found that small traditional markets provide fresh foods such as meat and vegetables at lower costs than supermarkets (at least initially), therefore making important nutrients and balanced diets more affordable. Anríquez & Stamoulis (2007) and Hazell *et al.* (2005; 2010) point to the importance of small-scale producers and agriculture as drivers of poverty reduction and rural economic growth. LFS, due to their prominent role in smallholder livelihoods, will as a result be important mediators of growth and development. Fraser *et al.* (2005) argue that diverse agriculture systems within a small region are more resilient to food system shocks. Tran *et al.* (2013) found that selling shrimp locally in Vietnam, although less potentially lucrative than global sales, provided price stability and was much easier due to less stringent standards. Belton & Little (2008) had a similar finding in Thailand, and argues that production for domestic markets had positive effects while exporting led to insecure livelihoods.

Third, they may generate social benefits. Requier-Desjardins *et al.* (2010) found that LFS can lead to producer collective action and improvements in competitive efficiency that may allow for more equitable participation in national and global markets. Harper *et al.* (2013) found that women working in fisheries made important contributions to local food security and economies. The LFS would have been an important mediator in this outcome.

Fourth, they may have greater potential to be environmentally sustainable. Looking at LFS in the United Kingdom, Pretty *et al.* (2005) found that it reduced

environmental costs associated with transportation. Erickson (2008) had a similar finding, arguing that localized food production and trade was more sustainable than large international systems. Cornia (1985) and Unal (2006) found that small farms generate higher yields, making food production more efficient.

While not all of these studies explicitly emphasize LFS, they provide important signals that they are worth investigating and understanding. Knowing how LFS impact food system actors, and therefore act as a mediator of rural development and sustainability, would allow researchers to forge better pathways to positive outcomes.

Although studies on the impacts of LFS in developing countries are scarce, appreciation for the importance of LFS has begun to show. Akram-Lodhi (2015), in making his case for food sovereignty, has argued that “local food systems that operate in conjunction with and reflect local landscapes, because of both their relatively more manageable scale and the greater scope for localized action, are optimal sites upon which to accelerate progress toward a more just food sovereign system,”(p.573). The importance of LFS for sustainable food systems has also been recognized by the FAO, who in 2013 produced a comprehensive list of indicators for assessing the sustainability of food systems (FAO, 2013). Locality is emphasized throughout both its themes and indicators, and is regularly cited as an ideal point of investigation and intervention. Achieving sustainability in the food system will inevitably require knowledge of, and pathways towards, sustainable LFS in the global South.

LFS are intricately linked with sustainable and local value chains, which are explored in section 2.3. LFS are also linked to the concept of food sovereignty. In the global North LFS are viewed as an important component of food sovereignty, both geographically and politically (Desmarais & Wittman, 2014; Wittman *et al.*, 2010). In the global South, because LFS are the rule rather than the exception, they contribute to food sovereignty, but how and to what extent is unclear. This connection is important to understand because the central Bolivian aquaculture system is highly localized, and exists within the Bolivian food sovereignty framework.

2.1.2 Food Sovereignty

A critical analysis of food sovereignty is important in this study because Bolivia has incorporated the concept into its constitution and is exploring its implementation as a framework for rural development. The aquaculture system in Bolivia is subject to this framework, but to what degree and with what effect is unknown. Therefore, investigating food sovereignty may yield insight into uncovering pathways to sustainable aquaculture systems in general, and is necessary for uncovering such pathways in Bolivia.

Local food systems in developed countries have been one of the most prominent spaces for activists to participate in and attempt to disrupt the hegemony of the conventional food system. In the Global south, however, there has not been a specific and widespread counter movement to the effects of the conventional global food system, until recently⁶. In 2007 a gathering of food activists in Selingue, Mali, led by the international movement of peasant farmers called Via Campesina, made the Nyeleni declaration and laid out their goal of food sovereignty:

“Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations. It defends the interests and inclusion of the next generation. It offers a strategy to resist and dismantle the current corporate trade and food regime, and directions for food, farming, pastoral and fisheries systems determined by local producers and users. Food sovereignty prioritizes local and national economies and markets and empowers peasant and family farmer-driven agriculture, artisanal - fishing, pastoralist-led grazing, and food production, distribution and consumption based on environmental, social and economic sustainability. Food sovereignty promotes transparent trade that guarantees just incomes to all peoples as well as the rights

⁶ The key terms are specific and widespread. Resistance to neoliberalism in the global South, especially Bolivia, has been a considerable force for decades (see chapter 3), but has not specifically been against the food system. Also, Edelman (2014a) points out that the origins of the concept of food sovereignty are older than commonly believed, particularly amongst Latin American peasant farmers, but that they did not reach prominence until the FAO sponsored World Food Conference in Rome in 1996, and it wasn't until the late 2000s that scholarship on the subject became common.

of consumers to control their food and nutrition. It ensures that the rights to use and manage lands, territories, waters, seeds, livestock and biodiversity are in the hands of those of us who produce food. Food sovereignty implies new social relations free of oppression and inequality between men and women, peoples, racial groups, social and economic classes and generations,” (Nyéléni, 2007).

The Nyeleni declaration was created through a collaboration of the people most negatively affected by the global food system, peasant farmers, which is one of its greatest strengths (Patel, 2009). It covers a large number of topics, and together they form a sweeping call for fundamental change to the food system. Akram-Lodhi (2015, p564-5) has managed to organize food sovereignty into five key components that, for clarity, are worth quoting in full here:

1. A focus on food for people: food sovereignty puts the right to sufficient, healthy and culturally appropriate food for all individuals, peoples and communities at the centre of food, agriculture, livestock and fisheries policies, and rejects the proposition that food is just another commodity.
2. The valuing of food providers: food sovereignty values and supports the contributions, and respects the rights, of women and men who grow, harvest and process food and rejects those policies, actions and programmes that undervalue them and threaten their livelihoods.
3. Localisation of food systems: food sovereignty puts food providers and food consumers at the centre of decision making on food issues; protects providers from the dumping of food in local markets; protects consumers from poor quality and unhealthy food, including food tainted with transgenic organisms; and rejects governance structures that depend on inequitable international trade and give power to corporations. It places control over territory, land, grazing, water, seeds, livestock and fish populations in the hands of local food providers and respects their rights to use and share them in socially and environmentally sustainable ways; it promotes positive interaction between food providers in different territories and from different sectors, which helps resolve conflicts; and rejects the privatisation of natural resources through laws, commercial contracts and intellectual property rights regimes.
4. The building of knowledge and skills: food sovereignty builds on the skills and local knowledge of food providers and their local organisations that conserve, develop and manage localised food production and harvesting systems, developing appropriate research systems to support this, and rejects technologies that undermine these.
5. Working with nature: food sovereignty uses the contributions of nature in diverse, low external-input agroecological production and harvesting methods that maximise the contribution of ecosystems and improve resilience. It rejects methods that harm ecosystem functions, and which depend on energy-intensive

monocultures and livestock factories and other industrialised production methods.

Based on these components, food sovereignty positions itself as an alternative to the “conventional” food system. It emphasizes the primacy of small-scale farmers, environmental preservation, and the importance of local food systems. However, several elements of the concept are under researched, contested and/or unclear.

Within the Nyeleni declaration itself there are elements that are contradictory. Take for example the phrase “it puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems.” This covers all people across the globe, including those who form the markets and corporations that are vilified later in the sentence. Or the phrase, “food produced through ecologically sound and sustainable methods, and their (people’s) right to define their own food and agriculture systems.” What if people choose methods that don’t fall under the definition of ecologically sound? What if people want to define their food systems based on affordability and price? While the spirit of the declaration is reasonably clear, the details are ambiguous.

Understanding the specifics of food sovereignty more broadly as activists and scholars have constructed it has its challenges as well. Edelman *et al.* (2014) identified ten topics within food sovereignty that remain poorly understood:

1. The origins of the concept
2. The role of long-distance and international trade
3. The capacity of food sovereignty to mobilize national food self-sufficiency
4. The role of urban agriculture
5. Who is the sovereign in food sovereignty?
6. What specific socio-political forms will the food system have to take?
7. How will land and property be organized?
8. How does food sovereignty fit with farmer tendency to move away from farming if they have the capacity and opportunity?
9. How does it relate to other rights oriented food movements?
10. What is and will be food sovereignty’s effect on broader social, political, and economic transformations?

Although scholars have begun to grapple with these issues, consensus has remained elusive. A key reason is that food sovereignty research tends to be theoretical or philosophical, and lacks empirical evidence of its impact (Edelman, 2014a; Shattuck *et al.*, 2015). It is also a concept that originated with peasants and activist scholars, but its real world effects are being constructed and contested mostly by national governments. This has caused various manifestations of the concept and ways in which its inconsistencies are being addressed.

Another contested element of the food sovereignty concept is its relationship to the concept of food security. Some analysts have sought to position food sovereignty as an alternative to food security, which they say ignores power asymmetries and tacitly supports “the corporate food regime” and its detrimental environmental and social effects (Akram-Lodhi, 2015, p565; McMichael, 2013; Schanbacher, 2010). However, others have debated the appropriateness of this dichotomy. Trauger (2014) points out that at the first conceptualization of food sovereignty in the NGO response to the Rome Declaration on World Food Security, food security was seen as a goal of food sovereignty. He argues that, “far from being the antithesis of food security, food sovereignty demands the political rights to govern agriculture and trade as a prerequisite for food security,” (p1137). Edelman (2014a) found that through the history of food security and food sovereignty, there was “considerable slippage and overlap between these concepts,” (p959). It therefore seems that although the two concepts are not exactly the same, they are not entirely mutually exclusive. The degree of the conflict depends on the underlying meaning that is ascribed to them by scholars.

This overall lack of clarity has generated a flurry of activity amongst scholars,⁷ many of whom wish to get past the conceptual shortcomings of food sovereignty. Patel (2010) has said that food sovereignty is a “big-tent concept” and

⁷ The *Journal of Peasant Studies* has co-sponsored two international conferences on food sovereignty in 2013 and 2014, and dedicated a special issue to the topic (2014, vol 41, issue 6). The journals *Third World Quarterly* (2015, vol 36, issue 3) and *Globalizations* (2015, vol 12, issue 4) each had a special issue on the topic as well. The interest in food sovereignty was also sparked by the food price crises of 2007-8, which provided a stark example of the shortcomings of the global food system and hastened calls for its reform (or overthrow).

in its first sense is a call “invoking a right to have rights over food,” (p186). McMichael (2010) believes that it has both formal and substantive meanings “because it must simultaneously address immediate needs and posit real alternatives,” (p172). Iles & Montenegro (2013) believe that “food sovereignty is an intrinsically *relational* concept, only taking on meaning in relation to other processes, functions, and forms, (p2).” Indeed, nearly all papers on food sovereignty devote some space to the thorny issue of its definition, which led Patel (2010) to claim that food sovereignty is “over defined,” (p186). The various dimensions of food sovereignty and the array of perceptions that they have engendered have thus led many to conclude that food sovereignty should simply be understood as a process rather than a rigidly defined concept (Edelman *et al.*, 2014; McMichael, 2015; Schiavoni, 2016). It also led Edelman in 2014(b) to proclaim that “rather than elaborating or debating yet one more definition, the urgent task is to think through and then face the political and policy challenges that the different understandings of food sovereignty imply (p183).”

However, this is problematic in the real world (Hospes, 2014). It is difficult to measure the successes and/or failures of food sovereignty, or its effects, without a more firmly established delineation of what is, and what is not, food sovereignty. Despite this, countries are moving ahead with its implementation. Bolivia is a leader amongst this group (Cockburn, 2014; McKay *et al.*, 2014). Chapter 3 provides a detailed outline of the conditions under which it has become a part of the country’s legal framework and what it is meaning for development. Here, it is simply important to note that the consequences of this implementation are convoluted and unclear (Cockburn, 2014). It is also unclear what it is meaning, and will mean, for the development of aquaculture specifically. This is an important gap to fill because whatever development pathways are presented for aquaculture in Bolivia will need to be conscious of, and ideally situated within, food sovereignty. Therefore, this study, due to the problems of food sovereignty’s theoretical framework and the role of food sovereignty in Bolivian political discourse, primarily uses the Bolivian experiment with food sovereignty as the framework for food sovereignty analysis. Commentary on how the aquaculture system in Bolivia fits with the broader concept

of food sovereignty will be provided when relevant, but what are important are the bidirectional effects between the aquaculture system and Bolivia's vision (and reality) of food sovereignty.

2.1.3 Navigating the “Modification” and “Alternative” Approaches

In this study local food systems are viewed as spaces that are under-appreciated and under studied as mediators of environmental and development outcomes from food value chain activities. They are considered through a positivist lens. They are not considered to be the be-all end-all to food system problems. They are socially and politically constructed, meaning that they are not inevitable (Purcell & Brown, 2005). While they may foster development benefits, they may also engender negatives such as being spaces of inequality and injustice (Akram-Lodhi, 2015; Purcell & Brown, 2005). Furthermore, it is acknowledged that global food systems also hold potential for poverty reduction and sustainability. Their role in the diffusion of technology and production methods, of generating economies of scale, of widely distributing nutritious foods, and their potential to generate higher incomes, employment, and economic growth are all good reasons to consider them as potential contributors to food security and more sustainable food systems.

This study views food sovereignty as a well-meaning blueprint for an alternative food system that is more socially, environmentally, and economically just. It is clear that for food systems to address the triple challenge, small-scale farmer participation and engagement needs to be improved, and their vulnerability needs to be reduced. There are many problematic environmental impacts that emanate either directly or indirectly from the food system, and these impacts need mitigation. Knowledge, transparency, and values in the food system will need to change to address the triple challenge.

However, where food sovereignty falls short is its tendency to prescribe mantras on how these goals should be achieved. Tools and strategies that do not fit within the food sovereignty framework, even if they may be beneficial to small-scale producers, are discarded or even vilified by some food sovereignty proponents. For

example, it takes a firm position against the use of genetically engineered crops despite a lack of evidence that they are more harmful to human health or the environment than traditional crops (Nicolia *et al.*, 2013), and in the face of evidence that they may be highly beneficial to small-scale farmers in developing countries (Huang *et al.*, 2005; Klumper & Qaim, 2014; Qaim & Zilberman, 2003). Food sovereignty proponents tend to downplay the transformative power of technology, and idealize the notion of the peasant and their work. This despite the reality that for many peasants life is one of toil and hardship, and that they are keen to upgrade into more profitable or easier on-farm livelihoods, or trade for off-farm work (Agarwal, 2014; Beuchelt & Virchow, 2012). Proponents' perceptions of the peasant also drives the implicit (and sometimes explicit) position that sustainable small-scale farming is an end in and of itself, rather than a stepping-stone out of poverty and towards higher value economic activity. While for some small-scale producers farming may be sufficient, the view by development advocates that it is the objective undermines the importance of macroeconomic growth, which is critical for broad and sustained poverty reduction (Neven, 2014). Food sovereignty supporters also tend to be disdainful of, or at least under appreciate, the centrality of market-based relationships and their tendency to manifest organically, which can complicate implementation of food sovereignty (Li, 2015; Trauger, 2014). Insufficient attention is also paid to the classic paradox of balancing low food costs for consumers and high food costs for producers. Food sovereignty's position as an antithesis to food security is also found to be problematic. The Nyeleni declaration does not explicitly denounce food security. Moreover, in the earlier Rome declaration food security was actually a required element of food sovereignty. The conflict has depended on food security being imbued with meaning that is not easily apparent otherwise, and in some cases runs counter to collaboratively established and widely accepted definitions of food security.

Food sovereignty is important in this study because it is a critical component of Bolivia's rural development framework. They are, however, moving forward with its implementation in ways that are unclear and are generating effects that are unknown.

The overarching goal of this thesis is to uncover pathways to more productive and sustainable food systems, particularly in aquaculture. It may be that local food systems play a role in facilitating such pathways, as may food sovereignty. But it may also be the case that elements of the “traditional” or “modern” food system play a role. In all likelihood elements of both will be needed (Foley, 2011; 2015). Finding this balance requires a holistic research approach that is willing to critically examine the evidence for what works and what doesn’t. It also requires an understanding of specific food systems. In the case of this study, that specific food system is small-scale finfish aquaculture.

2.2 Aquaculture Systems

Aquaculture is the aquatic equivalent of farming on land. Like terrestrial farming, the variety and scale of aquaculture systems is vast. Aquaculture can occur in freshwater, brackishwater, the ocean, or in man made tanks or ponds. It covers a wide range of animals such as crustaceans, finfish, and mollusks, as well as plants such as seaweed and macrophytes. A key characteristic of aquaculture is social; products from aquaculture are owned and reared by an individual or corporation. This is in contrast to fisheries, which are generally viewed as exploitable public common property (Edwards & Demaine, 1998). In 1988 the FAO introduced a definition of aquaculture that encompasses these characteristics:

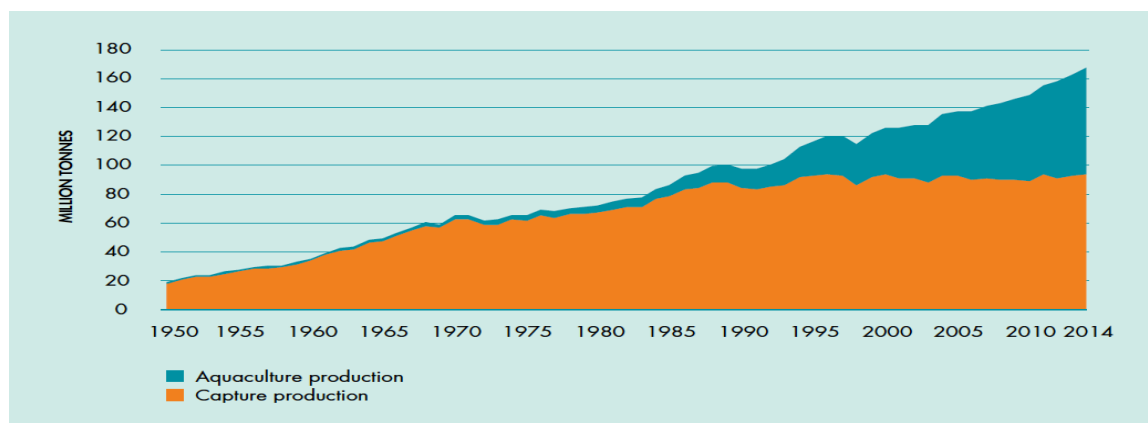
Aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated (FAO, 1988).

Aquaculture has a long history. Scholars believe that aquaculture, in the form of rearing fish in rice paddies, existed in China possibly as far back as 4000 years ago (Rabanal, 1988). From 1000 BC to 1500 AD it spread across Asia, and eventually Europe, and to a lesser extent Africa. Culture systems and cultured

species also diversified significantly during this time (Beveridge & Little, 2002; Hishamunda *et al.*, 2009). However, this long history is very geographically limited. Aquaculture remained prominent only in Asia, and to a lesser extent Europe. The nomadic nature of many African societies during that period kept it from becoming established there long-term. In North America, although fishing was an important source of food for indigenous peoples, fish farming was limited to some areas along the Pacific coast in the form of clam gardens (Beveridge & Little, 2002). Latin America had similarly low levels of explicit aquaculture activity (Rabanal, 1988).

Today aquaculture is global, and becoming an increasingly important source of food. It now produces 50% of consumed fish (FAO, 2016a). This has been spurred in part by the decline of capture fisheries, which for centuries supplied the vast majority of humankind's demand for fish. Thanks to over exploitation, poor management, and pollution, wild stocks in many regions have reached their productive limit or are in decline (Botsford *et al.*, 1997; FAO, 2016a; Pauly & Zeller, 2016). The other side of the same coin is the increasing and diversifying demand for fish by a new emerging global middle class, which is also driving the decline of capture fisheries (FAO, 2016a; World Bank, 2013a). These two changes to the supply and demand for fish over the past two decades has driven a rapid rise in aquaculture production (figure 2.2), making it the fastest growing food sector on the planet. The explosion of aquaculture has been dubbed the "Blue Revolution".

Figure 2.2: World capture fisheries and aquaculture production



Source: FAO (2016)

Aquaculture and fisheries combined are responsible for the livelihoods of over 800 million people and over 3 billion people rely on fish as their primary source of protein (FAO, 2016; WorldFish, 2017). In 2014 aquaculture for the first time provided more fish for human consumption than fisheries, and this trend is expected to continue (ibid.). That same year aquaculture was responsible for producing nearly 74 million tonnes of fish that was worth \$160 billion USD, both all time highs (FAO, 2014; 2016). Direct employment in aquaculture remains small relative to fisheries (18 million versus 38.6 million) but is growing much faster at 5.5% on average annually compared to fisheries at only 0.8% annual average (FAO, 2012a). Interestingly, this growth is causing the geography of aquaculture to change. While Asia, and particularly China, continues to dominate global aquaculture production (with 89% and 62% of the total respectively), their percentage of the global whole has leveled off. New regions, particularly Africa and Latin America, are experiencing rapid aquaculture growth. Average annual growth since 2000 in Africa has been 11.7% and in Latin America 10% (FAO, 2014; 2016), the two fastest growth rates of any regions in the world. Furthermore, Latin America has the largest aquaculture trade surplus of any region in the world, and countries such as Chile and Brazil are becoming major world aquaculture producers (FAO, 2016).

The rise of aquaculture presents numerous opportunities to current and potential aquaculture producers, workers, and business people in developing countries. Like agriculture, certain forms of aquaculture are more conducive to the economy and environment of some geographical areas versus others. In 2014 finfish aquaculture accounted for 67% of global aquaculture production by volume (49.8 million tonnes), and 62% by value (\$99.2 billion USD) (FAO, 2016). The Americas are second only to Asia in finfish aquaculture production and are led by Chile, which is the 9th largest aquaculture producing country in the world (ibid.). Chile's primary, and almost exclusive aquaculture product is Atlantic salmon, which is reared in coastal and offshore pens. The boom in this business has made Chile the third largest global producer of coastal aquaculture (after China and Norway), and

responsible for 44% of Latin America's total aquaculture output (ibid.). Brazil is the other major aquaculture player in the Americas, but much less so than Chile. In 2014 it produced less than half the volume of fish as Chile, almost all of which was in freshwater inland ponds. In this way the nature of aquaculture production in Brazil is much different. Whereas Chile focuses primarily on high value coastal fish for export, and thus has an industry that is led by a small number of large firms, Brazilian aquaculture is carried out by a large number of smaller-scale producers that rear a wider variety of species and who rely much more heavily on local, rather than international markets (Barton & Floysand, 2010; Roubach *et al.*, 2003). This large difference highlights the variability of aquaculture, and the potential it may engender for various firms and actors in Latin America.

The growth of aquaculture, and its diversity and flexibility to be adapted in a wide variety of contexts has led institutions and analysts alike to call for greater investment and research in the sector (FAO, 2016; World Bank, 2008; WorldFish, 2017). As Juergen Voegelé, director of the Agriculture and Environmental Services Department at the World Bank puts it:

“Aquaculture has grown at an impressive rate over the past decades. It has helped to produce more food fish, kept the overall price of fish down, and made fish and seafood more accessible to consumers around the world. That's why greater investment is needed in the industry - for new and safer technologies, their adaptation to local conditions, and their adoption in appropriate settings,” (World Bank, 2013a).

However, despite such enthusiasm, the variation in aquaculture forms and products means that it can, and does, yield a wide range of social, economic and environmental effects. These in turn vary by region and sociopolitical context. Some of these effects have proven adverse or controversial, and thus have engendered opposition amongst some towards aquaculture. It is therefore necessary to understand specific aquaculture systems and their associated opportunities and challenges.

2.2.1 Aquaculture and the Environment

Like the Green Revolution, the environmental consequences of the Blue Revolution were not initially carefully considered or managed (Mustafa, 2015). This led to a variety of environmental problems associated with aquaculture, but these have varied according to product and production system. They are also increasingly being mitigated, pushing aquaculture as a whole towards being more sustainable (Bene *et al.*, 2015; Edwards, 2015).

An environmental issue of concern is aquaculture's reliance on fishmeal and fish oil as feed inputs for carnivorous farmed fish. In essence, capture fisheries have been employed to fish for small bait fish as food for aquaculture, yielding a net negative in biomass from farmed fish and exacerbating fisheries impact on wild stocks. This has undermined aquaculture's claimed potential to alleviate problems with fisheries and to sustainably meet growing global fish demand (Naylor, *et al.* 1998; 2000). It has also worsened the trend of "fishing down the food web" which is fishing that "having depleted the large predatory fish on top of the food web, turns to increasingly smaller species, finally ending up with previously spurned small fish and invertebrates," by increasing demand for small fish (Pauly & Watson, 2009, p501; Pauly *et al.*, 1998). However, evidence shows a trend towards improvement. Although fishmeal and fish oil use remains high for Atlantic salmon, it is on the decline, and promising feed innovations are likely to continue the trend (Edwards, 2015; Naylor *et al.*, 2009). It is also important to note that the majority of aquaculture, primarily aquaculture systems in China, does not rely on fish meal (FAO, 2016).

There are other environmental problems with finfish aquaculture that have been identified as well. One is aquaculture's potential to be a vector for invasive species (Naylor *et al.*, 2001). Fish are often cultured in areas beyond their natural range for a variety of political, biological, and economic reasons. When they escape it can lead to interbreeding or competition with native stocks and species (Naylor, *et al.*, 2005). They also have the potential to spread pathogens (Jones *et al.*, 1999; Naylor & Burke, 2005; Naylor *et al.*, 2005). They can generate pollution through

nutrient, and sometimes chemical and pharmaceutical discharges as well (Goldberg & Naylor, 2004; Naylor *et al.*, 2003; Naylor & Burke, 2005). However, despite these challenges, finfish aquaculture remains a promising alternative to capture fisheries and is becoming increasingly environmentally sustainable (Bene *et al.*, 2015; Edwards, 2015; Naylor & Burke, 2005).

A large portion of research on the environmental impacts of aquaculture has focused on marine finfish⁸, and by extension the concerns that have been raised tend to be related to those systems. But, one form of aquaculture production that has received significantly less attention is pond reared freshwater finfish. This system is subject to similar feed concerns as marine finfish, that is fishing to feed fish, but only if the cultured species is carnivorous. There are also land use issues associated with freshwater pond systems, particularly with respect to deforestation. Though, such aquaculture systems tend to have a greater return in quantity and value of food per unit of land compared to other agriculture activities, and therefore can be better than many alternatives (Boyd & McNevin, 2015). There can also be problems with species escape. Floods, poor pond construction and fish mishandling can lead to fish escape, and this can also spread pathogens and disease. Effluent run-off can also potentially add fertilizers, chemicals and pharmaceuticals to waterways (Cao *et al.*, 2007). Effective management and technological adoption can mitigate these problems.

Despite these challenges, freshwater pond aquaculture can also generate environmental benefits. Mud from the bottom of ponds can be a valuable fertilizer for crops, particularly rice (Lin & Yi, 2003). This can extend the value of fish feed and reduce dependence on synthetic fertilizers. Aquaculture also has a lower carbon footprint and higher feed conversion ratio than most other animal production systems (Bene *et al.*, 2015; Hall *et al.*, 2011, Notenbaert *et al.*, 2016). Overall, there are noteworthy environmental issues with freshwater pond aquaculture, and more research is needed to fully understand their impacts, but the

⁸ There is also a robust body of work on the environmental impacts of shrimp aquaculture. Ironically, while finfish research has pointed out problems, the general consensus is that they can be overcome, whereas some forms of shrimp aquaculture have such a negative environmental impact that it has been recommended that they be banned outright (Flaherty *et al.*, 2000).

general attitude amongst analysts is cautious optimism (Beveridge and Phillips, 1993; Boyd & McNevin, 2015; Mustafa & Shapawi, 2015).

Environmental concerns regarding marine finfish aquaculture have caused a contagion of disapproval towards aquaculture generally in North America. In some cases this is well founded, but in general it lacks appreciation for the variety of aquaculture systems. In Latin America, support for aquaculture is mixed and region specific. There is recognition that aquaculture's environmental impact can be reduced, but many governments and analysts see it as a valuable driver of rural development and believe its environmental problems can be mitigated.

2.2.2 Aquaculture and Rural Development

There is a widespread belief that aquaculture, and rural small-scale aquaculture in particular, can be a driver of income generation, food security, and poverty reduction (Allison, 2011; Belton & Little, 2011; Bene *et al*, 2015; FAO, 2016; World Bank, 2008). However, as research has expanded, variations in aquaculture products, systems, geographies, and sociopolitical contexts have demonstrated the difficulty in prescribing a single narrative to an entire food sector. This has led to an acknowledgement by many analysts that the linkages between small-scale rural aquaculture and socioeconomic outcomes remain unclear and are in need of further research (Allison, 2011; Bene *et al.*, 2016).

Rural aquaculture has been defined by Edwards & Demaine (1998) as "... the farming of aquatic organisms by small-scale farming households using mainly extensive and semi-intensive husbandry for household consumption and/or income (p1.3)." Belton and Little (2011) in turn define small-scale aquaculture as "an activity practiced predominantly by quasi-peasant producers, for whom aquaculture constitutes one element of a larger total livelihood portfolio," (p.154). They state that these quasi-peasants depend primarily on agriculture and family labour, may use some of their produce for subsistence, engage with both formal and informal input and output markets, and may have some engagement with off-farm activities

(hence the use of “quasi”). This profile of small-scale aquaculturists provides a good definition of small-scale aquaculturists in Bolivia, and therefore is used in this study.

There are essentially three pathways through which small-scale aquaculture is said to affect poverty: food security, social development, and economic development. These affect poverty both directly and indirectly by providing food, income, and employment to producers and value chain actors.

Aquaculture and food security

The first pathway, food security, is perhaps the least contested. There is firm evidence of fish’s nutritional benefits. Fish provides essential nutrients and micronutrients such as protein, fatty acids, vitamins D, A, and B, and various minerals (Roos *et al.*, 2003; 2007; Tacon & Metian, 2013). The links to human health have also been robustly established. He *et al.* (2004) found that fish consumption can protect against stroke, and Larsen *et al.* (2011) found that it can protect against cardiovascular disease. There is also some evidence that it promotes foetal and infant development (Larsen *et al.*, 2011). Although there has also been in recent years concern over the contaminants that can be stored in the tissue of fish (such as mercury), it is widely agreed that the overall nutritional benefits of fish greatly outweigh the risks (FAO/WHO, 2011; Sidhu, 2003).

Fish farming has also been linked to improved food security. There is evidence that fish farming households consume more fish than other households (Dey *et al.*, 2005; Gomna & Rana, 2007). Ahmed & Lorica (2002) also found that aquaculture farming in Asia had positive consumption, as well as income effects for households. There is evidence that it improves fish consumption amongst the general population, including the poor, as well. Toufique & Belton (2014), looking at national data from Bangladesh found that fish consumption amongst the poor had risen between 2000 and 2010 thanks to increases in aquaculture production. Aquaculture also has indirect fish consumption benefits. Hishamunda & Ridler (2005) found that commercial aquaculture created employment in sub-Saharan Africa, which led to improved access and availability to food, both fish and non-fish, for the poor, although small-scale household aquaculture was largely out of their

reach. Aiga *et al.* (2009) found that children in poor fish farming households in Malawi suffered less malnutrition than children in other households, although the causality was assumed to be a mix of fish intake and the purchasing power that the activity provided. These studies point to the food security benefits of aquaculture, including for the poor, but highlight that the pathways are not always direct.

Despite the benefits of fish consumption for health, and the link between fish farming and higher fish consumption, there are some limits to aquaculture's health benefits. In a recent study, Bogard *et al.* (2017) found that in Bangladesh people are indeed eating more fish than in the past, but that the fish is providing them with smaller amounts of nutrients and micronutrients than it used to. The reason they found was that capture fisheries used to be the primary source of fish, including a wide variety of small fish that were typically consumed in their entirety. The fish of today tend to be a small variety of large fish produced through aquaculture whose flesh is only consumed. Small fish have higher levels of nutritional value, especially when their bones and heads are consumed (Bogard, 2015). Therefore, the ways in which fish consumption impacts food security is more nuanced than the commonly held adage that simply eating fish is good. Small-scale aquaculturists should therefore be encouraged to address this by polyculturing a variety of species, including small ones with high nutritional value, especially for home consumption.

Aquaculture and social development

The social development outcomes from aquaculture are also viewed positively, but lack sufficient research from which broad theories can be robustly established. Social outcomes of aquaculture can be either cultural, or specifically contribute to enhancing equality for marginalized groups. On the cultural front, fish can be a status symbol, and can help households improve their social position. Harrison (1996) found in Zambia that being an aquaculture farmer made it easy to slaughter an animal to honour guests. Haque *et al.* (2010) noted that people in Bangladesh appreciated aquaculture for its ability to allow them to gift fish to community members. In many countries of Latin America, the holiday of Semana Santa is associated with eating fish, making fish producers important contributors

to the celebrations. Although subjective, these outcomes of aquaculture are not insignificant in bolstering aquaculturist's social standing.

On the equality-building front, aquaculture is seen as a means to greater woman's empowerment. The nature of women's participation in fisheries has been found to be significant but under-valued and under-researched (Bennett, 2005; Harper *et al.*, 2013; Tindall & Holvoet, 2008). In aquaculture, the role of women has been similarly under-researched, but their importance is becoming increasingly apparent. Williams *et al.* (2012) conducted a survey of female graduates from aquaculture training centers in North America, Europe, Asia, and Africa, and found that rates have increased from near zero in the 1970s to 30-60% today, depending on location. Shanthi *et al.* (2012) found that in India some women are becoming entrepreneurial leaders in aquaculture. In Vietnam and Nigeria, Velu *et al.* (2009) found that although women face constraints, they play important roles in fish grow-out, processing and marketing. In Nepal, an aquaculture development project aimed at women showed that they made a priority of utilizing the fish they grew to enhance their family's nutrition (Rai *et al.*, 2012). There is also evidence at the household level that aquaculture can be empowering for women (Rahman & Naoroze, 2007). Kelkar (2001) argues that it is conducive to many rural women's lifestyles as it has a low time and labour requirement, and can usually be located in close proximity to the home. In this way it is only a minimal disruption to other household obligations but provides a lucrative form of income that can make her an important earner for the family. These studies point not only to the importance of women in aquaculture, but that in some contexts aquaculture may be, or become, an emancipatory livelihood.

However, an empowering role for women in aquaculture is not inherently natural or guaranteed. In their value chain study of women in aquaculture in Vietnam and Nigeria, Velu *et al.* (2009) found that women had difficulty accessing credit, often had no ownership over operations, and were sometimes subjected to labour exploitation. In Nigeria some aquaculture women were also constrained by cultural traditions that limited women's freedom of movement and ability to take leadership roles. Gamage *et al.* (2006) found that although women participated

extensively in the Bangladesh shrimp value chain, the nature of that participation was significantly inferior to that of men. Women received significantly less pay for similar work, were typically relegated to less lucrative nodes in the chain, and almost all were only given casual or temporary work. Nuruzzaman (2012) found that Bangladeshi women were also constrained by the conservative, male dominated culture of the country, and by the fact that they tended to have limited literacy and accountancy skills. In general, women face many constraints and barriers to upgrading their participation in aquaculture based on social and gender norms. But, it is worth noting that these are deeply rooted in sociocultural contexts, though evidence has shown that improvements are possible. For aquaculture systems to become more socially sustainable, women's participation will have to be appreciated and expanded.

Another dimension of social development related to aquaculture is ethnic identity. Ethnic minorities are often marginalized groups who struggle to obtain the same access to opportunities that the general population enjoys (Bates, 1999; Psacharopoulos & Patrinos, 1994). On this front there is far less literature related to aquaculture as compared to that on women and gender. In fact, a Google scholar search for "race", "ethnicity", and "aquaculture" in a paper title yielded zero results. A search for "indigenous" and "aquaculture" yielded a small number of papers related to Australian, Norwegian, and Canadian indigenous peoples and aquaculture, but none related to indigenous peoples of the global South. A search for "ethnic" and "aquaculture" was more successful, but only moderately so, with three papers, all based on cases in the global South. In this respect, Bhujel *et al.* (2008) looked at ethnic women in Nepal and found aquaculture to be a promising means to address poverty and, in theory at least, inequality. Ahmed & Flaherty (2014) explored the potential of aquaculture for the ethnic Garo community of Northern Bangladesh and found that despite low technical knowledge and financial support, and high production costs, "small-scale aquaculture could play an important role in the rural economy of the Garo community," (p24). Pant *et al.* (2014) researched the Adivasi community in Bangladesh and found aquaculture to be a livelihood activity that fit with their landless condition and could reduce their

marginalization. These few studies point to aquaculture's potential to be a beneficial activity for ethnic minorities and indigenous people, but there is clearly more work to be done to understand the full extent of the linkages.

Aquaculture and economic development

Perhaps the most varied and debated pathway from aquaculture to rural poverty reduction is through economic development. As outlined above, most aquaculture occurs in rural areas of developing countries. Demand for fish is on the rise in new locales due to diversifying diets and fish is proving to be a relatively low cost high value product to produce in comparison to many other agricultural commodities. These trends are presenting a variety of economic opportunities for small-scale aquaculture farmers. However, the linkages between aquaculture and economic development are subject to a wide variety of variables. Different products, production systems, and markets yield outcomes that vary according to context. This has made it difficult for analysts to generate widely applicable recommendations on which types of aquaculture systems work best for economic development, or to agree that small-scale aquaculture works well at all.

There is a widely held notion that small-scale aquaculture can make a positive contribution to household economics, but literature supporting this view is limited and requires careful interpretation (Bene *et al.*, 2016). Specifically, there are two dominant ways that aquaculture reduces poverty; directly through aquaculture as a livelihood adopted by small-scale farmers, and indirectly through larger scale operations that generate employment and therefore employ the poor. Debate over which is superior has been growing in recent years.

There is evidence that small-scale aquaculture benefits producers. Dey *et al.* (2010) found that Malawian farmers that adopted integrated aquaculture-agriculture technologies obtained higher farm income and returns to family labour. Jahan *et al.* (2009) showed in Bangladesh "that the uptake of improved aquaculture practices has had a significant and positive impact on income, employment and household nutrition for adopters, along with additional benefits such as the accumulation of social capital through gifting of fish to community members,"

(p493). However, in these cases, and in other anecdotal accounts, it seems that better off farmers tend to obtain the benefits from the introduction of aquaculture and related projects (Belton *et al.*, 2011). This has led some analysts to argue that while there can be benefits to producers, the extreme poor tend to miss out on the purported benefits of producing aquaculture. But, this too is contradicted in some contexts. Pant *et al.* (2014) found that the extreme poor in the Adivasi communities of Bangladesh who adopted aquaculture were able to maintain the activity and benefited from higher household incomes. Barman & Little (2011) found that poor Bangladeshi households who were introduced to tilapia seed production enjoyed success in home consumption and in generating revenues from sales. These mixed results complicate the question of aquaculture's impact on poverty reduction.

The other way that aquaculture can reduce poverty, the indirect pathway, has also been found to be effective. Irz *et al.* (2007) found that commercial aquaculture in the Philippines has been a boon to poor households thanks to the large amount of employment it has generated. Hishamunda *et al.* (2009) argues that commercial aquaculture in Asia has had, and will continue to have, significant impacts on rural livelihoods and economic growth. Brummett *et al.* (2008), analyzing the development of aquaculture in Africa over the past forty years, argue that commercial investments in small and medium scale enterprises would be the most effective at boosting African aquaculture and realizing its poverty reducing potential. These findings, coupled with the trend of larger and more well to do farmers capturing benefits, has led some analysts to argue that because of resource and capital constraints that limit the poor's capacity to undertake aquaculture (Belton & Little, 2012; Lewis, 1997), the best model for aquaculture to reduce poverty is through the promotion of mid to large scale commercial aquaculture operations that generate employment opportunities for the poor (Belton *et al.*, 2012; Stevenson & Irz, 2009). This has led to a dichotomous view of aquaculture development, with those who argue for the promotion of small-scale extensive forms of aquaculture on the one hand, and those who argue for intensive mid to large scale forms on the other. However, this ridged either-or argument is handicapped by the inconsistent, and occasionally contradictory current evidence,

as well as by the general lack of research on the question. The variety of aquaculture systems, and the significantly different outcomes they may generate, coupled with the narrowness of the literature (the majority focuses on Bangladesh), paints only the most basic of pictures. Therefore, further research on other systems in other contexts remains highly needed (Belton & Bush, 2013).

A further complicating element to the small-scale aquaculture as driver of development and poverty reduction question is the growing pressure on producers to globalize. Aquaculture products are the most internationally traded food category, which has led some analysts and multinational institutions to emphasize commercialization and engagement with global value chains (FAO, 2014; Islam, 2008; Schmidt, 2003; World Bank, 2008). They argue that this can contribute to economic growth, and by extension poverty reduction, by generating foreign exchange (Bostock *et al.*, 2004; Thorpe, 2004). However, this is met with skepticism by other analysts who argue that while “going global” can give producers access to larger and more lucrative markets, and theoretically raise their income; it also exposes them to the volatility and insecurity of the global marketplace, and can trap them in asymmetrical power relationships with an oligopsony of buyers (Lebel *et al.*, 2008; Loc *et al.*, 2010; Ponte *et al.*, 2014). One example is that the buyer-driven nature of most global food value chains allows lead firms, usually large food retailers, to mandate food standards that can be difficult for small-scale producers to meet (Reardon *et al.*, 2003). Small-scale aquaculture producers in many areas are facing this challenge, which often leads to their marginalization in both a social and economic sense (Belton *et al.*, 2010; Bush *et al.*, 2013; Tran *et al.*, 2013; Vandergeest, 2007). They are also challenged by the increased competition and price volatility associated with global markets (Loc *et al.*, 2010). Belton & Little (2008), looking at the globalization of aquaculture in Thailand and the resultant farmer engagement, found that “although (globalized) farmers are nominally independent, their livelihoods are vulnerable to both local pressures such as disease and external factors such as international competition, and that they have limited flexibility in their production strategies. As a result, the livelihoods of small and medium-scale shrimp farmers are less resilient in the long term than those of (localized)

integrated fish farmers despite having (until recently, at least) the potential to generate far greater financial returns,” (p.140). In a more specific analysis of fish trade and development, Bene *et al.* (2010) found that in sub Saharan Africa fish trade seemed to have little development effect for the poor. Therefore it seems that going global can have benefits to national revenues and the farmers with the capacity to engage, but complicates the livelihoods of small-scale aquaculturists, often adversely, and does not clearly translate into poverty reduction.

A key to answering the question, does small-scale aquaculture reduce poverty through economic development, is to adopt some flexibility and nuance in our understanding of the significance of outcomes. Bush and Kosy (2007) found that aquaculture in Laos served producers not only as a source of consumption and income, but also was a tool for minimizing risk and improving resilience in the face of environmental and economic change. Bush (2004) found that in Laos ponds were associated with modernity, which made them a “space of power” where community members, including senior members, would congregate and socialize. Harrison (1996) had a similar finding in Zambia, where she determined that aquaculture, more than a source of income, was a status symbol, which she concluded could lead farmers to “material benefits through access to development assistance,” (p273). Such findings point to the subjective and less tangible wellbeing outcomes that aquaculture may generate. Not only can these be beneficial in their own right, but may yield material benefits indirectly.

Another missing element to our understanding of aquaculture-poverty linkages is the variability and nature of rural poverty. Landlessness is often a critical barrier to aquaculture adoption by the poor, and also serves as a demarcation line between the poor and non-poor. However, there is wide variation in the socioeconomic construct of rural people. For example, the Organisation for Economic Co-operation and Development – Development Assistance Committee (OECD, 2010) have outlined five rural “worlds” that capture the variations in the poverty conditions of rural people:

Rural World 1 – large-scale commercial agricultural households and enterprises.

Rural World 2 – traditional landholders and enterprises, not internationally competitive.

Rural World 3 – subsistence agricultural households and micro- enterprises.

Rural World 4 – landless rural households and micro-enterprises.

Rural World 5 – chronically poor rural households, many no longer economically active.

All five rural worlds can be found in Latin America, including Bolivia. However, rural worlds 2, 3, and 4 are most common in Bolivia. Rural world 1 exists but is dominated by the small number of landholding elite. Rural world 5 also exists in Bolivia, but because of widespread land ownership (although plots are relatively small), an improving social support system, and a growing economy that has generated employment, it is less prevalent than rural worlds 2, 3 and 4. The critical factor is that in the rural worlds 2 and 3 in Bolivia, land holding does not equal poverty avoidance⁹. Many small-scale farmers are poor both in a material and multidimensional sense. This means that while their poverty would complicate the adoption of aquaculture, just as it would the adoption of any new livelihood activity, it would not outright preclude their participation. Therefore, there is reason to believe that in Bolivia, aquaculture as a livelihood could be beneficial to the poor.

There are also problems with the observation that small-scale aquaculturists tend to be better off than others in their communities (although not always). Some analysts have interpreted the situation to mean that the poor cannot access or benefit from aquaculture (except through employment). But, as Belton & Little (2011) put it, “such a conclusion overlooks the potentially important and rather less obvious role that small scale aquaculture may play in poverty *prevention*, particularly given that in locations such as Bangladesh the situation of even those who are well-off relative to their neighbours may remain perilous at best,” (p163). Another problem with the claim that aquaculture can only be undertaken by those who are better off is that it remains unclear whether those who are better off enter into aquaculture, or if people who enter into aquaculture become better off. Appreciating the nuanced nature of poverty is necessary for a more consistent and

⁹ A detailed description of the nature of rural living and livelihoods in Bolivia is available in chapter 3.

informed contribution to the discussion of aquaculture development and its poverty reducing potential.

This literature has shown that the pathways between aquaculture and economic development, either at the household or national levels, are varied, and often not fully understood. However, there is a broad agreement that aquaculture does and/or can improve the livelihoods of certain actors, but that further research is necessary to better understand the reasons.

2.2.3 Forging Pathways to Sustainable Aquaculture

The rising importance of aquaculture and the need for more research has been demonstrated in the last five years by the publication of a number of overviews on the state of aquaculture knowledge. Allison (2011) found that aquaculture development has been, and continues to be highly heterogeneous, and that contexts should be carefully understood when undertaking development interventions. He also points to the need for evidence-based political economy analysis and policy coherence with overarching development, poverty reduction, and food security strategies. Recommendations such as this led the UN High Level Panel of Experts on Food Security and Nutrition to state that fish is “crucial to any debate and action to reduce poverty and improve food security and nutrition, (HLPE, 2014).” Bene *et al.* (2016) had similar recommendations, and also outlined that despite a growing literature, the drivers of, and impacts from, aquaculture growth are unclear. Both studies point to the need for further research on the linkages between aquaculture and sustainability, as well as how to foster sustainable and equitable aquaculture adoption and growth.

Not only is there a need for further research on aquaculture, but also as the preceding sections have shown, there is a need for such research to be undertaken with understudied systems and geographies. The vast majority of aquaculture research is on Asia and, to a lesser extent Africa. Research on other regions, particularly Latin America, is virtually absent. Given the rapid growth of

aquaculture there, it is critical to understand how it is manifesting and what can be done to improve its yields and sustainability.

This lack of research makes answering the most important question, will aquaculture sustainably feed the future, currently quite difficult. The broad consensus has simply been that aquaculture systems will need to be made both more productive and more sustainable (Little *et al.*, 2016; Subasinghe *et al.*, 2009; Troell *et al.*, 2014).

To make aquaculture systems more productive and sustainable, we need to utilize effective approaches to research. Because of the complex nature of systems, and the need to understand how they affect various actors, and how such actors interact with one another, it is critical to adopt methods that are up to this task. Value chain analysis is one such method.

2.3 Value Chains

A value chain represents a specific product within a broader food system. A value chain is a metaphor for understanding the flow of activities and processes involved in taking a product to market, from upstream producers to downstream consumers, including the power relationships between different actors, governance structures, and institutions along the chain (Gereffi *et al.*, 2001; Gibbon *et al.*, 2008). Over the last two decades, value chain analysis (VCA) has emerged as an effective way to conceptualize and analyze this dynamic and often complex process. It has also been found to be useful in analyzing food systems since it allows for the delineation of boundaries for the scope of a study, making it manageable. It also captures some of the dynamism of the system, which allows for inference on the functioning and outcomes of that system.

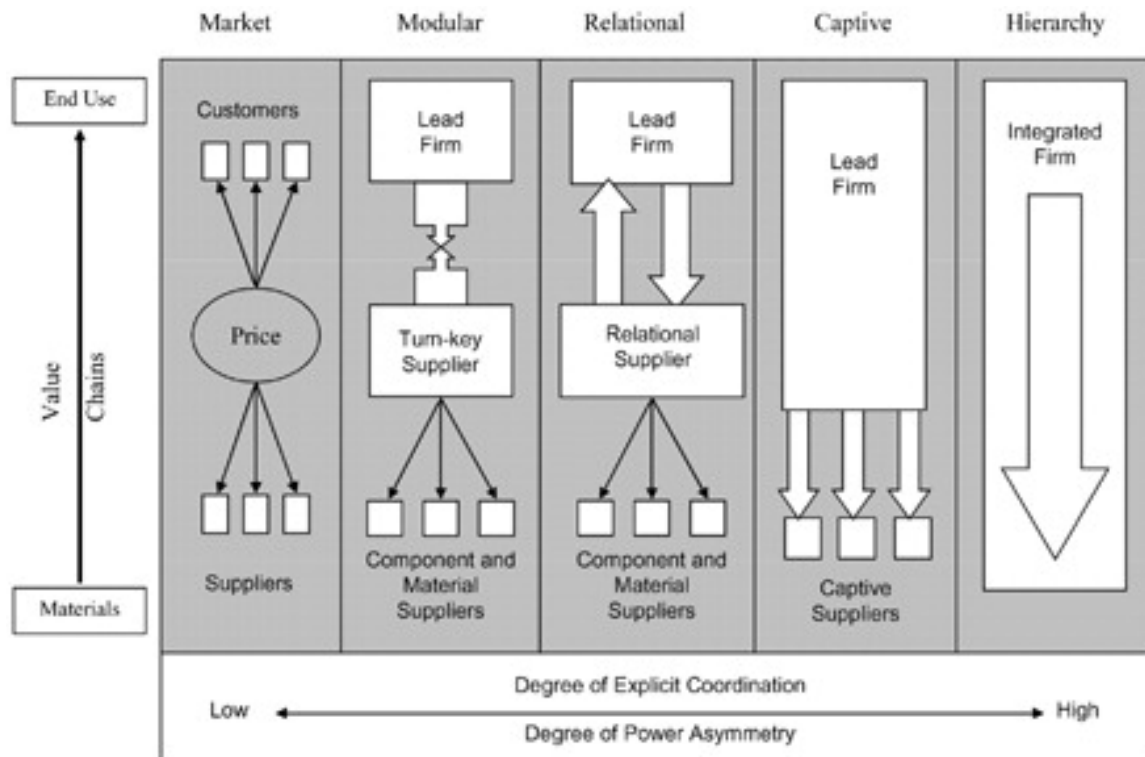
For these reasons VCA has become popular for analyzing global trade. First described as commodity chains, then global commodity chains, and often lumped together with supply chains and production networks, this branch of analysis is now commonly known as global value chains (Bair, 2005). Global value chain research is

rooted in the tradition of world systems theory and has evolved in response to the multiscalar dynamics of globalization, accounting for the embeddedness of global networks of production at regional and local levels (Henderson *et al.*, 2002; Hess, 2004). While this study does not focus on a *global* value chain, global value chains form the backbone of the vast majority of value chain theory. They are to an extent different from local value chains, but their functional similarities are numerous. Thus, global value chain theory can shed light on how local value chains can and do operate, and the various outcomes that they can generate.

The governance of value chains has been a key point of interest for many scholars. This is because the governance of value chains controls the distribution of power in the chain, which dictates who reaps which benefits, and how much. As outlined in Gereffi and Korzeniewicz (1994a), chains usually fall under one of two different types of governance structure; producer-driven or buyer-driven. Producer-driven chains are characteristic of higher-tech industries (auto, aerospace, electronics) where a lead firm coordinates chain activities and is often vertically integrated. Buyer-driven chains on the other hand are characteristic of simple products and commodities (food, clothing, consumables), and are usually driven by lead firms such as major brands or retailers that dictate terms of production to assorted suppliers (Gereffi & Korzeniewicz, 1994b). However, this dichotomy tended to be overly simplistic, which led Gereffi *et al.* (2005) to develop a broader list of governance structures that provided greater nuance to the power dynamics in global value chains. Five types of value chain governance were identified; Market, Modular, Relational, Captive, and Hierarchy (figure 2.4). Which structure a particular value chain falls into is based on three factors; “1.The complexity of information and knowledge transfer required to sustain a particular transaction, particularly with respect to product and process specifications. 2.The extent to which this information and knowledge can be codified and, therefore, transmitted efficiently and without transaction-specific investment between the parties to the transaction. 3.The capabilities of actual and potential suppliers in relation to the requirements of the transaction,” (ibid). Whether each factor is high or low, and in

which combination they manifest, is how to determine which type of governance structure a chain would fall under.

Figure 2.3: Five global value chain governance types



Source: Gereffi et al. 2005

The governance of a value chain is not static, nor does it always fall cleanly into one type, but can have elements of various types. It is also not always entirely located in the hands of one entity or node; it may shift between firms or towards other actors. It may also shift geographically, especially as new clusters of innovation, production and consumption emerge. For the rural poor, different chain governance presents different opportunities and challenges. Therefore, knowing which form of chain governance exists and which forms could exist is an advantage in shaping value chains to be more responsive to the needs of poor actors (Humphrey & Schmitz, 2000).

Often the primary purpose of undertaking value chain analysis, and understanding their governance, is to identify “upgrading” opportunities for certain

chain actors. Upgrading is broadly defined as “improving a firm’s (or group of actors) position within the chain, and this is generally associated with increased competitiveness that allows for the capture of greater value-added through the production process,” (Bair, 2005, p165). Gereffi *et al.* (2001) have identified four types of chain upgrading; product (produce a higher value product), process (improve production efficiency and scale), intra-chain (take on more or different chain activities), and inter-chain (diversify into other chains) upgrading. Ponte (2008) added “other forms” of upgrading to the list which can include “delivering larger volumes (even at lower quality), matching standards and certifications, delivering on logistics and lead times, and getting paid better for the same product (i.e. Fair Trade),” (p9). Like the governance typology, the categorization of upgrading is important for development initiatives because different forms of upgrading present different forms of risks and opportunities for different actors and communities (Humphrey & Schmitz, 2000).

Recently value chain literature, especially work focused on marginalized workers, has broadened its focus to include social upgrading in value chains. Social upgrading entails improvement of workers rights and entitlements, and enhancement of the quality of their employment (Barrientos *et al.*, 2011). Concern for social upgrading grew out of the acknowledgement that it does not always follow economic upgrading (Milburg & Winkler, 2011). The economic gains of value chain participation do not always translate into safe, secure, and empowering jobs. However, the links between economic and social upgrading are complex; certain workers may experience social upgrading while others do not. Upgrading and downgrading can also simultaneously occur in some contexts (Rossi, 2013). Considering social upgrading is an important step in value chain research, but more work remains to make VCA an effective tool to understand how to achieve poverty reduction.

One weakness of social upgrading literature is the definition of social upgrading. The term has been almost exclusively applied to labor, and therefore narrowly focuses on improvements in working conditions. This is unfortunate since the term ‘social upgrading’ implies a much wider spectrum of upgradable elements

of the 'social'. Health, education, equity, environmental and livelihood sustainability, and greater access to opportunities should be measured as outcomes of value chain participation and upgrading, and should fall under the banner of 'social upgrading'. VCA, therefore, needs to integrate a broader set of factors that influence upgrading, and the success of upgrading should be measured by improvements in those same factors. Traditional value chain approaches to upgrading tend to focus on market opportunities. While a detailed understanding of markets and linkages within markets where producers can add value is necessary for an effective upgrading strategy, alone it is not sufficient. Concern for other factors such as the environment and equity amongst producers may yield insight into opportunities for upgrading. Investments and practices that limit environmental degradation will lead to longer term profitability of products. Gender equity will empower women, which has been shown to have a number of benefits to households and communities including higher child education attainment, higher savings rates, and greater health, all of which contribute to further economic and social upgrading in the chain. Other forms of equity building, such as between social groups, could also feed into overall producer upgrading (Christian, 2012).

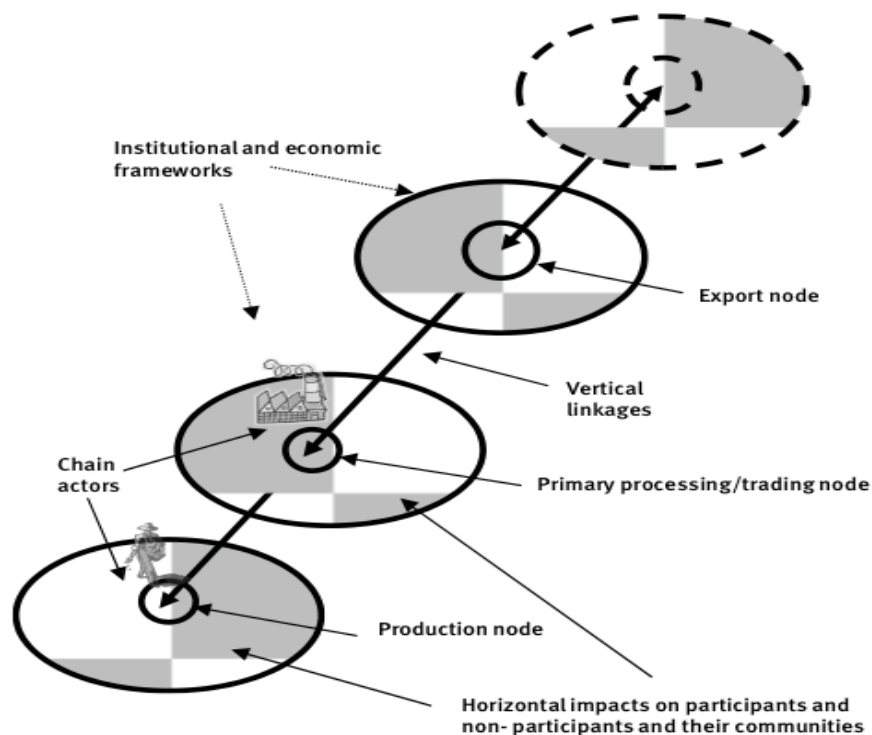
Social and environmental upgrading, coupled with economic upgrading, can improve the sustainability of a food system while also increasing its production. In the case of aquaculture, this can help it meet the triple challenge. Therefore, a more holistic approach to value chain analysis that incorporates horizontal linkages to social and environmental elements is needed.

2.3.1 Horizontal Linkages

As value chain researchers began to focus on broader factors that affected upgrading, they began to explicitly explore the horizontal linkages that influence chain participation and benefits. However, horizontal linkages within value chains are not well defined. Generally they are considered to be influential factors operating at the same scale of a specific node in a value chain. In the literature the

term has been used to refer to everything from competing firms, competing (or cooperating) producers, various physical inputs, labor organization, and more intangible factors such as knowledge exchange, poverty and the environment. For this study we draw from Riisgaard *et al.*'s (2010) interpretation of horizontal linkages; the “poverty, gender, labour and environmental concerns” (p195) associated with value chains. Bolwig *et al.* provide a visualization of how these relate to the vertical nature of value chains (figure 2.5). Ultimately the purpose of integrating horizontal factors is to generate a more holistic VCA that unveils upgrading strategies for both economic development and multidimensional poverty reduction. Riisgaard *et al.* (2010) define such upgrading as “a desirable change in chain participation that increases rewards and/or reduces exposure to risk – where rewards and risks are understood both in financial terms and with regard to outcomes related to poverty, gender, labour and the environment,” (p196).

Figure 2.4: Stylised value chain mapping highlighting horizontal and vertical elements



Source: Bolwig *et al.* 2010, p187

Some researchers have argued that horizontal linkages are so prevalent and important at all nodes of the chain that it is necessary to re-conceptualize the chain metaphor. They point out that capturing the complexity of the multi-scaler and multi-stakeholder nature of production, trade, and consumption would be accomplished more effectively through analysis using a network as a metaphor, and refer to this typology as a production network (PN) (Coe *et al.*, 2008). Coe *et al.* (2008) describes the linearity and the high degree of focus on governance of value chains as ignorant of many other attributes, and far too simplistic. They believe that trade and production, and the embedded power relationships, are much more complex than made out in the value chain literature, and are contingent and variable over time.

According to Parrilli *et al.* (2013), Instead of an entirely re-conceptualized approach to understanding the broader effects of value chains, that is abandoning VCA and bolstering PN analysis, the two should be more closely integrated. They argue that even though networks of actors and firms operate at every node of production chains, and often at several, the concept of linearity, that a commodity travels a path from production to consumption, remains highly valid. Value addition, and the socioeconomic and institutional context which mediate it, is indeed more complex than simplified chains suggest, but value is still added in a relatively linear fashion, each time receiving more processing or inputs, which build a product through stages, and value addition is rarely redundant or overlapping. The solution is to take steps to integrate the two approaches. Increasing focus on horizontal linkages within the value chain framework would go a long way in addressing this issue.

PN literature has criticized value chain literature for overlooking horizontal links (Henderson, *et al.*, 2002), but value chain literature has recently begun to adapt the PN framework and consider horizontal elements as the above-mentioned works of Riisgaard *et al.* (2010) and Bolwig *et al.* (2010) demonstrate. This has led to work looking at value chains and gender (Rubin & Manfre, 2014; Haverhals *et al.*, 2016; Velu *et al.*, 2009), the environment (de Marchi *et al.*, 2013; Donald, 2004;

Halberg, 2004; Halberg *et al.*, 2005), and poverty (du Toit, 2004; Humphrey & Navas-Aleman, 2010; Phillips, 2011a; 2011b; Phillips & Sakamoto, 2011; Stoian *et al.*, 2012).

Despite the growing value chain literature, there remains a number of critically lacking elements. On the empirical side there is a dearth of research on aquaculture value chains generally, and aquaculture value chains and their poverty reducing impact specifically. There is also a lack of understanding of food value chains, and aquaculture value chains, in Latin America, how they are affecting the formation and functioning of food systems, and what their developmental impact is and could be.

With respect to the theoretical shortcomings of development oriented value chain research, the vast majority focuses explicitly on global value chains. The rest does so implicitly, with a minimal focus on local value chains. This is extremely problematic since 95% of food systems operate in domestic markets, and a large portion of the food systems that form the domestic food system are likely quite territorially fixed to a particular region within a country. Therefore investigating the horizontal and vertical linkages of local, rather than global, value chains, may yield insights into how to undertake more impactful chain upgrading that has meaningful benefits not just for marginalized actors, but for whole communities. Furthermore, elements of environment, poverty, and gender are explored in several VCAs, but they are not taken holistically. For example, most VCA that looks at the environment uses Life Cycle Assessments, but overlooks more specific and contextual environmental risks and opportunities. The same is with poverty, which tends to take a monetary approach, and overlooks such dimensions as food security. Finally, there also tends to be a focus on how the chain affects horizontal elements - the environment, poverty or inequality - but little consideration of how these elements affect the functioning, capacity, and future potential of chains. Little is known about the mediating effects of the sociopolitical context in which value chains are necessarily embedded. These bi-directional effects of horizontal linkages, and their relative disconnect from one another, means that they have not been

conceptually well linked with the overarching goal of social, economic, and environmental sustainability.

This study undertakes a more holistic approach to VCA. It incorporates food security, broadens its analysis of poverty and the environment, and considers the gendered nature of the chain. It also utilizes value chain theory and the horizontal integration approach to investigate the functioning of a local value chain because this may yield new insights into how multidimensional upgrading may be achieved for chain actors. To do all of this, this study views sustainable value chains as the ideal tool, and one that drives outcomes that address the triple challenge for food systems and aquaculture.

2.3.2 Holistic Value Chains Analysis

For VCA to effectively address the triple challenge, it needs to incorporate horizontal linkages and to analyze them holistically, and must do so with the ultimate goal of sustainable intensification and development. Current value chain studies tend to investigate economic upgrading opportunities. Those that incorporate horizontal linkages also remain narrowly focused, and typically try to uncover one dimension of upgrading beyond the economic. For example, a VCA that looks at the environment tends to choose one aspect such as the carbon footprint, or ones that seek to improve gender simply look at what activities women do and do not participate in. Such dimensions need to be more thoroughly linked to the broader sociopolitical, economic, and environmental context because singular dimensions fall short of a holistic, and therefore more robust analysis (Gomez *et al.*, 2011). Thus, there is a need for a systems approach, rather than a fixation on one element or actor group in the chain (Neven, 2014). To do so, the unique attributes of the value chain in question, which in this study is a food value chain, must be understood. In recognition of the increasing popularity and importance of food value chain analysis and the need to make them more sustainable, the FAO has begun to assemble handbooks on this topic. In the first, Neven (2014) defines a sustainable food value chain, and it is this definition that is used in this study. It is:

the full range of farms and firms and their successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular food products that are sold to final consumers and disposed of after use, in a manner that is profitable throughout, has broad-based benefits for society, and does not permanently deplete natural resources, (p.vii).

Neven (2014) outlines some caveats to developing sustainable value chains for small-scale farmers, and many of them apply to local food system development as well. Bolstering small-scale farmers should not be an end in and of itself, but rather a stepping stone out of poverty and food insecurity. While investments in small-scale agriculture are shown to have a greater impact on poverty reduction than investments in other sectors, on-farm employment tends to be inferior to off-farm and/or urban employment. Successful small-scale farming operations tend to move people out of the most severe forms of economic insecurity, but only to a certain point, after which they remain economically and often socially unequal relative to other people with employment in secondary or tertiary economic sectors. Therefore, this progression should be acknowledged and planned for in development interventions and policies.

For sustainable aquaculture value chains that operate at the local scale, Neven's definition and caveats are highly applicable. However, this study is careful to acknowledge differences between aquaculture and other agricultural systems. Finfish are typically more valuable pound for pound, is (or can be) processed in more labour intensive ways, and generates more impactful food security benefits. The current and potential ways that it does or does not dovetail with women's capacity is also different. It also has different environmental concerns due to the nature of its land and water use, and its inputs. A VCA that incorporates horizontal linkages, sustainability, the uniqueness of finfish aquaculture, and does so holistically, is thus necessary.

A fully sustainable aquaculture value chain that addresses the triple challenge will need to reduce waste, increase production, have a neutral impact on the environment, and yield net positive outcomes on multiple dimensions of the

social and economic wellbeing of chain actors, from producers to consumers. While such a chain may be difficult to reach, it is critical that the process of making improvements begins now so that aquaculture can be put on a path towards contributing to more equitable, productive, and sustainable food systems.

2.4 Summary

This chapter has laid out the broad concepts needed to investigate the central Bolivian aquaculture value chain and uncover ways that it can be made more productive, and socially, economically, and environmentally sustainable. How it can contribute to addressing the triple challenge.

The first section of this chapter presented the current problems with food systems and how they developed. It then discussed the ideas of local food systems and food sovereignty as frameworks for altering the food systems. In the case of local food systems, these are spaces that may generate particular socioeconomic and environmental outcomes, and should be investigated. In the case of food sovereignty, it serves as a powerful, but somewhat flawed, blueprint for how food systems should work, and is central to Bolivian rural development. It concludes by discussing the advantages and limits of these frameworks in navigating the triple challenge.

In the second section of this chapter the relationship between aquaculture and rural development was discussed. The evolution of aquaculture has generated a food system that is rife with opportunities and challenges. Demand for aquaculture continues to grow thanks to changing socioeconomic demographics and collapsing fisheries, making it the fastest growing food sector in the world. Rural producers are particularly well poised to take advantage of these trends, which has made aquaculture appealing to a wide array of analysts and institutions. However, environmental, social, and economic problems and questions make the pathways between aquaculture and rural development unclear. Therefore it is becoming

increasingly necessary to understand these linkages better, and to forge more sustainable aquaculture systems.

In the third section it was argued that better tools for understanding the dynamics of food systems were needed if the triple challenge was to be effectively addressed. Value chains were outlined as useful in this, but that conventional value chain analysis has been lacking. It was then argued that it was therefore necessary to incorporate horizontal elements – environmental, social, and poverty reduction - into the traditional vertical economic analysis. It was also argued that horizontal linkages should not be rigid, but constitute a holistic view of value chains that uncovers the qualitative linkages between functions and outcomes. Sustainable food value chain analysis was outlined as a useful method for framing a holistic VCA.

In the next chapter, this analysis of the food system is complimented by an analysis of the history of Bolivia and the context in which the evolution of aquaculture will take place.

Chapter 3: Bolivia

This chapter outlines Bolivia's recent history, its transition to a democratic socialist state, and the effects this has had on social and economic development. It specifically examines how the evolving political landscape has and has not benefited the poor and marginalized, particularly those whose livelihoods depend on agriculture. This macro development story is then woven into the micro development story of small-scale aquaculture's recent emergence and growth in the country.

The purpose of this chapter is two fold. First, it is imperative that any attempt to investigate the development of food systems in Bolivia carefully considers the influence of the country's history, society, and culture. Furthermore, these factors have an important mediating effect on the opportunities and challenges that are being created by aquaculture. Second, this chapter contributes to providing a holistic value chain analysis that is a key methodological contribution of this study. Such an approach allows for deeper understanding of how to forge effective pathways towards more economically, socially, and environmentally sustainable food systems.

3.1 The Evolution of a Rich and Poor Country

Bolivia has a remarkable amount of cultural diversity. While such diversity is a point of pride and strength for the country, it has also fostered tensions and disparity. This dynamic sociocultural context has shaped the country into what it is today, a nation of both riches and poverty, in both people and resources. This unique context has played an outsized role in the development of Bolivia's food system generally, and its aquaculture system specifically.

3.1.1 Cultural Diversity and Conflict

The largest ethnic group in Bolivia, based on Bolivian self-identification, is indigenous. Thus it has the highest percentage of indigenous people of any country in the Americas. The lineages vary significantly with dozens of different groups having been identified. The largest are the Quechuas (44%), Aymaras (38%), Chiquitanos (3.5%), and Guarani (2.3%). The self-identifying nature of the census, however, does not permit *mestizo*¹⁰ (mixed) as a response, which is estimated to be in actuality the largest ethnic group (INE, 2016). The number of self-identified indigenous people also varies greatly from census to census with 62% of the population in 2001 but only 40% in 2012. This was because the question regarding ethnicity became a little more restrictive, Bolivians tend to have a fluid definition of what constitutes indigenous (or not), and the term became more politicized (IADB, 2014). Before the Spanish, different groups occupied different regions and were only loosely affiliated with one another. The primary ethnic division was between the more populous altiplano peoples (Quechua, Aymara) and the Northern and Eastern lowlands peoples (Guarani, and others). Over the years the location of these groups became less uniform as they migrated for land, work, or were moved by force. For example, today over half of rural inhabitants around the lowland city of Santa Cruz originate from the Andean region (Fabricant, 2012). As in most other Latin American countries, many Bolivians, particularly the urban and the wealthy, have some Spanish ancestry. Bolivia also has many other groups of people from all over the world including Africans, Chinese, Europeans, and East Indians. There are colonies of Japanese people who settled after World War 2, and Mennonite colonies of German immigrants as well. The country recognizes 36 official languages, but most are used infrequently. Spanish is the primary language, is used for official purposes, and is taught in all schools. Quechua, Aymara, and Guarani are the most widely spoken indigenous languages.

¹⁰ *Mestizo* in Latin America means a person of combined European and Amerindian ancestry. In Bolivia the term is used loosely as many people have various mixes of ancestral lineage.

The vast cultural and ethnic diversity of Bolivia has long made it a country rife with civil conflict. The most severe and enduring division is between those with Spanish ancestry and those who are indigenous. The former politically and violently dominated the wealth and resources of the country while the latter were exploited and marginalized. This was perpetuated in various forms throughout Bolivian history, and today has become a rather convoluted division; “the high degree of racial mixing that occurred over time, and the social norms linking status to proportion of Spanish ancestry, created a singularly complex hierarchy that ranged along a color spectrum with somewhat fluid boundaries,” (Crawford Young, quoted from Van Cott, 2000, p.xiii). This hierarchy has complicated group identities and associated conflicts by shifting them from simply being ethnic to being also driven by socio-political and economic status.

Despite the large population of indigenous people and their dispersal throughout the country, divisions between indigenous groups in Bolivia has also been, and continues to be, quite common. The most apparent racial tension and ill will are between the historical peoples of the highlands and the historical people of the lowlands, but group-by-group racism also occurs regularly (Pila, 2014; Weber, 2013). The animosity is centuries old, and is often public, overt, and occasionally violent (Brie, 2008; Fabricant, 2009). The experiences and actions of these different groups have at times hampered improvements in indigenous rights and freedoms (Canessa, 2014). The rocky relations have also contributed to complicating economic and social development and poverty reduction, particularly in rural areas, by creating friction in policy formation, projects, and programs that must by nature involve various groups (Pila, 2014). However, rather than fitting into commonly held notions of indigeneity as a uniform concept, it is important to note that Bolivian indigeneity is multi-faceted and complex. For example, the *mestizo* nature of most Bolivians lineage allows them to identify with different groups at different times for different reasons. This has caused conflicts to be more nuanced than simple racism, and causes peoples positions and beliefs, which they associate with cultural heritage, to in fact be intertwined with other influential factors such as social class and geography. Divides amongst Bolivian people are therefore often formed by a

combination of divisive factors such as uplands versus lowlands, urban versus rural, and rich versus poor. Such divides have created and continue to create various complex and competing visions and demands of the state that have set significant hurdles for economic and social reform, and have perpetuated massive inequality (Pila, 2014; Weber, 2013).

While tensions along class, cultural, and geographical lines (which are often interrelated) have complicated Bolivia's evolution as a nation, they are deeply embedded within, and largely formed by, the overarching social construct of colonialism. Colonial and post-colonial processes have been integral to Bolivia's socioeconomic trajectory, and continue to shape and define it today. According to de Mesa (1999, quoted from Kohl & Farthing, 2006, p.34) these processes can be grouped into three interrelated and recurring themes: "the appropriation of the country's wealth by national and international elites, ongoing resistance by the indigenous majority, and tensions between the regions and center." While these are not unique to Bolivia, indeed they are experiences shared widely throughout the developing world, they have been particularly acute in the country. They have contributed to creating "one of the most extreme cases of economic dependency in Latin America," (Kohl & Farthing, 2006, p.34).

The effects of colonialism have permeated all aspects of Bolivian society, but have disproportionately affected the rural indigenous majority who suffered a long history of oppression and exploitation (Klein, 1982). Soon after decimating the Incan empire, the Spanish began extracting silver found in large deposits around the mountains of the center-south of the country. The mines were integral to Spain's economy and colonial ambitions and, despite attempts to hire workers, eventually required forced labour to remain as productive as was needed by the Spanish crown. The indigenous population provided the necessary workers who toiled in extremely hazardous conditions, with an estimated four million perishing in the mines (Klein, 1998; Lane, 2015). Indigenous people also lost much of their agricultural land. Prior to Spanish contact, land was held communally, but through colonial violence, Western systems of private land ownership were introduced and expanded. Land tenure became quasi-feudal, and remained that way both under the

Spanish, and then under the minority white ruling elite after independence (Klein, 1982). Both groups coerced indigenous people into deplorable work conditions on large plantations. The only other option for Indigenous people was to toil on remote and marginal lands for which they had no title (Langer, 1989).

Dissatisfaction with the ruling elite led workers and middle class people to unite and incite the Bolivian National Revolution, which led to the introduction of universal suffrage and agrarian reforms. It wasn't until 1951 that the conditions faced by rural indigenous peoples began to improve. According to Klein (1982), "The resulting social, economic, and political reforms, while they did not destroy the dual society or eliminate the one-sided acculturation of Indians, did radically reduce the level of exploitation," (p.ix). Although indigenous empowerment and social activism continued to develop slowly after the revolution, Gotkowitz (2008) has argued that rural indigenous activists played a key role in the revolution and laid the foundation for the indigenous social activism that came to be a defining aspect of the country. Emboldened by the revolution, indigenous led agricultural unions began seizing land and pressing the government for titles and recognition. Prior to the revolution, 615 haciendas owned over half of all arable land and extorted labour, and sometimes sexual favors, from indigenous serf workers (Patch, 1961). After the revolution this concentration of ownership was diluted, but only partially. Although the conditions faced by rural agricultural workers garnered sympathy and sparked demand for social change, the government was primarily swayed towards land redistribution and titling as a means to modernizing the agricultural sector and improving the national economy (Farthing & Kohl, 2014).

Through the latter half of the 20th century conditions for indigenous people continued to improve, but they remained on the margins of politics and the economy. Key pillars for indigenous equality such as land reform and social freedoms also continued to be built, but like many political undertakings in Bolivia at the time, were plagued by corruption and half-measures (Farthing & Kohl, 2014). They were also often fractious due to competing visions and demands of different cultural, regional, and economic groups. The length of time it took to begin to address indigenous hardship and marginalization, and the subsequent rocky road to

a full recognition of indigenous rights and freedoms, was also due in part to the country's perpetual state of political upheaval. Bolivia has the distinction of having had more *coups d'état* than any other country (157 between 1825 and 1982¹¹) a historical legacy that stunted both social and economic development. The cultural diversity of Bolivia, and the consequent social conflicts, coupled with consistently unstable governance and institutions, were critical in laying the foundation of popular unrest and a desire for sweeping change (Artaraz, 2012).

3.1.2 Neoliberalism and Resistance in Bolivia

Bolivia has always been dependent on the world economy, more so than most other countries in Latin America. Its globalization began with the first cargo of silver that was pulled out of the ground and shipped to Europe, and it has remained reliant on foreign markets ever since (Tsolakis, 2011). As outlined earlier, reliance on resources perpetuated a governmental system of exploitation and corruption that marginalized the indigenous majority for the benefit of the minority economic elite. By the 1980s this had caused prolonged and often violent unrest among the rural and working classes. This threw the country into economic and political chaos, and ultimately caused a shaky democracy to emerge in Bolivia, which sparked hope for a more equitable future. The subsequent response to the country's economic problems however, proved to be just as, if not more so, detrimental to the realization of economic and social justice.

David Harvey (2005) defines neoliberalism as “a theory of political economic practices that proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an institutional framework characterized by strong private property rights, free markets, and free trade,” (p.2). Bolivia became a testing ground for this theory and its related policies and governance (Kohl, 2006), the consequences of which reverberate today. Bolivia

¹¹ Taken from Farthing & Kohl (2014), who took it from Dunkerley (2007, p.5) who found the information from the Guinness Book of World Records, but they no longer have an entry for such a topic on their website. Nonetheless, even if the number is not exact, many sources indicate that Bolivia has had more coups than any other nation.

serves as a stark example for how the neoliberal system functions, but also for how popular resistance to it can take shape (Kohl & Farthing, 2006). Understanding this history is central to understanding rural development in the country as it has shaped and complicated the nation's economic and social development, especially for the indigenous rural poor.

From 1970 until 1982, Bolivia went through seventeen changes in governmental leadership, most of which were military dictatorships and some administrations lasted merely a few days (Wikipedia, 2016). Although Bolivia's first democratically elected president came to power in 1982, his grip on power was shaky and the economic system teetered on the brink of collapse. Hyperinflation had reached an annual rate of 24,000%, general strikes were common, and social tension was at a boiling point. However, economic crisis was averted with new elections held in 1985 and stronger leadership taking the reigns. The late 1980s saw Bolivia begin to stabilize both economically and socially, due in part to the introduction of new neoliberal policies (Kohl, 2006). One of the earliest manifestations of neoliberalism was in 1985, with the introduction of structural adjustment policies intended to stave off the impending economic collapse (Sachs, 1987). Another was when tin prices collapsed in the same year and the state laid-off twenty thousand miners. The episode served as the spark for governmental interest in the privatization of state owned assets (Van Cott, 2000).

In 1993 Gonzalo Sánchez de Lozada, a successful mining businessman from Cochabamba who was educated at the University of Chicago, became President of Bolivia. He had been the former Planning Minister and was responsible for getting the country's hyperinflation under control in 1985. Soon after being elected he introduced the "Plan de Todo" (Plan for All), which sought to simultaneously address historical injustices and economic mismanagement through an aggressive neoliberal agenda. This included the privatization of dozens of public enterprises including resource, transportation, telecommunication, and utility companies. It also included large-scale decentralization of government control that was passed down to more regional and local governmental levels (de Lozada & Faguet, 2014; Kohl, 2002). In 1997 de Lozada was defeated in national elections but his economic

policies continued, and he himself was not out of the spotlight (Van Cott, 2000). Although disparate groups had opposed de Lozada's (de)construction of Bolivian governance, widespread opposition did not coalesce until the infamous water wars and gas wars of the early 2000s.

Bolivian neoliberalization was not only fostered from within, but also from without. Key actors in the country's saga of neoliberalism included the International Monetary Fund (IMF), the World Bank, and the United States government, with each having their own set of interests (Van Cott, 2000; Kohl, 2006). The IMF was concerned with national economic management and was closely involved in forming Bolivia's economic stabilization policies. The World Bank concerned itself with Bolivia's economic growth, development, and general poverty reduction (in that order). The United States government, while serving as an ideological supporter of the other two institutions, and as a force that could apply political and economic pressure when needed, was also deeply concerned about, and involved in, efforts to eradicate coca production in the country (more about this in the following section). The combined actions of these actors fostered both the neoliberalization of the country, and through this, the subsequent backlash (Artaraz, 2012; Farthing & Kohl, 2014; Kohl & Farthing, 2006; Tsolakis, 2011).

One of the two most significant examples of the backlash started in 2000 when the World Bank called for the privatization of water services in Cochabamba, Bolivia's fourth largest city, as a condition for receiving a development loan. The agreement went ahead and the city's water works were sold to a consortium of companies, the largest shareholder being an American multinational corporation with a 55% stake. The new managers promptly introduced a 35% rate hike on users. Large-scale protests followed almost immediately. A city-wide general strike was also carried out which brought the city's economy to a standstill, and protests eventually led to violence. The protest also spread to other cities and rural areas. The "Cochabamba water wars" became a rallying point for protest and dissent against neoliberalism more broadly. Disparate groups, from police officer unions to coca growers associations, all with various gripes, came together to oppose the privatization and the governmental system in general. In April of 2000, after an

extended period of violence, a national state of emergency was declared. Then, in an effort to regain national social and economic peace, the government capitulated and revoked the agreement to privatize Cochabamba's water (Finnegan, 2002; Kohl & Farthing, 2006; Olivera, 2004).

Despite the protestor's victory, little changed in the national government or in economic management following the incident. Although a brief period of calm fell over the country, it was soon disrupted by many of the same groups who had been emboldened by their earlier success. In 2002 a new grassroots political party, the MAS, that represented rural indigenous people and was led by a charismatic indigenous coca grower named Evo Morales, came in a close second in the national election. The winner was a former president and the country's leading champion of neoliberalism, Gonzalo Sánchez de Lozada. The election result could not have more starkly demonstrated the largest division in Bolivian society; the largely urban and "white" minority who constitute the socially and economically privileged represented by de Lozada on the one hand, and the poor rural indigenous majority who constitute the exploited and oppressed led by Morales on the other (Kohl & Farthing, 2006). The election did little to quell popular anger over governmental management and economic policy, and protests, blockades, and demonstrations once again began to grow (Perreault, 2006).

The second of the two most significant backlashes to neoliberalism began soon after de Lozada's election. At issue was the future of Bolivia's natural gas resources, the second largest in South America. de Lozada's government believed that privatization and a focus on exports, particularly to Chile, would generate billions in royalties that could be put towards social services and economic growth. However, popular skepticism of neoliberalism, indigenous resistance to the presence of foreign companies, and distaste for dealing with nationally hated Chile (who are to this day derided in Bolivia for taking away access to the sea), among various other grievances, brought popular unrest once again to a boil (Kohl, 2006; Perreault, 2006). "The Bolivian Gas Wars" ensued, and brought about widespread protest, civil unrest, and another state of emergency. Violence once again reared its ugly head and the death of protestors at the hands of the military in the city of El

Alto (a poor suburb of La Paz) drove de Lozada to resign and flee to the United States, where, despite extradition requests by subsequent Bolivian governments, he continues to live today. The “Gas Wars” continued with varying degrees of severity for two years, and kept the Bolivian government, economy, and society in a state of weakness and tension (Kohl & Farthing, 2006). Stability finally returned with national elections in 2005. This time the electorate made a resounding decision to reject neoliberal policies, indigenous exclusion, and foreign influence. They elected Evo Morales (Farthing & Kohl, 2014).

Neoliberalism in Bolivia had a profound effect on virtually all facets of life (Kohl & Farthing, 2006). It was a guiding framework for the state that spanned many dimensions, and, for some, was the answer to the country’s long history of social conflict and poverty (Kohl, 2006). Indeed there are a few bright lights as some policies that it engendered have not been as widely condemned or criticized as others. Decentralization of federal power and control, which placed more responsibility for the utilization and distribution of resources in the hands of local people, in some cases increased governmental responsiveness to local needs (Faguet, 2004; Kohl, 2003). Land reform and the establishment of formal ownership titles was also carried out, particularly for rural indigenous people, and some desires for communal land ownership systems were recognized and enshrined into law (Anthias & Radcliff, 2015). In certain cases neoliberalism also led to unintended but relatively positive social outcomes. The combination of vesting power with individuals while eroding the state’s capacity to support social welfare, led previously disenfranchised groups to develop new attitudes about their place in society (Kohl, 2006). This caused women, the poor, the rural, the indigenous, and others, to become more empowered and politically active than ever before (Artaraz, 2012).

However, despite these benefits, neoliberalism has left a tarnished legacy. Not only did its enforcement, and the resistance to it, lead to overt violence and loss of life, but it also fostered less direct forms of violence such as lynching and vigilantism (Goldstein, 2005). Social and economic development, particularly in rural areas, has been greatly complicated due to the skepticism and suspicion

neoliberalism wrought towards “outsiders” such as NGOs and development workers, some of whom indeed perpetuated the neoliberal model and occasionally contributed to undermining grassroots organization (Arellano-Lopez & Petras, 1994; Gill, 1997; Walsh, 2014). The most overarching and detrimental effect neoliberalism had in Bolivia was the further entrenchment of inequality by shifting wealth from the state, to multinational corporations and their economically elite representatives. It proved to be “a system that privileges the market, reduces the ability of the state to provide social services, and simultaneously concentrates wealth among an elite minority while it reinforces poverty among the majority,” (Kohl & Farthing, 2006, p.2).

The developmental conditions within Bolivia today are a direct result of the rejection of the neoliberal experiment of the past. Resistance to neoliberalism galvanized disparate groups to work towards a common goal of greater social justice. It provided the catalyst needed to confront the inequality that was perpetuated by the country’s institutions. It empowered the most marginalized people to break the ruling elites grasp over their lives and their control over the direction of the country. This can be seen in the modern forms of social organization, the increase in political participation, and the slow but steady progress towards poverty reduction in the country. However, the roots of neoliberalism ran deep, and its construct continues to pull on political and economic levers. Inequality still abounds between people of different ethnicities, between the rich and the poor, and between the urban and the rural. Neoliberal policies have been highly resilient in political policy-making and discourse, which continues the skepticism and suspicion that many direct towards Bolivian governments and their development efforts. The consequences of this permeate Bolivian society, but are particularly acute for people who are searching for pathways out of poverty, especially rural indigenous farmers.

3.1.3 Coca, Indigeneity, and National Sovereignty

Interwoven in the story of Bolivia's experience with neoliberalism and its consequent effects, is the story of neo-imperialism and the fight over a plant. Although many resources have played important roles in shaping Bolivia as a country, none has been as profound in shaping the interconnectedness of indigenous identity, nationalism, and sovereignty, as coca.

The coca plant is native to South America and was cultivated in Bolivia long before Spanish arrival (photo 3.1). The leaves are traditionally dried and chewed or made into tea. They are desired for their low alkaloid content, which gives the user a mild stimulation similar to drinking a cup of coffee. People of the area have attributed many medicinal benefits to coca, some of which include treatment for altitude sickness, for upset stomach, an aid for digestion, an anesthetic, and a hunger suppressant. For these reasons coca has become a cultural staple in many South American countries, particularly for indigenous rural people, many of whom consider coca to be sacred (Martin, 1970; Transnational Institute, 2014).

Photo 3.1: The coca plant



Source: Author (2016)

Conflict over coca has a long history. In the sixteenth century newly arrived Spanish friars looking to convert the indigenous population to Christianity found coca hindered their mission. They took a critical view, and believed that “chewing coca dulled their clients sensibilities, retarding their conversion to Catholicism, (Gibson & Godoy, 1993, p.1008).” Coca was also criticized for fostering crime, perpetuating malnourishment, and was often looked upon by colonists as an element of indigenous heritage that needed to be stamped out (Gagliano, 1965; Gibson & Godoy, 1993). Despite this, the Spaniards eventually realized that it was important for keeping social order, especially amongst the silver miners who depended on coca to cope with the deplorable mining conditions, so they decided it would be permitted but taxed. However, the issue of coca had not been settled, and the episode foreshadowed future conflicts between locals and foreigners over the plant and its importance to life in Bolivia. In the words of de Franco & Godoy (1993), “like most debates in Bolivia, this debate never ended; it was merely suspended among new social problems only to reopen, like a festering wound, centuries later (p.379).”

During the 19th century a simple chemical process was discovered that extracted and concentrated the alkaloid in the coca leaf to make the narcotic cocaine. Cocaine was initially used for a variety of purposes, but principally in various pharmaceuticals and most famously, as the key ingredient in Coca-Cola (Karch, 2006). As the addictive qualities of cocaine became increasingly apparent, the United States progressively restricted the substance, finally banning it in the 1920s (ibid.). After several decades of relative obscurity, the societal changes of the 1960s and 1970s fueled a renewed interest in the drug. It quickly became the second most consumed narcotic after cannabis in North America and Europe, thanks in part to marketing by organized crime. Due to its popularity and perceived detrimental effect on society, US President Richard Nixon declared the “War on Drugs” which received extensive funding, led to direct American involvement and intervention in coca producing countries, and has been continued by every president up to the present (ibid.).

Prior to the 1970s, coca in Bolivia was almost exclusively cultivated for domestic consumption and, due to its ubiquity, was not a very valuable crop. Cultivation was principally concentrated in the mountainous Yungas region of La Paz department. To this day the region supplies the bulk of the leaves that are used for traditional purposes, as they are preferred for their superior flavor. Coca was also widespread in the central sub-tropical foothills region of Cochabamba department, but primarily only for household consumption as links to markets were virtually non-existent and the flavour was considered inferior. This changed in the 1970s when road construction projects throughout Bolivia opened up the Chapare frontier region in the Cochabamba department and connected thousands of previously isolated farmers to the national and international market. At the beginning of the 1970s the region was responsible for 5-10% of national coca production. Once the paved road was built and the export market was opened, however, coca production in Chapare skyrocketed. This was further helped by the Chapare region's natural endowments. Compared to coca from Yungas, coca grown in Chapare contains more alkaloids which allow for the production of more cocaine, does not require costly infrastructure (terraces built into the sides of hills), and can be harvested four times a year instead of three¹² (Leons, 1993). By the end of the decade the area accounted for over 70% of national production, most of which was destined for export (Klein, 1982). Bolivia quickly became one of the top global producers of coca for the international drug trade. During the 1980s the industry employed between 2-11% of the national workforce (likely much higher in the producing regions) and the value of coca exports exceeded that of all other exports combined (de Franco & Godoy, 1992; Healy, 1988). In many ways coca production was an ideal rural and agricultural development commodity. Tullis (1987) concurred: "the coca industry... is labour-intensive, decentralized, growth-pole oriented, cottage industry promoting, and foreign exchange earning. If the coca

¹² It was largely for these reasons that the Yungas region, despite its longer history with coca and more established production, was initially not involved in the cocaine boom, and has never eclipsed Chapare's contribution to the drug trade (Leons, 1993).

industry were completely licit and high returns to the growers held, it could be the final answer to rural development in economically stagnating areas.”

The effect of coca’s emergence on farmers in the Chapare region cannot be overstated. Prior to road access, farmers lived on small plots of land and subsisted on a small variety of indigenous foods, only small surpluses, when achieved, were ever sold (Leons, 1993). Many of these farming families that had migrated to the region looking for economic opportunities actually ended up living lives of such squalor and drudgery that many re-migrated to where they had come from (Eastwood & Pollard, 1985; Zebellos, 1975). However, once the market for coca emerged, coupled with improvements in road and communication infrastructure, many farmers in the region found a beneficial livelihood activity. Coca had been the regions most important crop since as early as the 1940s, but only because it was the only one that could be sold reliably. By the 1960s it had grown considerably and was a key source of revenue, accounting for 77% of farmers’ cash income (de Franco & Godoy, 1992). Over the period of 1960 to 1985, returns from coca production grew by 11% annually for farmers (ibid.). The crop’s profitability not only pulled many farming families out of extreme poverty, but generated regional multiplier effects as well. Employment in the coca/cocaine system was estimated at over a 100,000 people and to be much more lucrative than alternative labour jobs (de Franco & Godoy, 1992; Tullis, 1987). Even though the majority of profits from the coca/cocaine value chain accrued to those at the top, and most rural producers remained economically insecure, they had for the first time a valuable cash crop, which they deeply appreciated for its role in pulling them out of a life of squalor. This engendered a deep social and economic attachment to coca growing that farmers vehemently protect up to today. Being a coca grower became a point of pride, not only because it was intricately linked with rural Bolivian culture, but also because it was a transformational agricultural crop that was fostered within the communities (Healy, 1988).

American foreign intervention was particularly pervasive in Bolivia. The combination of the Monroe Doctrine, the Cold War, and the War on Drugs, provided the justification American policy makers needed to ignore sovereignty in developing

countries. Many Latin American countries during the 70s 80s and 90s capitulated to American pressure to stamp out their domestic drug production, even permitting American nationals to operate in their countries, and Bolivia was no exception. As mentioned in the previous section, this fostered a neoliberal political-economic structure in the country, but it also brought American authority into direct confrontation with the marginalized indigenous populations of the countryside (Healy, 1988; Kohl & Farthing, 2006). Such contact usually took one of two forms; American drug fighters directing military personnel to destroy coca crops and root out drug producers and smugglers, and, aid workers seeking to introduce alternative livelihood activities. Large sums of money from the United States flowed into Bolivia, and the Chapare region especially, during this time (Painter, 1994). However, local resistance was common as many viewed the money and projects as paternalistic, ineffective, and insufficient in replacing lost coca-based livelihoods (Farthing & Kohl, 2014; Sanabria, 1993).

Many indigenous people, coca growers especially, already held the perception that their national government was operated by and for the minority white economic elite. But with growing American interference and influence, they also began to see their government as indifferent to national and indigenous sovereignty and identity. Many indigenous people, both producers and non-producers, viewed the state of national governance as a continuation of the colonialist system that had oppressed them for centuries (Artaraz, 2012; Kohl & Farthing, 2006). America itself became regarded as an imperialist power, and indigenous coca grower sentiment was well captured by their slogan; “Kausachun coca! Wanuchun Yanquis!” (Long live coca! Death to Yankees!) (quoted from Farthing & Kohl, 2014). The persecution of impoverished farmers for growing one of the few cash crops available to them, and which happened to be closely intertwined with their heritage, provided a rallying point for festering indigenous and rural dissatisfaction over their second-class status. Their resistance formed the backbone of a renewed sense of indigenous identity and pride, served as the foundation for the emergence of the MAS party, and proved to be a tipping point

towards profound economic and political change (Artaraz, 2012; Kohl & Farthing, 2006; Tsolakis, 2011).

Coca is integral to both the economy and society of central Bolivia, but is steeped in controversy and conflict. Many farmers rely on coca for much needed incomes and financial security, but have faced a multitude of foreign pressures to reject it and adopt other farm-based livelihood activities, most of which are clearly inferior income generators. The resistance to these pressures has turned coca from an average commodity into one that is interwoven into the fabric of rural Central Bolivian life. It has also made rural producers, especially coca growers, and particularly those from the Chapare region, fiercely independent, confident, and politically active, as well as skeptical and suspicious of outsiders. Therefore, working with farmers of the region to undertake development activities must be sensitive to, and ideally incorporate, the realities of coca production. Those conducting research must be aware of coca's potential to mediate perceptions and valuations of farm-based livelihood alternatives, and coca livelihoods should be incorporated into strategies and interventions if they are to be effective.

3.1.4 The Rise of Indigenous and Socialist Politics

In 2006, after a sequence of social and political crises, Bolivia's first indigenous leader was elected. Evo Morales of the MAS party and coca farmer from the Chapare region won the presidency with 53.7% of the popular vote, the first absolute majority in the country's democratic history. He won on a platform of change that wholly embraced the growing indigenous empowerment sweeping the country:

"In 2006, I entered the presidential palace in the main square of La Paz as the first indigenous president of Bolivia. Our government, under the slogan 'Bolivia Changes,' is committed to ending the colonialism, racism and exclusion that many of our people lived under for many centuries," (Morales, 2010).

Morales's election added Bolivia to the list of Marxist oriented nations of Latin America who constituted the "Pink-Tide". He was given a strong mandate to

overhaul the country's institutions and bring about fundamental change. To achieve this, laws and policies were introduced which gave the country greater control over natural resources, increased social spending, recognized minorities and their aspirations, imbued nature with intrinsic value, and re-wrote the terms of what constituted development. His administration has also legalized coca cultivation and severed relations with the United States. Overall, his government has sought to define how a post-neoliberal country should look and feel.

Many of the accomplishments and ambitions of Morales and the MAS party are admirable. Through peaceful and democratic means, South America's poorest and most indigenous country for the first time elected a leader who comes from the majority. This has given a voice to the marginalized and empowered them to play an active part in shaping their future. Many analysts believe that the process of reinvention and decolonization has led the country to become the representative of anti-globalization and anti-neoliberalism worldwide, and has inspired leftist activists across the globe. According to Farthing & Kohl (2014), the small nation has become a "workshop for those that believe that another world is possible (p.5)."

Bolivian history and culture collided in a remarkable way to produce a country simultaneously rich and poor in society and economy. This situation has perpetuated both intra and inter-national tension and occasionally conflict, and by extension severely complicated development efforts. Domestic elites and foreigners have for centuries simultaneously oppressed the poor, thus fostering their skepticism and trepidation of outsiders. Development actors are often both foreign and comparably elite, and therefore face significant challenges when working to improve the welfare of Bolivians, particularly the indigenous rural poor. Their work has been further complicated by their historical association with attempts at economic and cultural change rooted in the coca disputes. Therefore, modern development practitioners and researchers must carefully incorporate this context into their work. However, Bolivian history and culture also provide promising opportunities for development. Thanks to the unintended but profound effects the Bolivian neoliberal experiment had on the solidarity, identity, and organization of the rural indigenous poor, many rural people have become active and engaged

participants in the development of their communities. It was also this empowerment that led to the rise of a new politics in Bolivia and the first indigenous president, but how this sociopolitical shift has affected development, and what it means for rural poverty reduction, remains a critical point in need of investigation, and to which we now turn.

3.2 The Socio-Political Continuity and Change

Depending on whom you talk to, and whether they are indigenous or white, rural or urban, Andean or Lowlander, farmer or business owner, their perception of how Morales's "process of change" is faring will likely vary. In a general sense, improvements can be seen in a number of areas. Economic growth and poverty reduction statistics have been favorable, social unrest is less prevalent than in the past, and new infrastructure such as schools, electrical grids, and roads has been built throughout the country. However, despite these strides, many problems and challenges remain. Many changes in governance have been superficial, improvements in the economy and the welfare of citizens has been inconsistent and spotty, and many institutional barriers remain intact (Kennemoe & Weeks, 2011). Morales and his party have also found themselves at odds with the populist and democratic principles that brought them to power. In early 2016 the electorate rebuffed Morales in his attempts to change the constitution to remove presidential term limits and thereby extend his term in office. Although he has accepted the decision, it is commonly believed he will try to keep power through less direct means (pers. comm., 2016).

The Morales administration and the social, political, and economic changes it has brought forth, whether concrete or not, are nothing if not polarizing. While understanding where real improvements have been made and where work remains is highly important for development, just as important is the appreciation for the diversity of people in the country and the perceptions of development that they engender. This section provides an overview of how the MAS party is seeking to achieve its post-neoliberal plurinational state and what its progress has been like

thus far. While the changes that the state has introduced have been wide-ranging, three changes that are particularly pertinent to this study, namely decentralization, food sovereignty, and rural development are investigated in further detail.

3.2.1 The Morales Government's Policies and Priorities for Development

One of the first policy undertakings of the new Morales administration was to address widespread demands for a new constitution. Construction of the document was daunting; the competing visions of the state held by various social and ethnic groups complicated the process. However, after three years of consultations, the new constitution was ratified in 2009 by national referendum. The new vision of Bolivia was well captured in the constitution's preamble:

In ancient times mountains arose, rivers moved, and lakes were formed. Our Amazonia, our swamps, our highlands, and our plains and valleys were covered with greenery and flowers. We populated this sacred Mother Earth with different faces, and since that time we have understood the plurality that exists in all things and in our diversity as human beings and cultures. Thus, our peoples were formed, and we never knew racism until we were subjected to it during the terrible times of colonialism.

We, the Bolivian people, of plural composition, from the depths of history, inspired by the struggles of the past, by the anti-colonial indigenous uprising, and in independence, by the popular struggles of liberation, by the indigenous, social and labor marches, by the water and October wars, by the struggles for land and territory, construct a new State in memory of our martyrs.

A State based on respect and equality for all, on principles of sovereignty, dignity, interdependence, solidarity, harmony, and equity in the distribution and redistribution of the social wealth, where the search for a good life predominates; based on respect for the economic, social, juridical, political and cultural pluralism of the inhabitants of this land; and on collective coexistence with access to water, work, education, health and housing for all.

We have left the colonial, republican and neo-liberal State in the past. We take on the historic challenge of collectively constructing a Unified Social State of Pluri-National Communitarian law, which includes and articulates the goal of advancing toward a democratic, productive, peace-loving and peaceful Bolivia, committed to the full development and free determination of the peoples.

We women and men, through the Constituent Assembly (Asamblea Constituyente) and with power originating from the people, demonstrate our commitment to the unity and integrity of the country.

We found Bolivia anew, fulfilling the mandate of our people, with the strength of our Pachamama and with gratefulness to God.

Honor and glory to the martyrs of the heroic constituent and liberating effort, who have made this new history possible.

(Bolivian Constitution, 2009, p.6)

Notable changes in the nature of the Bolivian state included the redefinition of Bolivia as a “plurinational” state that not only recognizes but also values the nation’s multiculturalism, indigenous majority, and unique cultural characteristics (Hammond, 2011). It also addressed social inequality, participatory democracy, and the structure of governance, effectively shedding centuries of colonialism and indigenous oppression. However, critics have found a number of limits and problems. Albro (2010) points out that the constitution treats indigenous people as homogenous based on an Aymara-centric (Andean) interpretation of indigeneity, despite significant differences between indigenous groups. Schilling-Vacaflor (2011) is skeptical that the document will translate words into results given the many incentives faced by the government to maintain the historical status quo of governance. While the document has indeed been transformative in a qualitative sense and holds much potential, real results have been slow to manifest.

The overarching philosophy adopted by the Morales government that guided the creation of the constitution, and which served as a framework for new development, was *Vivir Bien* (living well). “*Vivir Bien* seeks harmony, consensus, and good governance, prioritizing community values of self and mutual respect, redistribution of wealth, and elimination of all kinds of discrimination within a framework of valuing diversity, community over individual rights, and the natural environment,” (Farthing & Kohl, 2014, p.99). This framework prioritizes social outcomes, even at the expense of economic outcomes, and emphasizes culture, community, and ecology as vehicles through which it can be achieved (Mamani,

2010). As an alternative to, and in many ways a rejection of, the Western development model, it positioned the country's development ambitions firmly within the MAS's anti-colonial and indigenous discourse. This was in keeping with the desires of many rural communities (Lennon, 2012). Calestani (2009) has argued, however, that the harmonious social relations that *Vivir Bien* calls for are unrealistic, and Ranta (2015) has shown that the translation of *Vivir Bien* discourses into state practice has generally not been achieved.

Another legal landmark introduced by the Morales administration was, first, the *Ley de Derechos de la Madre Tierra* (Law of the Rights of Mother Earth), and the more comprehensive follow-up; *La Ley Marco de la Madre Tierra y Desarrollo Integral para Vivir Bien* (Framework Law of Mother Earth and Integral Development for Living Well). The former adopted an indigenous perception of nature, drawing on the Andean notion of *Pachamama* (an indigenous goddess conceptually similar to "Mother Earth") and invested it with legal rights (Vidal, 2011). This was precedent setting for national environmental legislation. It constituted a major shift from an anthropocentric view of nature to one that respects its intrinsic value. The latter legislation went further by outlining how the former would be operationalized within Bolivian governance, society, and economy. This included recognition of the environment as a fundamental aspect of national and rural development, as well as being integral to human well-being (Ley No. 300, 2012). Morales has used this legislation to position Bolivia as an international champion of environmentalism and to call for significant efforts to tackle climate change. Although some environmentalists have admired both pieces of legislation for their progressive pro-environmental stance, like *Vivir Bien*, they too are generally viewed as lacking substance and the necessary political action to enact their intentions. Critics have pointed to Bolivia's heavy dependence on resource extraction in particular as fundamentally at odds with both the spirit and provisions of the laws (Kaijser, 2014).

Under Evo, policies towards coca have also changed. Respect for its cultural significance was enshrined in the new constitution under article 384:

The State protects the native and ancestral coca as cultural patrimony, as a renewable natural resource of the biodiversity of Bolivia, and as a factor of social unity. In its natural state coca is not a narcotic. The revaluation, production, sale and industrialization of coca shall be governed by law.

This led to the policy known as “Coca yes, Cocaine no”, which legalized but restricted the production of coca. The new policy permitted coca to be produced only in the Yungus and Chapare regions, and farmers could only grow a maximum of 1600 square meters (photo 3.2). Investment in processing facilities was also carried out as a means of promoting domestic consumption and providing value added to coca. In reality however, little changed except the degree of animosity between producers and the government. Although the national drug police have a heavy presence in the region, and tend to carry out their duties of monitoring producer plot sizes and stamping out cocaine production facilities, the prevalence of cocaine manufacturing is widely known and generally accepted (Farthing & Kohl, 2014).

Photo 3.2: A 40mx40m customary plot of coca plants



Source: Author (2016)

The laws and policies that have been adopted by the Morales administration have generally been well received among the Bolivian population and are looked upon with admiration by many activists and progressives around the world. The government deserves credit for following through on promises to alter the fabric of governance in the country and to firmly place values associated with indigeneity, the environment, and the rights of the marginalized, front and center. This has provided an effective framework and discourse to animate the “process of change”, but unfortunately has often lacked political action. Such conflict between rhetoric and action has become a defining feature of the Morales administration and has in many ways stunted social and economic development. The consequences of this for rural development and associated development interventions has been a greater engagement by participants looking to improve their communities on the one hand, but little improvement to the actual barriers of progress on the other. Bureaucratic inconsistency, complexity, and ineptitude, along with outright corruption in some cases, remains prevalent and tends to politicize, and hence complicate, even basic community and regional development initiatives.

3.2.2 Social Development

The historical marginalization of the poor rural indigenous majority led to one of the most thorough rebukes of Western systems of governance in the developing world. Once Morales came to power, “The poor, who typically see themselves as beggars seated on a throne of gold, believed that their time had come at last,” (Farthing & Kohl, 2014, p.1). Indigenous values and concern for marginalized groups affected how the government valued life, and generated the philosophy of *Vivir Bien*. Since its articulation, it has been Bolivia’s roadmap for development, which heavily emphasizes improvements to citizens’ social condition. This has driven a re-focusing of government policies that has benefited rural areas in particular, a segment of the population that was often overlooked in past development policy but is typically the most in need. Social development has generally been positive in the country, particularly in a qualitative sense, but many

challenges and problems remain. Table 3.1 below provides some insight into Bolivia's social development progress over time and vis-à-vis the rest of Latin America and the Caribbean.

Table 3.1: Selected social development indicators of Bolivia and Latin America and the Caribbean between 2000 and 2014.

Indicator	2000		2014	
	Bolivia	Latin America and Caribbean	Bolivia	Latin America and Caribbean
Adult literacy rate (% 15 and over)	84.4	87.7	94.5 (2012)	92.4 (2010)
Life expectancy at birth	61	72	68	75
Infant mortality rate (per 1000 live births)	29.9	14.7	20.1	9.75
Prevalence of under-5 stunting (%)	33.1 (1998)	16.5	27.2 (2008)	10 (2015)
Students who progress to secondary school (%)	92	93	96.5	95
Human Development Index	0.643 (ranked 114)	0.758	0.662 (ranked 119)	0.748

Source: UNDP (2000; 2015) & World Bank (2016)

The social condition of Bolivians has generally improved but the role of the state in generating these improvements has been mixed. Educational reforms have been positive, despite bureaucratic hurdles and political favoritism (Faguet & Sanchez, 2008; Howard, 2009). The restructuring of the health system, although innovative at times, has had limited impact due to competing ideologies and factions within the system (Johnson, 2010). Nonetheless, a significant qualitative improvement in Bolivia's social condition has taken place since 2005. One of the successes of Morales and the MAS was bringing together different indigenous groups to form the popular coalition needed for an indigenous led government (Postero, 2010). The election of an indigenous leader, and the new influence of

indigenous culture and values over government policy, was emancipatory for a group that had been either exploited or ignored for five hundred years. This not only generated indigenous pride and identity, but also through it, engendered a broader dignity amongst people who were rural farmers, many of whom were the nation's poor. The empowering effect this had cannot be denied and should not be overlooked. It has had a profound effect not only on Bolivia, but also on government-indigenous relations across the globe (Artaraz, 2012; Tsolakis, 2011).

However, the complexities of a "plurinational" state, and the competing visions and priorities that are divided along geographical, social, economic, ideological, and ethnic lines have not only made achievements in social development challenging, but have caused old governance models to die hard. The MAS's "indigenous solidarity" remains shaky, and is complicated by culturally engrained intra-indigenous racism, which has opened new fissures of inequality based on disputes over land and access to power (Albro, 2010; Canessa, 2014; Perrault & Green, 2013; Pila, 2014). Morales himself has been found wanting by the very indigenous groups who propelled him to power. The realities of governing and handling competing interests has led to compromises, which came as a disappointment to many in Morales's core political base of Chapare who initially believed his agenda was synonymous with their own (Grisaffi, 2013). The response to this perceived insubordination has been reminiscent of the past, and is somewhat paradoxical for the MAS. In many ways they have sought to use the national purse strings as leverage, and have been reluctant to grant too much autonomy to local groups, despite public discourse and policies that claim they seek the opposite (Kennemore & Weeks, 2011; Tockman & Cameron, 2014).

One aspect of social development that is particularly noteworthy and for which the MAS deserves much credit is the advancement of the rights and equality of women. Women have historically been, and in many places continue to be, oppressed actors in Bolivian society due to a culture of *machismo* that emphasizes female servitude. Recognizing this, the MAS added in the new constitution articles 11 and 26 which affirmed that women are equal actors in the new participatory democracy, and Article 15 states that "Everyone, in particular women, have the right

not to suffer physical, sexual or psychological violence, in the family as well as in the society,” (Bolivian Constitution, 2009). It also went further by outlining protections for women during maternity (article 45), equal participation and remuneration in the workforce (article 48), equal access to governmental positions (articles 147 and 210), and equal rights to land (article 395 and 402). The MAS have also had resounding success in improving female representation in parliament. Women make up 51.8% of Bolivia’s parliament, one of the highest rates of all countries globally, and a significant improvement from 2000 when only 10% of parliamentarians were women (UNDP, 2015). Women also play important roles, although often over burdened ones, in development contexts thanks to increasing emphasis on women’s participation (Hippert, 2011).

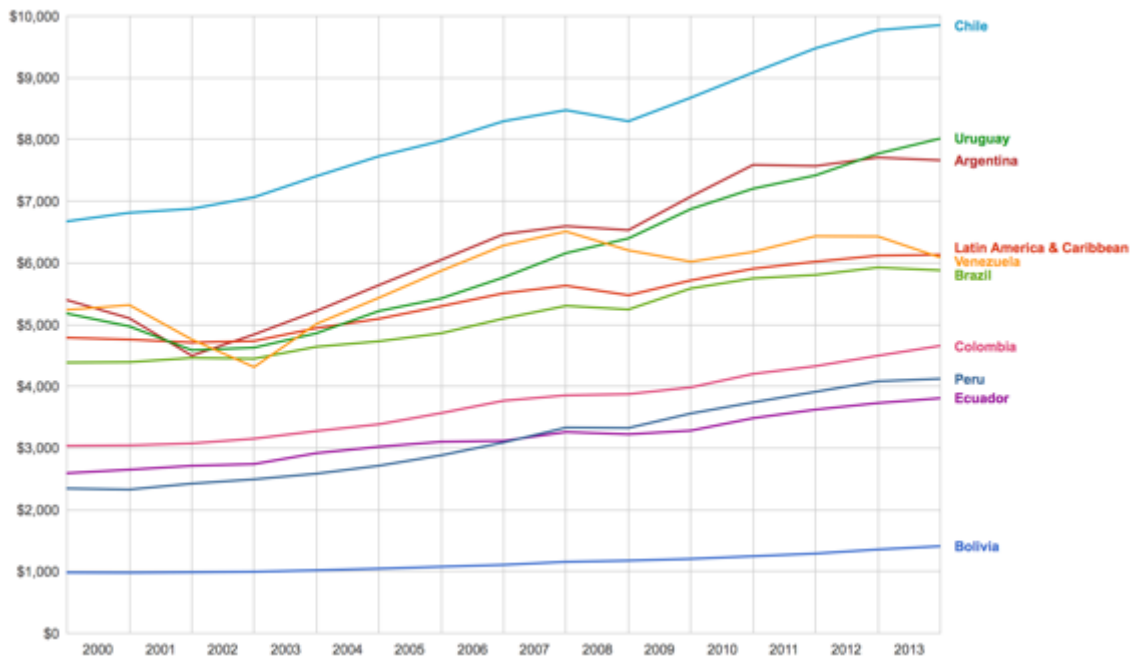
While important progress on women’s issues has been made, a lot of work remains. Women live on average 5 years longer than men, but this is 1.5 years less than in Latin America and the Caribbean. Women also have one less year of schooling on average than men, and the current gap in mean years of schooling is 1.5 in favour of men (UNDP, 2015). One area where women fare particularly poorly in contrast to men is income: the gross national income per capita of women in Bolivia is \$4,383 while for men it is \$7,140, or 39% higher. Although it should be mentioned that this is better than the Latin American average, which has men earning 45% more than women (UNDP, 2015). The most disturbing aspect of women’s continued oppression is domestic violence, which is highly prevalent but often ignored in Bolivia (Shahriari, 2015). The Pan American Health Organization (Bott *et al.*, 2013) found that 53% of married women had at some time been subjected to physical or sexual violence from their spouse, and that 25% had been subjected to such violence in 2008 alone, indicating that it is both widespread and frequent in the country. These rates were by far the highest amongst the twelve Latin American and Caribbean countries targeted for the study. The same report also found that over 15% of Bolivian women had been raped by an intimate partner, the highest of all countries studied, and 18% had been raped by any perpetrator, second only to Haiti. Amongst the twelve countries, Bolivia was second to last for victims seeking help.

Despite important progress during the Morales administration, women clearly remain a marginalized group within Bolivia. Not only should women's position as second-class citizens be abolished for clear inherent moral reasons, but it also presents a significant benefit for rural development in the country and beyond. Women are critical to family planning, and hence to slowing population growth (Ramdas, 2010). They also place a higher priority on the health, education, and welfare of children (Engelman & Sheffield, 2012). In Bolivia this has the potential to translate into sustainable poverty reduction and food security. However, the local conditions can pose a challenge to achieving these objectives. It is therefore necessary that women are considered integral in development processes, and are given prioritized opportunities to participate.

3.2.3 Economic Development

Under Morales, Bolivia's macroeconomic growth has exceeded expectations. In the years 1975 – 1989 Bolivia's average annual gross domestic product (GDP) growth was -0.2%. Between 1990 and 2003 it was 3.5%, but from 2004 to 2014, most of the years Morales has been in power, average annual growth has been 4.9%, one of the best rates of any country in the world over that period (World Bank, 2016). In 2015 the GDP growth was expected to continue at 4.8%, unemployment was a little high at 7.4%, as was inflation at 4.5%, while public debt was relatively low at 37.5% of GDP (CIA, 2016). Despite the admirable growth Bolivia achieved over the past decade, the country's success was not quite unique, with relatively strong growth throughout South America (World Bank, 2016). Furthermore, as figure 3.1 shows, the country still lags far behind the rest of the continent in absolute terms.

Figure 3.1: GDP per capita of select South American countries (constant 2000 US\$)



Source: World Bank (2016)

While Bolivia has had strong macroeconomic growth over the last decade, the overarching problem of economic inequality remains a challenge. Bolivia’s GINI score¹³ improved between 2005 and 2011, dropping from 58.5 to 46.3, but is now on its way back up and was at 48 in 2013 (World Bank, 2016). The economic inequality tends to follow the same lines as it did in the past; positively affecting the “white” economic elite and negatively affecting the rural and indigenous (Artaraz, 2012). Nonetheless, the country has made large strides in reducing absolute poverty. Table 3.2 shows that the number of people living below both the national and international poverty lines has decreased significantly over the past fifteen years. This has been another feather in the cap of the Morales administration. However, although Bolivia remains the poorest country in South America, the decline mirrors the South American trend. If it hopes to pull out of its position at the

¹³ The GINI score is a measure of economic inequality. It calculates the extent to which the distribution of income deviates from a perfectly equal distribution. 0 represents perfect equality while 100 represents perfect inequality.

bottom of the pack, more concerted and impactful development efforts will need to be undertaken.

Table 3.2: Bolivian poverty statistics

Statistic	2000	2015
Percentage of population below national poverty line ¹⁴	66.4	39.3
Percentage of population below international poverty line. (\$1.25US/day)	29.7	7.7

Source: World Bank (2016)

During Morale’s tenure aid flows have declined from a high of 1.24 billion in 2003 to 669 million in 2014 (World Bank, 2016). The largest drop happened during the political turmoil of the mid 2000s and the arrival of the MAS party, which alienated the United States. The US had previously been the largest donor and was also a large influence on the funding decisions of multinational institutions such as the World Bank. Although aid flows have continued to decline, they are more constant than in the past, primarily due to a more diversified portfolio of lenders with China playing an increasingly large role.

The international and national business community initially greeted the arrival of the Morales government with resentment and fear. In 2005, the year Morales won office, foreign direct investment (FDI) in Bolivia dropped to -2.5% of GDP as investors scrambled to take their money out of the country. Morales’s rhetoric of national self-determination and nationalization of certain industries were the key drivers of the panic. However, when Morales’s policies became clearer, and it was evident that “21st century socialism” was not economically a significant departure from business friendly neoliberalism, investment began to trickle back in. By 2013 FDI was at 5.7% of GDP, still less than half of its peak of 12% in 1999, but nonetheless a relatively swift and strong recovery. What was

¹⁴ Calculated based on average consumer prices for the 9 departmental capital cities and for rural areas in general. In 2014 the average poverty line used for urban areas was approximately \$3.60US per person per day, and for rural areas it was \$2.65US per person per day (INE, 2016).

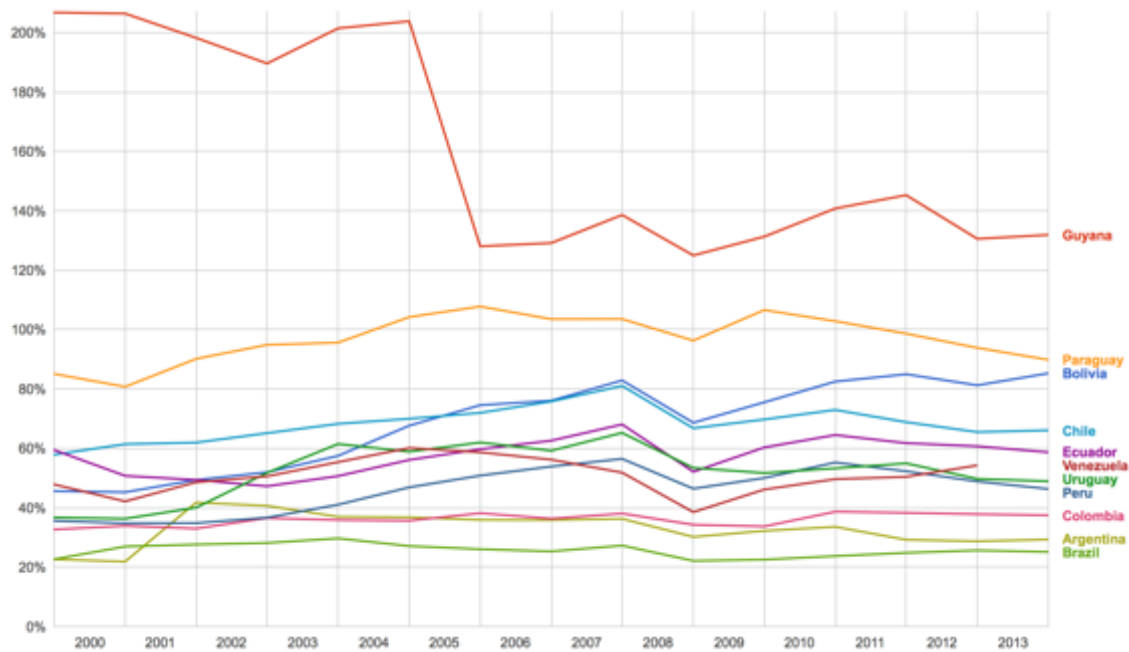
notable was that the face of foreign investment had changed. Businesses rooted in Western countries were replaced with those from other regions of Latin America and Asia, notably China. Today, like its role in Bolivian aid, China plays a central role in Bolivian trade and investment. Its companies account for nearly a billion dollars in state contracts for national infrastructure, but such a cozy relationship has led to scandals that have plagued the government and Morales himself (Brocchetto, 2016).

As part of the anti-neoliberal and anti-imperial platform of the MAS party, one of Morales's key election promises, and the most contentious, was to nationalize Bolivia's resources, particularly the natural gas sector. Prior to the MAS coming to power, royalties from natural gas accounted for the vast majority of the state's income. Nationalizing the industry was therefore problematic as any dip in production would have significant consequences for the state's coffers, and would undermine promised social reform. In the end, while nationalization had occurred, economic realities caused it to be carried out in a manner less radical than many in the peasantry had hoped for (Kohl & Farthing, 2012). Multinational companies and an orientation towards exports remained central tenets of the "new" economic system. The whole nationalization episode demonstrated the deep roots of neoliberalism and its dynamic influence over a resource dependent country hungry for income for development (Kaup, 2010). Morales's less than clean break from neoliberal policies has garnered frustration, particularly from his rural base, and has contributed to a continuing distrust of government and outsider led development.

The neoliberal framework for economic management has proven resilient in the mining sector as well. Large foreign firms still lead the sector, and often do so to the detriment of rural small-scale producers. Pollution, poor labour standards, and dominance of natural resources such as land and water all remain considerable problems (Perreault, 2013). Bolivia remains heavily reliant on trade of natural resources, with 85% of GDP made up of trade activity. It is the highest rate in South America after the small countries of Guyana and Paraguay (figure 3.2). The upward trend over the past five years demonstrates the government's inability to bolster the domestic market and that it remains stunted. The consequence is a low capacity to redistribute wealth through taxation and thus reduce inequality (Lustig *et al.*, 2014).

Direct cash transfers have also been ineffective because programs do not target the poor and the burden of in-direct taxes is high (ibid.). The Morales government has thus found itself in many ways dependent on the neoliberal economic system it purports to overturn, which is detrimental to, and at odds with, the desires of their core constituents (Kohl & Farthing, 2012).

Figure 3.2: Trade as a percentage of GDP for selected South American countries



Source: World Bank (2016)

Bolivia's complicated yet enduring relationship with neoliberal economic policies has facilitated strong macroeconomic growth but significant economic inequality and societal divisions in the country remain. This has not gone unnoticed by the peasantry, who despite their continued support for Morales, continue to utilize the tactics that brought about the first indigenous led government in 2006. Marches, protests, and road blockades are common occurrences. Although they tend not to last very long and are usually resolved peacefully, they pose a challenge to growth and development. Bolivia's economy also continues to lack diversification, and is heavily reliant on the primary sector and the export of high

value natural resources. This has supported some investment in rural areas, but more will be needed to yield better development outcomes and inclusion.

3.2.4 Shifting from Governance from Above to Governance from Below

There have been numerous changes in the economy and governance of Bolivia over the past three decades, but one that deserves further attention is the decentralization of federal government power down to the regional and local scale. While this has had the benefit of refocusing governmental expenditures on local priorities in rural areas, it also can often complicate development efforts. The complexity of the various scales of governance, and the resultant systems of influence and responsibility, can affect policy and project outcomes. Therefore, being able to understand and navigate this system of governance is necessary for effective development interventions.

As noted in section 3.1.2, decentralization was one of the few neoliberal policies that had some positive effect on disenfranchised communities. It is also one of the few policy continuations undertaken by Morales that has been favourably regarded by some analysts, and in fact, has been used as a landmark for similar reforms in other countries (Bardhan, 2002; Yanez-Pagans & Machicado-Salas, 2014). Decentralization in Bolivia has gone through two distinct rounds. The first was under the neoliberal system, and the second under Morales's post-neoliberal system. The two differed, however, in their underlying purposes. The former promoted individualism, democracy, and types of land ownership. The latter is meant to foster empowerment, rights, and locally guided development, particularly for rural and indigenous people. In practice both have been implemented in similar fashions and have generated similar outcomes. The key form that decentralization took under both systems was increased flows of national tax revenues to lower levels of government, increased local autonomy over natural resources and infrastructure, incorporation of spending oversight by local grassroots organizations, and the creation of more and smaller units of governance (an outline of the governance hierarchy follows shortly) (Van Cott, 2000; Faguet, 2004; 2013).

Morales enshrined his decentralization policies in chapter VIII of the country's constitution (Bolivian Constitution, 2009).

The consequences of this decentralization have been mixed and are contested amongst academics. Faguet (2004) and Faguet & Sanchez (2008) found that the first round under neoliberalism generally improved governmental responsiveness to local needs, particularly for the poorest communities. Channa and Faguet (2016) and Faguet & Sanchez (2008) cite evidence that decentralization improves health and education. Faguet (2013) also believes that the second round of decentralization under Morales has been, and will continue to be, socially beneficial. However, Kohl (2003) has argued that, despite some successes that were fostered by grassroots organizations, the majority of the time “the policy resulted in the entrenchment of local elites, the strengthening of clientelistic relationships, and the decentralization of corruption,” (p.153). Hiskey & Seligson (2003) found that decentralization was popular among the population, but poorly performing local governments engendered negative views of the political system. For resource management, the success of decentralization has been dependent on a combination of strong local leadership, social capital, and local incentives for key actors. However, these are often weak or lacking in many Bolivian municipalities (Andersson, 2003; Andersson *et al.*, 2006). Decentralization has also complicated indigenous autonomy in Bolivia by creating conflict over pre and post colonial territorial boundaries (Tockman, 2016). Yanez-Pagans and Machicado-Salas (2014) point out that bureaucracy, monitoring, and local power politics remain challenges under decentralization in Bolivia. Overall, Bolivia's process of decentralization has created a complex and highly bureaucratic governance system that presents both opportunities and challenges for development.

Almost all of the institutions that form Bolivia's national government, such as the legislature, the presidential office, and government ministries, are located in the national capital of La Paz. The one notable exception is The Supreme Tribunal of Justice, Bolivia's highest court, which is located in the historical capital of Sucre. Governance at the sub-national level is divided into nine departments, each with a capital city (figure 3.3). Below the departmental level, in descending order of size,

are provinces, municipalities, and communities (figure 3.4). There are between ten and twenty provinces per department, usually between five and ten municipalities per province, and anywhere from dozens to hundreds of communities per municipality (INE, 2015).

Figure 3.3: Departmental map of Bolivia



Source: boliviabella.com

Figure 3.4: Hierarchy of levels of government in Bolivia



Having a grasp of how Bolivian communities and municipalities fit within the governmental structure and hierarchy is particularly important for rural development practitioners. It is at these two levels that many funding decisions, policies, and priorities are made, particularly towards agricultural livelihood development. It is also where the most effective partnerships and collaborations are likely to be found. A municipality is a geographic region that is characterized as usually having many communities but only about one large town, which serves as the commercial hub. Communities in Bolivia, particularly those in the central-west lowlands, are geographically and organizationally different than what a commonly held Western notion of a community would imply. They are highly numerous (there can be anywhere from 150 to over 300 per municipality), have a relatively small population, often lack any clear urban component or central point of identification such as a plaza or concentration of houses, and tend to be situated along roads that have been carved into the jungle to open it up to agriculture. These roads often do not follow any particular pattern, and therefore neither does the layout of the community. It is common for roads to be dead ends, and also to be built nearly parallel to another road only a mile or two away, but not be connected. This leads to

people at the end of the road being several miles away from people near the beginning of the road, but being a part of the same community. Furthermore, people who live at the end of one road may be less than a mile from other people who live at the end of another nearby road, but because they live on different roads, they are usually considered to be from different communities.

Further scales of governance at the local level are organizations with authority over certain livelihood activities. Usually each rural community has a *syndicato* (syndicate) that represents agricultural producers. Participation is optional but membership is mandatory. The *syndicatos* make decisions and allocate spending regarding agricultural production and infrastructure priorities. In many communities almost all people are producers. Therefore they fall under both the community government and the *syndicato*, but what the jurisdictions are, and how the powers of the two institutions are separate or overlap, is not completely clear. Nonetheless, both can be quite effective at spurring rural development due to their close relationship with the people and their influence over the agricultural livelihood and infrastructure development of the area. They also are responsible for a lot of the development funds that are handed down from the departmental and national governments thanks to the process of decentralization. However, their efficacy varies according to endowments of social and human capital.

Communities/*syndicatos* take both a leadership and financing role in guiding agricultural development, essentially choosing which livelihood activity(s) will be prioritized. In some cases the population and the two government structures are in agreement about what should be the agricultural commodity of focus, and this yields a highly homogenized agricultural landscape. But in other cases, changes in crop viability or profitability, or simple evolution in perceptions and desires of some constituents towards different food commodities, can challenge existing norms. Sometimes this is met with an open mind by the local government, and the viability of changes or alternatives are explored and decisions are made to support sustainable growth of a commodity with superior socioeconomic potential. Sometimes though, the group of local farmers looking for change run up against the entrenched priorities and traditions of other farmers. In these cases communities

can become divided along agro-political lines that foster conflict and tension. This can lead to difficulties with decision-making that can make it difficult to carry out development activities. This regional micromanagement has led to uneven agricultural landscapes not only within, but also between communities. This has led in some cases to clustering of agricultural activities based not on land use efficiency, transportation costs, or natural capital endowments, but on politics. This is particularly noticeable for aquaculture as it tends to be clustered in one or two communities where many people will be producers, but the distance between clusters can be many miles. Furthermore, this local governance situation not only clusters or disperses agricultural activities, but it also causes variation in their forms. Again this is evident in aquaculture. For example one community may have many producers with quality ponds and profitable operations, whereas another will have many producers but with small poorly constructed ponds that are somewhat neglected. As a further remarkable feature, this difference can sometimes be observed between neighboring communities. It is therefore clear that local governance plays a key role in facilitating both the type and form of agricultural development, and can be a lynchpin of its success or failure.

Out of the local agro-politics has also sprung specific livelihood associations. These are organizations that are usually formed by a group of farmers in a small region who produce the same commodity. Such associations are usually made up of producers from multiple communities but remain in the same municipality. Their size, purpose, and degree of activity, can vary considerably. For aquaculture associations, some tasks that may be undertaken include building members' capacity, lobbying for funding or support from government, and liaising with rural development NGOs. Politics play a large role in determining each associations' mission and goals. Local agro-politics often drive aquaculture producers to organize to push for investment. Even national politics play a role. Because Morales is from the Chapare region, the national government takes a keen interest in producers of the area, with aquaculture being no exception. Some associations exist almost exclusively to work with the national government in developing aquaculture infrastructure. Competing visions and priorities have also led to, in some cases,

more than one association forming in the same region. The capacity of associations can also vary a lot, which can further complicate funding and development efforts. Pathways to development are therefore presented with a difficult situation. To develop aquaculture, the pathway may be one that not only builds association capacity, but also increases its clout through building broader participation and seeking common purpose amongst producers.

Overall, decentralization has led to a governmental system that has given power and autonomy to local actors who are in a better position to focus on local needs. This reorganization of responsibilities, however, has not eliminated broader governance problems such as inefficiency, corruption, and public skepticism towards governments and their agents. In fact, in many ways it has exacerbated them. This can be seen in the complex functioning of local and regional governments and associations, and the consequent agro-political problems that arise. For rural development generally, and aquaculture specifically, avoiding this governance system is likely impossible. Therefore it should be engaged with and improved upon. Larger, more inclusive associations would allow better government engagement and would allow more effective and efficient dissemination of production and market information. More aquaculture producers working together are likely to generate more benefits to the aquaculture sector.

3.2.5 Rural Livelihoods and Development

The MAS government has made sustainable rural development and supporting rural livelihoods a priority. The topic received an entire section (Title III) in the 2009 constitution¹⁵, and features prominently in many other laws and policies. The interest in rural areas under the MAS is a departure from governments of the past who tended to overlook rural regions, or narrowly value them for their natural resources. The MAS by contrast owes its existence to the disenfranchisement that was intricately linked to being rural and the subsequent

¹⁵ On an interesting and telling note, the word “rural” appears 138 times in the constitution whereas the word “urban” appears 13 times.

rural based movements that propelled them to power. To this day the government's most solid and continuous support comes from rural areas. It is for these reasons that the country has focused on rural development, and on promoting and supporting small-scale farmer livelihoods.

Rural development is carried out in Bolivia through a variety of channels. Mining and natural gas extraction continue to act as key drivers of rural employment. The government has also invested in rural education and health. But the most specific form of rural development for the purposes of widespread poverty reduction and rural economic growth has been an emphasis on agricultural livelihoods. Agriculture plays an important role in Bolivia's economy, accounting for 13% of GDP, or 27% if agribusiness is included (Cuesta *et al.*, 2011; World Bank, 2016). The sector also employs 35-40% of the national workforce (World Bank, 2016). While the majority of those workers are small-scale farmers, agribusiness is also a large driver of employment, particularly more lucrative employment. It also generates significant multiplier effects. Santa Cruz is the country's largest and most prosperous city, which is a direct result of it being the center of the country's agricultural industry. Although Bolivia has followed the global trend towards urbanization over the last half century, 31% of the population still resides rurally, a rate that is 11% higher than the Latin America and Caribbean average (*ibid.*). Of that 31% who are rural, 90% of them depend on agriculture for their livelihoods (INE, 2015). Agriculture in the country is highly heterogeneous, varying significantly due to agro-ecological and socioeconomic diversity across regions. This both enriches and complicates agriculture based rural development. On the one hand, this variety of growing conditions and associated food crops allows for a diversified agricultural sector, which in turn contributes to the necessary conditions for specialized farm-based livelihoods. On the other hand, the variety often makes implementing widespread and effective agricultural programs to improve farm production difficult since different commodities require different infrastructure, land allocations, and financial products. Furthermore, as the previous section outlined, agro-politics that form around specific commodities is a pervasive phenomenon in rural regions of Bolivia. This exacerbates political tensions since

there are so many actors representing different crops and competing against one another for funding and support.

Despite the scale and importance of agriculture in Bolivia, the country has one of the lowest rates of agricultural productivity in Latin America due to low technological capacity and inefficient use of land and labour (Cuesta, 2011). This is exacerbated by weak institutions and fractured priorities across scales of governance (World Bank, 2011). Although grassroots organizations formed at the local scale try to step in to fill the vacuum, they tend to be inefficient and lack the capacity to tackle many agricultural production and marketing issues that exist at higher scales (de Morree, 2009). A further, and perhaps more acute problem, is the continuing inherent inequality in Bolivia's agricultural system. Large farms of over 1000 hectares account for over half of the country's 2.76 million hectares of farmland, but are owned by less than 1% of the 871,927 farmers (INE, 2015). 27% of farmers own less than a hectare and 59% farm less than five acres. The top quintile of farmers own 93.5% of all farmland. The wealthy landowners who dominate the sector can undermine small-scale farmers' capacity to productively engage in the agriculture economy. Their ability to affect prices and compete through economies of scale perpetuates small-scale farmer poverty and makes agriculture-based pathways out of poverty difficult to forge.

The country's poorest are overwhelmingly concentrated in rural areas and are dependent on agricultural livelihoods. This has led the World Bank (2013) to declare that "Reducing poverty in Bolivia comes down to two words: Rural Development." Progress in the reduction of rural poverty in Bolivia has been noteworthy. According to World Bank (2016) data, in 2000 87% of rural people were below the national poverty line. When the MAS came to power in 2006 it was 76.5%, and in 2014 it was 57.6% (the national poverty line today is \$3.60US per person per day for urban areas and \$2.65US per person per day in rural areas). One example of a policy that has reduced poverty in rural Bolivia is a shift in the governance of coca. The government adopted a social control approach, rather than a prohibition approach, which significantly contributed to rural development in the Yungus and Chapare regions (Farthing & Kohl, 2010). By legalizing and controlling

coca production, and also funneling money into product enhancement and markets, it has legitimized a widespread rural livelihood. Sector by sector food production and marketing programs, particularly for corn, soy, cattle, and rice, have also helped reduce rural poverty in certain regions. However, most rural poverty reduction has been due to indirect rather than direct governmental activity. The most significant factor has been GDP growth, which has led to poverty being reduced at the same rate in both rural and urban settings, but it remains twice as prevalent in rural areas (IFAD, 2016).

A commonly identified barrier to improved rural livelihoods is a lack of access to credit. In Bolivia, the government and some NGOs have undertaken concerted efforts to reduce this barrier. Credit is currently available from conventional banks, development banks, and from microcredit institutions. People also often borrow money from businesses or private lenders (INE, 2015). There is evidence that such programs have had success at reducing poverty in Bolivia (Gonzales *et al.*, 2015). Maclean (2010) found that microcredit that targets women in rural Bolivia, although not without complications, has contributed to improved incomes. This relative success has generated a credit industry in Bolivia with new and creative financial instruments and loan packages for rural producers. The institutions that support the sector tend to have a sustainable and positive impact on rural development (Schicks, 2007). However, the majority of farming units in Bolivia choose not to apply for credit (Table 3.3). Whether they do not because they believe they would not obtain it, or because they find it too burdensome, or because they don't need it, cannot be determined due to a lack of research. The relationship between access to credit and farm size is also unknown. Based on the higher approval rates in departments that tend to have larger landholders, it is an interesting hypothesis. Nonetheless, of those who do apply for credit, over three quarters are approved. The primary reasons farmers did not receive credit was a lack of collateral, improper documentation, and already outstanding debt (INE, 2015).

Table 3.3: Number of farming units that applied for and received credit

Region	# of Farming Units	# that applied for credit in the past 3 years	% that applied for credit	# that were approved for credit	% that were approved for credit
Bolivia	871,927	95,384	10.9	73,413	77.0
Chuquisaca	73,388	6,312	8.6	4,233	67.1
La Paz	245,455	28,151	11.5	21,924	77.9
Cochabamba	181,536	18,281	10.1	15,404	84.3
Oruro	62,692	4,057	6.5	2,032	50.1
Potosi	123,991	4,710	3.8	2,403	51.0
Tarija	41,539	5,597	13.5	5,036	90.0
Santa Cruz	115,027	24,023	20.9	19,962	83.1
Beni	20,762	3,293	15.9	1,993	60.5
Pando	7,537	960	12.7	426	44.4

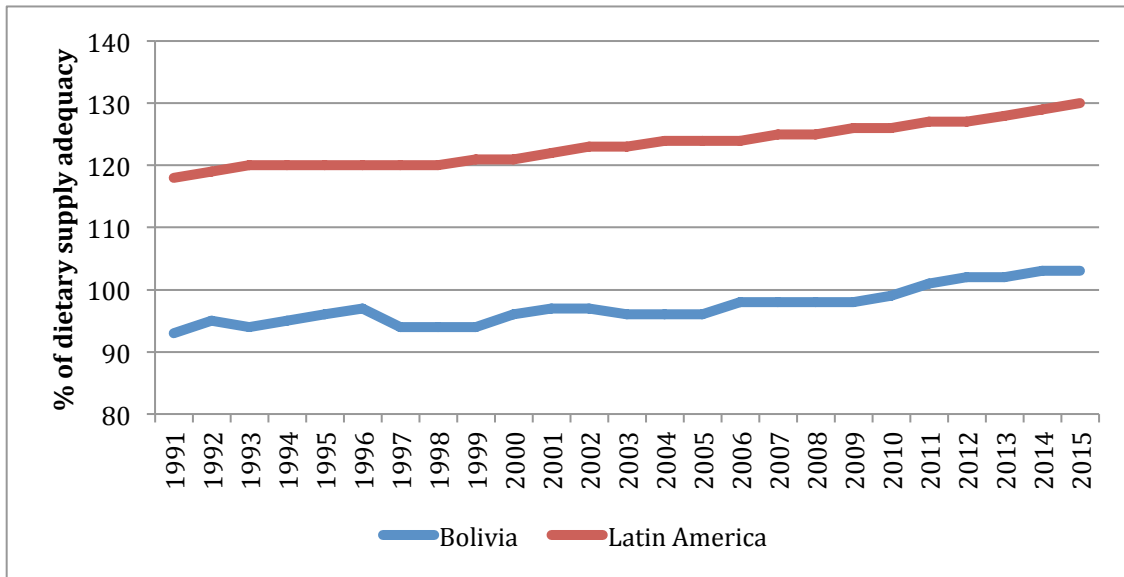
Source: INE (2015)

Environmental challenges that test the resiliency of small-scale farmers are significant in Bolivia. Temperature fluctuations and severe storms frequently wreak havoc on crops and livestock in the Eastern and Northern Amazonian lowlands (INE, 2014). Floods are particularly problematic as exemplified by the 2014 Amazonian flood that affected tens of thousands of people and caused over \$180 million in agricultural losses (Achtenberg, 2014; Espinoza *et al.*, 2014). These weather events have been closely linked to climate change and are expected to increase in frequency and severity across Latin America (FAO, 2016). Addressing climate change is an interest of the Morales government, but since Bolivia is such a minor contributor to the problem, their capacity to affect change is limited, and they must focus on adaptation instead.

Food security, particularly in rural areas, remains problematic for Bolivia. The country struggles with food affordability, availability, quality and safety, making it the most food insecure nation in South America (EIU, 2016). Climate change, urbanization, and shifts in dietary preferences away from traditional foods and towards manufactured foods all have deeply affected the country's capacity to facilitate food security for the population (Cuesta *et al.*, 2010; Ormaechea, 2009).

The increasing turbulence of international food prices has also posed problems as Bolivia has one of the highest rates of food price volatility in all of Latin America (HDR, 2015). The rural areas of the country are further vulnerable due to limited road cover and infrastructure, which inhibits domestic market integration and access to food. In connection with its pro-indigenous, pro-rural, and pro-poor ideology, the Morales government has made food security a priority by emphasizing it in policies, and by forming international partnerships with large donors (World Bank, 2013). Indeed they have achieved some positive results. The prevalence of under-nutrition in Bolivia was 16% in 2015, down from 35% in 2000, impressive progress, although still far short of the current Latin American average of 5% (FAOSTAT, 2016). The percentage of children under five years of age who are underweight also dropped over the same time period from 5.9% to 4.5% (*ibid.*), as did childhood stunting, which is down from 33.1% in 1998 to 27.2% in 2008. Average dietary supply adequacy (compares food supply with food requirements) has also gone up, but trails the Latin American average as well (figure 3.5). Cuesta *et al.* (2011) found that governmental spending on health, education and agriculture has been finding its way to the rural areas most vulnerable to food insecurity, but has struggled to reduce vulnerability. They theorize that the reason for this is that the composition of these spending programs is inefficient or lacks efficacy. This is likely a reflection of the problems that have manifested at local levels thanks to decentralization and complex local governance arrangements as outlined in section 3.2.4.

Figure 3.5: Average dietary supply adequacy in Bolivia and Latin America



Source: FAOSTAT (2016)

Although Bolivia has made notable strides in rural development, rural areas remain the locus of poverty and vulnerability in the country. It also continues to lag behind the Latin American and Caribbean averages, and especially far behind South American averages. Not only is more technical and financial support needed for rural regions, but also in particular, new forms of farm-based income generation, greater value added to products, and expansion of local and domestic markets for locally produced foodstuffs are critical if Bolivia is going to make greater progress on reducing poverty and increasing food security.

3.2.6 Creating a Food Sovereign Nation

Food sovereignty is a central theme of this study, not only because it is a new and emerging paradigm for food security, food system management, and rural development, but also because it is particularly pertinent in Bolivia. In 2009, as part of its new constitution, Bolivia became one of only eleven countries in the world to

explicitly incorporate the concept of food sovereignty into law. The following articles of the constitution explicitly address food sovereignty:

Article 255

II. The negotiation, signing and ratification of international relations shall be guided by the principles of:

8. Food security and sovereignty for the entire population; the prohibition of importation, production and commercialization of genetically modified organisms and toxic elements that harm health and the environment.

Article 309

The form of state economic organization includes the enterprises and other economic entities that are state property, which shall comply with the following objectives:

4. To promote economic democracy and achieve the food sovereignty of the population.

Article 405

Comprehensive, sustainable rural development is a fundamental part of the economic policies of the State, which shall prioritize its actions to encourage all communitarian economic undertakings and those of the group of rural actors, placing emphasis on food security and sovereignty, by means of the following:

Article 407

The objectives of the policy of the State for comprehensive rural development, in coordination with the autonomous and decentralized territorial entities, are the following:

1. To guarantee food security and sovereignty, prioritizing the production and consumption of agricultural foods produced in the territory of Bolivia.

A number of articles also reference elements of the food sovereignty concept without stating the term explicitly. The articles cover key aspects of the concept including its rejection of GMO and “harmful” inputs, the prioritization of food production that is run by, and beneficial to rural farmers, and protection of the domestic food industry. However, the language is somewhat vague and does not define how these goals must be carried out, leaving the interpretation up to collaboration and contestation between the state and local actors (McKay, 2014).

The emergence of food sovereignty in Bolivian political discourse, and its incorporation into the constitution are the result of a combination of social factors

intertwined with Bolivia's recent history. The backlash towards neoliberalism in the country permeated all facets of Bolivian society, but was particularly intense for farmers in rural areas. Under neoliberal policies, traditional ways of farming were eroded through mechanization, land accumulation, international competition, and shifting emphasis from local markets to international markets (Zimmerer, 2009). This became a challenge for capital and skill deprived small-scale farmers. Many farmers viewed such a system as being intricately linked with a modern form of colonialism that perpetuated the exploitation of those who depended on farm-based livelihoods for the benefit of the economic elite. They also perceived the system as neo-imperialist, favoring the interests of foreign companies. As indigenous identity became fortified amongst the rural population thanks to the coca controversies and the resultant activism and empowerment, farmers and sympathetic intellectuals sought to define a system that was more in keeping with traditional values and more directly supportive of the majority small-scale producers. Inspired and supported by such international small-scale farmer advocacy organizations such as La Via Campesina and the International Federation of Organic Agriculture Movements (IFOAM), small-scale Bolivian farmers began advocating for food sovereignty as the system to replace the neoliberal system of food production, trade, and consumption (Desmarais, 2002; Martínez-Torres & Rosset, 2010; Zimmerer, 2009).

However, the idealism of food sovereignty in Bolivia has often been found to conflict with local, national, and international realities. At the local level, consumer preferences for processed foods and a resistance to a diversified diet concentrates demand towards a few staples, thus leading to health issues and low volumes of trade of local food products. At the national level, urbanization and increasing affluence is driving demand for new food products, many of which are produced by large agribusiness and multinational corporations. Problems with the health and safety of nationally produced foods, particularly those that are not well established, has also been a challenge. On the international front, the focus on food sovereignty has complicated the much needed foreign exchange earning potential of some

agricultural products that are seeing rapidly rising international demand (Cockburn, 2013).

The Bolivian state's adoption of food sovereignty also raises questions around whose purposes it should serve. As outlined in chapter 2, the concept of food sovereignty is characterized by contradictions and inconsistencies. One of the most prominent for Bolivia is food sovereignty's need for a strong developmentalist state that fosters its implementation, but to keep with its principles, the state must redistribute and relinquish power over food systems, which in turn threatens state power and control (McKay, *et al.*, 2014). In Bolivia food sovereignty has become closely linked with indigenous empowerment and de-colonization, two processes which the MAS has internalized and made their *raison d'être*. As a result, food sovereignty "has been used to galvanize consent and popular support, with state actors co-opting or consolidating food sovereignty as their own in ways that result in state-society power dynamics that significantly favour the former," (ibid., p.1178).

Not only has the Bolivian government struggled to orient itself with emerging realities while also addressing the inconsistencies in food sovereignty, but in many cases it has actively gone against food sovereignty principles. Despite a stated desire to increase domestic production and consumption, the quantity and variety of foreign food imports has grown under the MAS government. Not only has this further exposed small-scale Bolivian farmers to international competition and price fluctuations, but it has made Bolivian consumers more dependent on food supply and access that is controlled by actors outside the country (Ormaechea, 2009). As mentioned earlier, agricultural land also continues to be overwhelmingly owned by large producers, a group that the MAS have sought to appease rather than dissolve, which perpetuates the government's focus on agribusiness and mono-crop exports (Cockburn, 2014). An excellent example of this is the growing Quinoa sector. Quinoa is grown in the Bolivian altiplano and it is one of the few regions in the world where it can thrive. Although indigenous people have been growing it there for centuries, its popularity never spread much further until recently. Over the last five years the demand for Quinoa has skyrocketed thanks in part to celebrities in the global North praising its health benefits. This has led Bolivia to

turn to agribusiness to scale up Quinoa production and generate foreign exchange. The result has been large corporate farms squeezing small-scale farmers out of the market and the erosion of agro-biodiversity. Cockburn (2013) found that the national government has chosen to twist the concept of food sovereignty towards an emphasis on sovereignty in the sense of national autonomy, which they use in turn to justify the perpetuation of agribusiness led agricultural schemes such as the one for quinoa. She argues that this is “one of many examples that illustrate the double narratives and policies of the Morales administration,” (p.1). This construction of the food sovereignty concept demonstrates its contested nature and points to its shortcomings in practice in the Bolivian context.

As discussed in chapter 2, food sovereignty is a somewhat fluid concept, and has been shaped more by theoretical exercises than real-world applications. Therefore criticism towards Bolivia for deviating from elements of the food sovereignty concept must be doled out cautiously. Food sovereignty is shaping Bolivian rural development and food policy as much as Bolivia is shaping notions of food sovereignty. The bi-directional power effects between the concept and the implementing authority cannot be ignored, and their effects are important for understanding how to produce greater equity in food systems through improved governance.

Overall the social progress and economic changes in Bolivia under Morales have been significant by many measures. Poverty and food insecurity have decreased, and population health and incomes have improved. However, with the exception of GDP growth, Bolivia has not achieved the momentum to outpace Latin America’s development in general, which is needed for Bolivia to get closer to the continental average. Bolivia’s growth and development are difficult to attribute to the Morales government and their “process of change”. Although they deserve credit for management that has broken with the political turmoil of the country’s past, the country continues to be plagued by entrenched notions of governance and social and economic inequality. This mixed bag of progress and problems will be a highly influential factor for rural development moving forward. For Bolivia’s relatively new and growing aquaculture sector it is particularly pertinent. Aquaculture has

been touted as an effective means for livelihood diversification and socioeconomic development. However, the pathway to engaging a much greater number of consumers and producers and deliver better incomes, improve food security, and increase sustainability will depend heavily on understanding the local context. This study therefore provides a critical contribution by providing a thorough analysis of the mediating effect of Bolivia's sociopolitical and cultural realities on aquaculture development.

3.3 Aquaculture in Bolivia

Bolivia has the lowest rate of fish consumption in the Americas and one of the lowest globally. Fish has never been a major food source for most Bolivians, with the exception of some indigenous groups in the Amazon. Historically there has been little interest on the part of the government to increase fish consumption or promote aquaculture, but recently this trend has shifted. Small-scale family-based aquaculture is starting to be promoted by NGOs and government agencies as a vehicle for rural poverty reduction. A governmental department called the Decentralized Public Agency for Fisheries and Aquaculture (Institución Pública Desconcentrada de Pesca y Acuicultura – IPD PACU) has been established to grow aquaculture in the country and meet a remarkable goal of increasing annual national fish consumption from an average of 1.8kg to 6kg over the next few years (Los Tiempos, 2015). Two pathways to the poverty reduction and consumption goals have been envisioned. The first is the adoption of aquaculture by smallholder farmers as a livelihood activity that generates increased income through sales and enhances food security through home consumption. The second is the increased availability of fish to the general population, which provides a high quality source of nutrients and therefore improves nutrition (IPD PACU, 2015). Currently neither pathway is well developed. In general, aquaculture has seen slow growth in Bolivia, which has complicated these plans. Despite seemingly strong and growing market demand for fish, small-scale farmers have not been quick to adopt aquaculture into

their livelihood portfolios. When they do, it has often been due to NGO support and encouragement (FAO, 2005; Van Damme *et al.*, 2014). This indicates that smallholder farmers still perceive aquaculture as a livelihood activity with inherent risks and challenges.

Improving aquaculture-based livelihoods is dependent on a thorough understanding of how those livelihoods are embedded in the country's food system and in its socioeconomic context. This section describes fish as part of the food system in Bolivia, the history and recent emergence of aquaculture, and what institutional barriers and opportunities affect the aquaculture sector.

3.3.1 The Bolivian Fish Production System

Bolivian fish production is carried out through a combination of capture fisheries and aquaculture. The former has a long and culturally significant history in Bolivia, while the latter is a relatively new livelihood activity that has struggled to become established. The earliest and longest running aquaculture in Bolivia began in the 1930s in and around the Andean Lake Titicaca where farmers reared rainbow trout in cages. The sector was started by missionaries as a way to supply food and cash earnings to the indigenous groups of the area. In the 1950s and 1960s local universities and NGOs got involved in developing the aquaculture sector and supported the introduction of tropical and subtropical species of Nile Tilapia (*Oreochromis niloticus*) and Asian (Common) Carp (*Cyprinus carpio*) in the central lowland regions of the country. In the 1980s and 1990s USAID took an interest in aquaculture, particularly in the Chapare region, as an alternative rural livelihood development model to coca. By the late 1990s, however, USAID's interest began to wane primarily due to minimal effectiveness in diverting producers away from a reliance on the crop, although projects and financial support did not end altogether. Funding continued on a community-by-community basis into the 2010s as part of the NGO driven development complex that influences rural development and spending in Bolivia (photos 3.3 & 3.4). Interest and activities driven by The University of San Simón and Gabriel René Moreno University provided support and

continuity to efforts at establishing aquaculture (FAO, 2006). Despite regularly mediocre results in production and marketing, the potential for aquaculture in the Bolivian lowlands as a rural livelihood and provider of food security has buoyed optimism and continues to inspire efforts to develop the sector.

Photo 3.3: USAID Aquaculture development project sign located in Carrasco province.



Photo 3.4: European Union aquaculture development project sign located in Carrasco province.



Although Bolivia has low fish consumption per capita overall, wild caught fish is a prominent food source and livelihood for households in certain regions. In the eastern and northern tropical lowland departments such as Pando, Beni, and Santa Cruz, where there are many waterways, fishing is quite common (see table 3.4). It is also an activity that is closely intertwined with indigenous culture and identity. Tribes of the region relied on fishing Amazonian rivers and lakes as the cornerstone of their subsistence for hundreds of years (Zycherman, 2013). However, increasing connectivity with markets and urban areas has begun to alter diets towards less traditional and more processed foods. It has also reduced the subsistence nature of fishing in the area and increased fishing for commercial purposes (McNaughton *et al.*, 2015; Zycherman, 2013).

Table 3.4: Number of Rural Production Units (Families) that engage in fishing as a commercial activity.

Region	Total # of Farming	Rural families that engage in fishing	
	Operations	Number	% of Total Farmers
Bolivia	871,927	105,379	12.1
Chuquisaca	73,388	3,253	4.4
La Paz	245,455	14,767	6.0
Cochabamba	181,536	26,877	14.8
Oruro	62,692	2,470	3.9
Potosi	123,991	4,318	3.5
Tarija	41,539	4,416	10.6
Santa Cruz	115,027	31,525	27.4
Beni	20,762	12,236	58.9
Pando	7,537	5,517	73.2

Source: INE (2014)

Most fishing in Bolivia occurs in the tropical lowlands to the East and North that constitute about two thirds of the country's total land mass. Of the approximately 635 endemic fish species in the country, about twenty-three from the tropical lowlands have commercial value (see appendix 1 for pictures and descriptions). Almost all of the commercially viable fish of the Amazon are harvested through fishing. The popularity of each species with consumers varies by region, but the leading ones, as known in the markets, are Surubi (*Pseudoplatystoma fasciatum*), Benton (*Hoplias cf. malabaricus*), wild Pacu (*Colossoma macropomum*), and Paiche (*Arapaima gigas*).

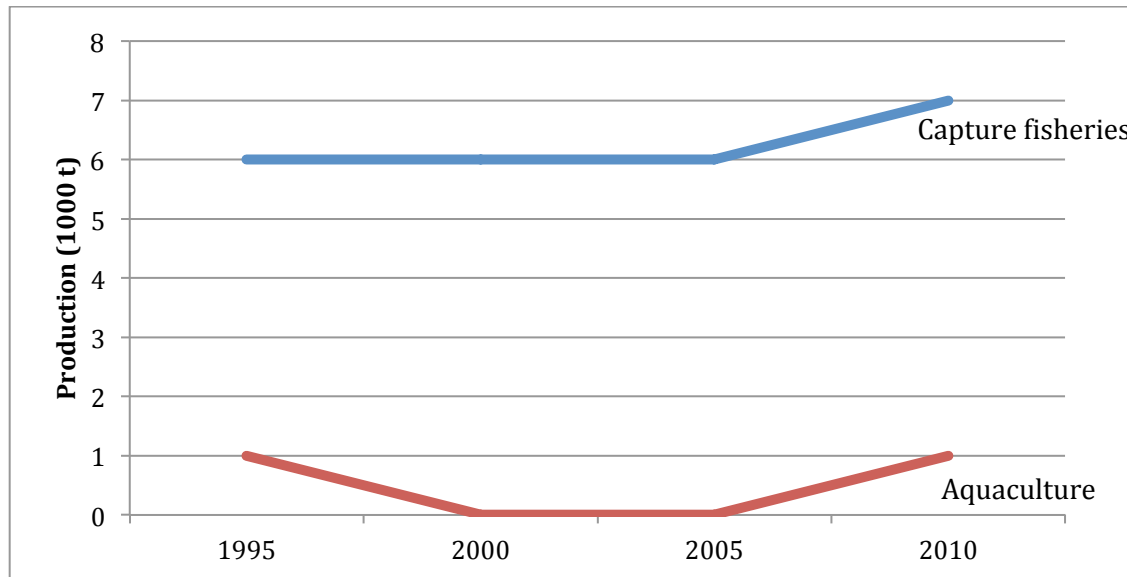
According to the Bolivian agricultural census (INE, 2014), fish production in Bolivia has been quite stable over the past twenty years (figure 3.6). However, the accuracy of this data should be considered cautiously, especially in regard to capture fisheries. Although communal and informal aquaculture production exists, it tends to be the exception. Most aquaculture production is commercial and hence better accounted for. Considering the low levels of production and the small size of the sector, the data are likely only slightly underestimated. This is in contrast to

capture fisheries within the study area, which are often informal. Many small-scale fishers catch fish as part of a diversified livelihood strategy rather than as a primary livelihood activity. Many are labourers or farmers that only fish occasionally, such as when they are not occupied with their other jobs, and/or when river stocks are high and catching fish is quick and easy. However, there are some fishers who depend on fishing as their sole source of income. Although little information was collected in this study about the welfare of fishers, according to discussions with market managers who deal with them frequently, and also through observation, the general view is that fishers in the study region tended to be poor, even compared to others in the community. Those that fished part time did so as a means to supplement their farm incomes, or to reduce income and employment volatility that is often associated with basic labour work. Many in these cases would likely not actually consider themselves fishers. In the case of those who depend on fishing for their entire livelihood, they are likely landless. When fishers, regardless of group, have fish to sell they will sell directly to fish stall managers at rural markets. The quantities are usually small and the species can be diverse. It is not uncommon for rural markets to have a glut or shortage of a particular species that is due to the degree and nature of local fisher activity. This study captured less information about fisher activity at urban markets, but due to issues of transport, volume, supply consistency and quality, it is likely that larger scale and more geographically diverse fishing operations were their suppliers.

Production through fisheries is poorly tracked since data on sales and purchases at local markets (the location where most fish trade takes place outside major cities) lacks record keeping on the part of managers, a lack of accounting of subsistence fishers, and the heterogeneity of catches between remote communities (Castello, 2013). Furthermore, fishers frequently sell to family, friends, and fellow community members. For these reasons the data on capture fisheries are likely more reflective of medium and large commercial fishers, who make up a small percentage of those who are fishing, and therefore annual captures are likely much higher. This is supported by reports of many species being over-exploited in

Amazonian rivers largely due to over-fishing (Castello *et al.*, 2011; Oberdorff *et al.*, 2015; Petrere, 2004).

Figure 3.6: Bolivian fish production by source and quantity



Source: FAOSTAT (2016)

3.3.2 The Re-emergence of Aquaculture in Bolivia

Over the past few years there has been a surge in aquaculture production in Bolivia. The increase has primarily been in the central region of the country that forms the southern edge of the Amazon rain forest and extends up to the city of Trinidad. The heart of aquaculture production is in the Northeast portion of the Cochabamba department and the adjoining central-Western portion of the Santa Cruz department. The majority (56%) of the country's aquaculture producers are located in the two departments, and are mostly concentrated in the aquaculture heartland (table 3.5). Although some aquaculture exists in other areas, it tends to be one-off producers rather than clusters of activity (the one exception is cage farming of trout in Andean lakes). It is worth noting that less than 0.5% of farms in Bolivia engage in aquaculture, and even in the aquaculture producing regions it is an

uncommon livelihood. The reasons for the relatively more robust growth of aquaculture in the area as compared to others includes factors such as environmental conditions, NGO and local governmental encouragement and support, a culture and history of food production and fishing, and widespread land ownership (Van Damme *et al.*, 2014).

Table 3.5: Total number of producers, and aquaculture producers, by department

Department	Total number of Producers (all types)	Aquaculture Producers	
		Number	Percentage
Bolivia	871,927	4,525	0.5
Chuquisaca	73,388	102	0.1
La Paz	245,455	940	0.4
Cochabamba	181,536	1,463	0.8
Oruro	62,692	53	0.1
Potosi	123,991	73	0.1
Tarija	41,539	548	1.3
Santa Cruz	115,027	1,065	0.9
Beni	20,762	188	0.9
Pando	7,537	93	1.2

Source: Instituto Nacional de Estadística (2014)

Nearly all aquaculture in Bolivia can be described as artisanal; large-scale corporate and/or industrial operations are virtually unheard of. Markets for fish produced through aquaculture exist throughout the country but are relatively larger and more active in proximity to the central production region and in Santa Cruz city. Market outlets for aquaculture products are primarily retail food markets or restaurants, with informal sales direct from producers to consumers being another, albeit less substantial outlet. The key actors in the aquaculture value chain include the producers, input businesses, various labourers, and marketers. The main input businesses are fingerling breeders and feed manufacturers. Labourers include people who work on farms, for input businesses, or for marketers and retailers. Indirect chain actors include policy makers (usually from the local level but

increasingly from the national level as well), researchers from local universities, and NGOs. Although some aquaculture production has national reach and enjoys a degree of production and marketing sophistication, such operations are uncommon. In general, Bolivian aquaculture value chains tend to be short and localized.

These producers and chain actors face a number of endogenous challenges related to their socioeconomic condition and the institutional framework in which they operate. Local, regional, and state institutional support for their livelihoods has historically been inconsistent (FAO, 2005). Corruption and lack of technical skills can be a problem amongst authorities at all levels of government and complicates allocation of development funds and certification systems, such as those for food health and safety, which is particularly pertinent for aquaculture development (Wickberg, 2012). Infrastructure is poor and unreliable, which makes it difficult to access markets as well as form and maintain relationships with retailers in distant areas and urban markets. Social cohesion in the aquaculture region can at times be strained. Many aquaculturists are descendants of altiplano immigrants, and they tend to have an adversarial relationship with the lowland peoples who they live in proximity to. Political strife continues to be the norm in Bolivia, and in rural areas in particular, which often leads to protests, riots, and road blockades (Farthing & Kohl, 2014). The politics of coca also factors prominently in the aquaculture region, and affects development and funding decisions as well as civic-state relations. The most pressing challenge to aquaculture development is that most producers and chain actors tend to be poor and have marginal endowments of livelihood capital (Canal-Beeby, 2012; INE, 2012).

The future potential for aquaculture has its challenges, but many are common to small-scale farm-based livelihoods in the rural tropical lowlands of Bolivia. Aquaculture itself, and as a livelihood in the region, is said to have a number of characteristics that may prove beneficial to rural development and food security. Many women are becoming involved in the activity, and it seems to fit well with their livelihood portfolios and traditional household obligations, thereby making them contributors to household income and improving gender equality (Rainville *et al.*, 2014). Aquaculture in the area is also seemingly lucrative, generating positive

returns on investment and requiring relatively modest maintenance costs. It is also generating increased food security through the nutritional value of fish, which is being consumed more in the homes of producers, and more broadly by local communities. The increasing demand has had multiplier effects through new entrepreneurship and employment related to restaurants that specialize in fish. It may also be argued that aquaculture is contributing to food sovereignty by generating domestic production, empowering farmers, boosting local trade, and by being environmentally sustainable.

The future of aquaculture development in the region is uncertain. The complex social and economic processes and conditions that are present in Bolivia generally, and in rural areas specifically, are having, and will continue to have, a profound effect on the success and/or failure of individual aquaculture farmers as well as the sector as a whole. Therefore, if aquaculture is to meet its potential, and contribute to sustainable food production in Bolivia, it needs to be further investigated. Specifically, it is necessary to uncover how the aquaculture value chain functions, and impacts the social, economic, and natural environment. It is also necessary to determine what contribution it is making to the food supply today, and what it can offer for tomorrow. Determining these things will make an important contribution to our understanding of aquaculture's potential to address the triple challenge of providing food to a growing population while reducing its environmental footprint and reducing rural poverty.

3.3.3 Cultured Species

Carp is the most commonly cultured fish in Bolivia, but it tends to be added to rice paddies as a supplement to household food consumption rather than being a commercial product. Trout and tilapia have the longest history in the country and are common in the highlands and foothill regions due to their tolerance of cooler climates. However, it is the Pacu (*Colossoma Macropomum*) (photo 3.5) and the Tambaqui (*Piaractus Brachypomus*) (photo 3.6), the only two native fish cultured in

Bolivia, that are principally responsible for the recent growth of the aquaculture sector in the tropical lowlands (table 3.6).

Table 3.6: Number of aquaculture producers by department and species.

Department	Carp	Pacu	Trout	Tambaqui	Tilapia	Sabalo	Turtles	Benton	Sardines	Surubi
Bolivia	1692	921	799	522	503	215	77	67	64	45
Chuquisaca	70	6	2	-	-	10	-	-	1	1
La Paz	111	26	357	5	332	11	9	2	-	2
Cochabamba	599	136	361	334	39	41	5	9	15	8
Oruro	-	-	32	-	-	-	2	-	-	-
Potosi	-	-	39	-	-	-	6	-	-	-
Tarija	496	42	3	-	5	16	-	-	-	-
Santa Cruz	400	567	5	92	97	98	15	38	42	27
Beni	-	127	-	48	8	14	24	11	4	3
Pando	9	17	-	43	22	25	16	7	2	3

Source: INE (2015)

Pacu and Tambaqui are quite similar to one another in ecology and appearance, which often leads to confusion and the use of their common names interchangeably.¹⁶ Scientific classification has also struggled to effectively differentiate them (Magallanes, 2008). They are endemic to the Amazon and Orinoco river basins and may reach weights of 40kg in the wild. They are omnivorous fish and in the wild primarily eat fruits, but also nuts, seeds, zooplankton, insects, snails, and plants, and as such serve as important distributors of seeds throughout river systems (Lovshin, 1995; Lucas, 2008). To handle this atypical diet, and due to their evolution from piranha, they have evolved teeth that have an uncanny resemblance to those of humans (photo 3.7).

¹⁶ Both common names have been found to be used for each species, therefore the names given in this study were used because that is the name that is used by the workers and producers in Bolivia.

Photo 3.5: A very large wild caught Pacu (with head removed and being held upside down).



Photo 3.6: Farmed Tambaqui (approximately 800grams each).



Photo 3.7: Pacu teeth.



Source: amusingplanet.com, 2014

Both Tambaqui and Pacu have a variety of characteristics that make them ideal for cultivation in man-made ponds in tropical regions. They are tolerant of pH changes in water (Val *et al.*, 1998), have physiological and behavioral traits that increase their tolerance of low levels of dissolved oxygen (Val, 1995), are resistant to diseases and pollutants (Kochhann *et al.*, 2015), and are all around quite hardy

(Campos-Baca & Kohler, 2005). They also have several qualities that tend to make their culturing environmentally sustainable. Their diets permit feeds that primarily use soy and occasionally a small quantity of roughage from cattle processing to supply required protein (pers. comm. with feed manufacturer, 2016). Species escape and contamination of the wild gene pool is also an ongoing concern with aquaculture but appears to be minimal with Pacu and Tambaqui. Aguiar (2013) found that the genetic variation between captive and wild Tambaqui in Brazil tended to vary by region. In some states genetic diversity amongst brood stock was similar to that of wild fish, which would minimize the negative consequences of escapes, but in other states there was indications of endogamy in the breeding stocks. In Bolivia, although no formal research has been done in this regard, it is likely that farmed fish have a high degree of genetic similarity to wild fish as there are only a handful of fingerling suppliers and they rely heavily on wild caught fish for their brood stock (pers. comm. with fingerling producer, 2016).

3.3.4 The Market for Aquaculture

The market for fish in Bolivia is relatively small compared to other countries but is growing. Increasing affluence across the entire population is making it easier for consumers to acquire new and/or relatively higher value foods. Fish is also widely understood to be both flavorful and healthy. This has made it popular for special occasions such as birthdays and festivals. Its association with Catholicism has led it to be very popular during religious holidays such as Christmas and, in particular, Semana Santa.

However, although fish consumption is on the rise, it has not yet become a regular component of Bolivian diets. While fish prices are not unaffordable, they tend to be higher on average than other meats such as beef and poultry. Food preferences in rural areas are also problematic. They tend to be highly engrained; many people eat similar foods and similar dishes day after day, making the widespread adoption of regular fish consumption a significant and complicated challenge (refer to chapter five for evidence and discussion about this behavior).

Greater rural consumption also faces barriers formed by low asset endowments associated with poverty. Many people do not own fridges or freezers, making the storage of highly perishable fish very difficult. It also makes people second guess purchasing fresh fish, as leftovers cannot be easily kept, a key concern for food insecure households. Domestic fish products that address these problems, such as smoked or canned fish, have yet to be produced at any commercial scale in the country, and are unlikely to materialize any time soon without concerted public and private interest and investment.

Urban consumers, with their higher incomes and more diversified diets, would seem like better candidates as fish consumers, but they too face barriers. While urban people tend to consume a greater variety of foods, and the variety and quantity is increasing, the new consumption space is largely being filled by processed foods. There is also increasing preference for beef as it is endowed with a perception of luxury. A key barrier to more urban consumption of fish is its generally poor quality in Bolivia. Perceptions of health and sanitation risks are manifest out of poor infrastructure and shipping and handling (photo 3.8). Refrigerated transportation is primitive and sparse, and markets tend to lack cleanliness and quality control (photos 3.9, 3.10, 3.11 & 3.12). There also tends to be only modest and/or inconsistent governmental oversight.

Photo 3.8: Bag of fish transported from pond to a rural market on the back of a motorbike.



Photo 3.9: Fish seller at Santa Cruz's "upscale" fish market



Photo 3.10: Fish sellers at Santa Cruz's open air fish market



Photo 3.11: Fish (Sabalo) stored at Santa Cruz's open air fish market



Photo 3.12: Fish seller at rural open air fish market



Both supply and demand of wild caught fish in the study region is higher than that for aquaculture produced fish. It has the advantage of having a larger variety of species and products, many of which are more ubiquitous than those of aquaculture, and production is more widespread and therefore reaches markets with less friction. The informal economy that surrounds study region fish is also quite large, and while it exists in aquaculture, it is much more prominent in the fishery. There are few barriers to entry for fishing, therefore many people do it part time, and rely on local networks of family and friends as customers, and therefore achieve much wider market reach than aquaculture currently does. They also engage in sharing and exchange, which further expands their market, and is the form through which

many of the poor consume fish. However, the fishery is challenged by unsustainability and an inconsistent supply of various species. The informal nature of the fishery due to the majority of producers being individuals and often part-time also limits its potential expansion into urban areas. It is also poorly developed in a commercial sense.

In the study region, although some value adding does occur in the form of fillets and various other cuts, most fish is sold whole. Higher value packaged products are not produced in significant quantity. Although the fishery currently generates more production and enjoys greater market share than aquaculture, scaling it up would be a much more challenging prospect.

The supply and demand for aquaculture fish is less than that of wild caught fish mainly due to the small size of the aquaculture sector that limits its market reach, and the small number of marketable aquaculture species. There is also virtually no value added products from aquaculture such as specific cuts or packaging. Almost all fish is simply gutted and sold whole. While this form is popular at rural fish centered restaurants (photo 3.13), it stunts broader expansion into typical restaurants, especially those in urban areas. Nonetheless, aquaculture has a number of characteristics that indicate greater market potential. It is more sustainable than capture fisheries, and has the potential to provide steady year round supply. There is also theoretically more room for price reductions since aquaculture production is more capable of achieving economies of scale. In rural areas, producers are also taking more control of their product and vertically integrating. Some have opened restaurants and these have become quite popular in some towns. There is also growing interest from governmental agencies and companies to feed more domestically produced aquaculture fish to workers and school children (pers. comm. with a producer, 2016). Ironically, however, the enforcement of health and safety standards, which are questioned by many consumers and therefore act as a barrier to more fish consumption, also act to impede small-scale producers from selling to government as they do not have the infrastructure and equipment needed to meet regulations (pers. comm. with a producer, 2016). While this is indeed a problem, aquaculturists also have a greater

capacity than fishers to make investments in product improvement and some are currently exploring methods to improve quality and safety.

Photo 3.13: A whole Tambaqui prepared at a rural restaurant

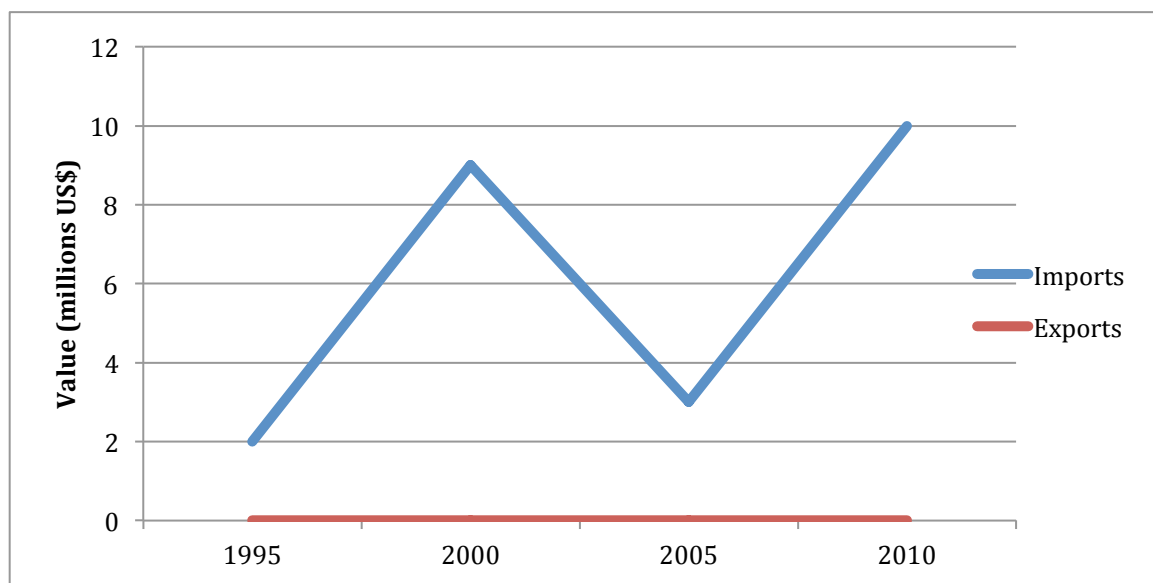


An overall challenge for aquaculturists and the aquaculture market is that fish is a fungible commodity. Consumers will easily change preference from aquaculture fish to wild caught fish (or vice versa) depending on price, quality, and type of product. Consumers are often even willing to replace fish with other types of meat if their preferred product is not available or if the price and quality are not satisfactory. Even though demand is growing, it is not particularly intense, meaning that availability and affordability of fish products is critical for attracting new consumers and retaining old ones.

The international market for fish is often looked upon to provide growth, but is currently beyond the reach of Bolivian fish producers. Figure 3.7 shows the value of fish imports and exports over the last twenty years. Despite more than eight thousand tons of production, Bolivia has almost no fish exports. This is due to a number of factors that have been outlined in this chapter. Being land locked and

endowed with a marginal road network makes transportation of a perishable good such as fish cost intensive and organizationally challenging. Being land locked also excludes the production of higher value and demanded marine products. The low skill and capital endowment of farmers challenges their capacity to produce quality, export worthy fish. Most species of fish that are caught or cultured in Bolivia are also common in neighboring countries, making international competition a factor as well.

Figure 3.7: Trade values of fishery products in Bolivia



Source: FAOSTAT (2016)

While Bolivian fish exports are virtually non-existent, fish imports have fluctuated significantly over the past twenty years, and have steadily increased since the arrival of the MAS government in 2006. The increase in imports can somewhat be attributed to increasing consumer affluence in urban areas and the consequential rise in demand for higher value foodstuffs. Oddly though, there is a large urban demand for Sabalo (*Prochilodus nigricans*) (photo 3.14), a fish acquired from a freshwater fishery in Argentina and imported by large refrigerated trucks (photo 3.15). The reason why this fish is in demand is unclear. It is similar to Tambaqui in boniness and flavor (some say Tambaqui is better as it is fattier), and is just as easily

produced. The most likely explanation is that it is about 40% cheaper at urban markets since the Argentinian importers have achieved better economies of scale than the domestic aquaculture producers, and have more consistent supply. The Argentine Peso has also historically been half to a third of the value of a Boliviano, which has also likely been a factor in the low cost. At rural markets Sabalo is popular, but not as much, as there the price is more on par with Tambaqui and the rurally popular Surubi. Although Argentinian Sabalo presents competition for domestic aquaculture producers, it also represents an opportunity. If domestic producers can organize transportation and increase volume that maintains quality, all the while lowering the price, they may find themselves on a competitive footing.

Photo 3.14: Sabalo



Photo 3.15: Refrigerated semi-trucks used to import Argentinian Sabalo



3.3.5 Research Context

This research was carried out in the central lowlands of Bolivia in an area that encompasses the Chapare region in the Cochabamba department, and the Western agricultural region of the Santa Cruz department. It is the heartland of aquaculture in the country, and has been the recent subject of efforts at developing aquaculture livelihoods. In 2012 the Peces Para La Vida (PPV) project was initiated through a partnership between the NGOs World Fisheries Trust of Canada, Agua Sustentable of Bolivia, and Faunagua of Bolivia, and funded by the International

Development Research Centre (IDRC) of Canada and the Canadian government. Its goal was to support the development of fisheries and aquaculture for poverty reduction and increased food security in the Amazonian region of Bolivia (Carolsfeld & Rainville, 2014). Based on that project's identification of target areas for fisheries and aquaculture improvement, a second round of funding was awarded by IDRC to an expanded project team in 2015. The new project is called *Pesces Para la Vida 2* (PPV2) and the team consists of the University of Victoria and World Fisheries Trust, both of Canada, and Faunagua, IMG Consulting (IMG), Centro de Promocion Agropecuaria Campesina (CEPAC), and Centro de Investigación y Desarrollo Regional (CIDRE), all of Bolivia. The project mandate is to sustainably scale-up fisheries and aquaculture for poverty reduction and food security in Bolivia. This dissertation is a component of, and is supported by, the PPV2 project.

The culture, history, politics, and people of Bolivia, and of the central lowlands in particular, greatly influence how research is carried out, and findings are interpreted. The context provides a rich picture from which to draw insightful and meaningful conclusions about rural livelihoods and aquaculture in Bolivia and beyond. However, it also presents numerous challenges. There is a relatively large literature on Bolivian topics related to political science and anthropology. The unique sociopolitical history and governmental system has attracted the attention of many critical theorists, but the same system poses challenges for empirical researchers. Some research on development in Bolivia exists, but tends to be more theoretical than applied, thus providing insight but few concrete recommendations for action. There is also very little data on Bolivian aquaculture, either from scholarly publications or from government sources (Canal-Beeby, 2012). This situation has therefore led to a heavy reliance on my own data, experience, and the work and insight of project partners. It was also a driving factor in the choice to incorporate exploratory research as the linkages between livelihoods, socioeconomic conditions, and aquaculture in the Bolivian Amazon are not well documented or understood.

3.4 Summary

Bolivia has undergone significant change in recent years, but remains a country of evolving contrasts, contradictions, and unrest. In 2005, with the election of Evo Morales and his Movimiento al Socialismo (Movement for Socialism, or MAS) party, the country joined the “pink-tide” of socialist governments that were gaining popularity in Latin America. Morales introduced an overarching policy of navigating the country through a “*proceso de cambio*” (process of change) that set it on a distinctly new development path. This included the formation of a decentralized government system that sought to ameliorate the conditions of the marginalized by emphasizing and investing in sustainability, sovereignty, and social justice (Farthing & Kohl, 2014). The consequences of this shift in governance have been profound, but perhaps just as interesting is what remains stubbornly problematic: rural poverty, gender inequality, food insecurity, and their tendency to disproportionately affect indigenous people. Despite admirable progress, Bolivia today remains the poorest and most food insecure country in South America (EIU, 2016; World Bank, 2015).

In the first section of this chapter, the history and social characteristics of Bolivia and its central sub-Amazonian region were outlined. It was argued that the unique history of oppression perpetuated severe poverty, but eventually led to a resistance that fostered indigenous identity and empowerment, and shaped regional and national politics and forms of governance. In the second section the impacts of the new and unique government of Evo Morales were assessed. It was found that despite progress in various dimensions of development, many social and economic problems persist. It was argued that this context must be engaged and navigated, rather than avoided, if development generally, and aquaculture system development specifically, is to yield desirable outcomes. In the third section Bolivia’s aquaculture system was outlined and the drivers of its functioning were explored. The primary point of this chapter has been to articulate the contextual and often nuanced ways that Bolivia’s unique history, culture, society, economy, environment, and governance, has, and will continue to, affect the development of the aquaculture

system. This forms a critical component of forging pathways towards an aquaculture system that addresses the triple challenge by being more productive, equitable, and sustainable.

Chapter 4: Research Design

This chapter presents the methodology that guided the design of this research. It then goes on to outline the methods and tools used for data collection and analysis.

4.1 Methodology

For a study to be rigorous and ethical, it is necessary for the researcher to outline their social-scientific philosophy. This is because, as Prowse (2010) puts it, “there are substantial benefits in adhering to a clear methodology and being explicit about a philosophical standpoint... Doing so can help to explain how research findings are generated, how robust findings are, and how findings can or cannot be extrapolated,” (p. 211). In development research this is particularly important given the myriad inherent conflicts that are the result of various competing interests (for example between researchers and donors), as well as the expanding acceptance of what constitutes development research (Camfield, 2014; Humphrey, 2007).

This research is neither purely positivist and empirical, nor is it constructivist. It assumes that seeking out empirical information should form the backbone of explanation that appreciates the mediating effect of human systems. Furthermore, this research does not claim to be predictive, and in fact is critical of predictive claims, but rather points to tendencies as a means to explain causal mechanisms and appreciates that such tendencies are influenced by time and place. Therefore, the philosophical position that underpins this study is critical realism (CR), which Bhaskar (n.d.) describes as follows:

Critical realism emerged from the vision of realizing an adequate realist philosophy of science, of social science, and of explanatory critique. As this unfolds in critical realism, it proceeds according to a two-fold critique against established positions. Firstly, against empirical realism (positivism) and transcendental idealism (constructivism), critical realism argues for the necessity of ontology. Being realist about ontology means being able to speak

and understand being apart from human thought and language. It establishes that things exist apart from our experience and knowledge of those things. Secondly, against the implicit ontology of the empiricists and idealists, it argues for a structured and differentiated account of reality in which difference, stratification and change is central. In short, critical realism argues *for* ontology, and *for a new* ontology.

In other words, as Prowse (2010) outlines, “CR may provide social researchers with a philosophical route out of the staid and unproductive dualism of positivism and social constructivism,” (p. 217). He argues that CR provides a good foundation for investigating issues within development, particularly causal events across scales and how they relate to livelihoods. Academics have called for CR to play a stronger role in other related disciplines as well, such as in Lawson’s (1997) *Economics and Reality* where he calls on economists to root their work more firmly in the real world and to be skeptical of clean but verifiably flawed premises such as universality and rational choice. It is within this conceptual framework of social science research that the approach and methods adopted for this study were developed.

Effectively mixing theory with realities is critical for social scientists investigating food systems. Traditionally a researcher would delve into the literature and secondary data available to them, and from that craft methods for their study that would answer their research question or test their hypothesis in a rigorous way. Such methods would be expected to reflect both the theory related to the topics under investigation, and the reality of the conditions where their research is to take place. In Bolivia, however, information, research, and data on rural regions is sparse, and is particularly lacking for aquaculture (Canal-Beeby, 2012). Therefore, this research relied in part on an exploratory approach to build up understanding of the linkages between aquaculture activities and its socioeconomic effects in Bolivia. Stebbins (2001) defines the exploratory approach in the social sciences as “a broad-ranging, purposive, systematic, prearranged undertaking designed to maximize the discovery of generalizations leading to description and understanding of an area of social or psychological life,” (p. 3). The exploratory approach was particularly valuable for investigating the circumstances in Bolivia,

but because aquaculture's effects on economics and social structures has been investigated in other contexts, this study was able to meld exploration with deeper examinations of specific factors, therefore providing description and explanation and more profound insights than an exploratory study would have done on its own (Babbie, 2016).

To simultaneously contribute to understanding food system dynamics and to improve aquaculture for Bolivian chain actors, this research was designed to yield both applied research findings and to contribute to theory building. One component of the research goal is to contribute to, and improve upon, our current theories on the relationship between aquaculture, small-scale farmer livelihood development, and food systems. Such a goal dovetails with the aim of basic research to advance fundamental knowledge about the social world (Neuman, 2006), and it is the root of this study's unique contribution to knowledge. The other component of the research goal is to utilize the findings of this study to improve the aquaculture value chain in Bolivia for its current and/or potential participant workers and small-scale producers, particularly those that are economically and/or socially marginalized. That goal therefore aligns with applied research and its aim to offer practical solutions to concrete problems (*ibid.*). A further reason for the generation of both research types, and for the entire research philosophy and approach generally, is more personal; it jives with the author's desire to generate knowledge that is impactful both on the state of knowledge, and on the real lives of the rural poor.

4.2 Data Collection Methods

The overarching method used in this study was a value chain (VC) analysis that incorporated the rural livelihoods framework. This combination enriched the economic oriented nature of VC analysis with the social considerations inherent in the livelihoods approach. Both these components rely on a mix of quantitative and qualitative data collection methods.

This study draws from the value chain analysis methods laid out in Kaplinsky & Morris (2001), Bellu (2013), and Riisgaard *et al.* (2010). Kaplinsky & Morris

provide a general framework for conducting value chain research for development. Bellu (2013) outlines the steps needed to produce an economic accounting of the value chain that identifies where, how, and by whom value adding occurs, the economic performance of chain actors, and where bottlenecks in the chain exist. Riisgaard *et al.* (2010) provides insight into how value chain research can be expanded to be action-oriented, and encompass “horizontal” dimensions such as poverty, gender, and environmental concerns, into the traditionally vertical nature of value chain studies.

The rural livelihoods framework (Ellis, 2000) was also used in this study as a framework for investigating the aquaculture chain’s social effects. Ellis (2000) states that a livelihood comprises “the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household,” (p.10). As such, the livelihoods framework provides a means for integrating a multidimensional poverty analysis into value chain analysis that is appreciative of multi-scaler factors such as markets and institutions (Ellis & Freeman, 2005). The integration of livelihoods and value chain analyses has been shown to be a useful method for investigating the socioeconomic conditions that are created and perpetrated by food systems (for example see Challies & Murray, 2011; Jha *et al.*, 2011; Schure *et al.*, 2013), including aquaculture (Loc *et al.*, 2010).

To conduct the value chain analysis, this study used a mixed methods approach. Combining qualitative and quantitative research methods is considered an effective approach for poverty analysis and development research (Addison *et al.*, 2008; Bamberger, 2000; Kanbur, 2003). It is also important for studying gender issues as it provides valid measures of inequality and also gives voice to underrepresented women in the policy process (Spalter-Roth, 2000).

4.3 Assessment Tools

The following section outlines the formal assessment tools developed by other researchers and/or organizations that were used in the analysis of food

security and poverty, and partially for the role of women. These tools provide comparability and standardized results that have been validated in a number of relevant contexts, something that self-devised questions on these topics would not have. This increases the value of this research by not only improving our understanding of the socioeconomic conditions of aquaculturists in Bolivia, but how they compare to other small-scale producers around the world.

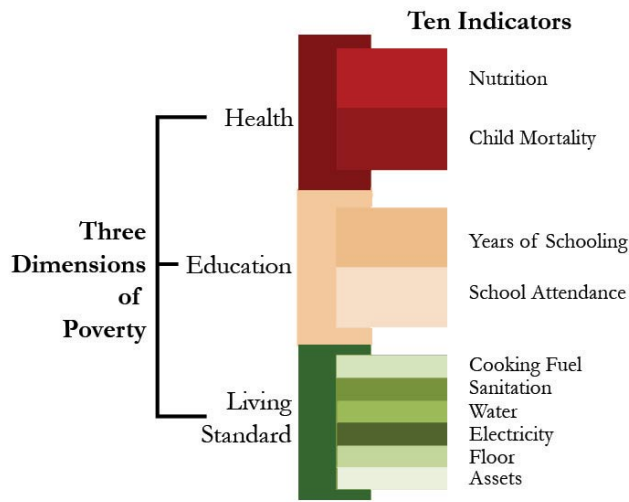
4.3.1 Poverty

Poverty is notoriously difficult to measure primarily because it is so complex and contested. As outlined in chapter 2, there are many dimensions to poverty that span the physical dimension of assets and income to the mental dimensions such as empowerment, security, and connectedness. The plethora of tools and approaches can overwhelm the time and analysis that goes into a study, therefore key indicators and tools related to multidimensional poverty were chosen to investigate the socioeconomic condition of chain actors.

To measure poverty, information on the income of small-scale aquaculture producers was gathered and compared to the national and international poverty lines. Measuring income is an effective indicator of wellbeing, and the international poverty line is also an effective threshold for identifying food deprivation (Gasparini *et al.*, 2013).

Other indicators of living standards, education, and health were collected. The Multidimensional Poverty Index (MPI) drove the choice to collect these indicators (figure 4.1) (Santos & Alkire, 2011). However, due to a combination of limitations including unavailable data, sensitive nature of questions, and the fact that the investigation is carried out at the household rather than at the national scale, not all MPI indicators were collected. The choice of indicators was adapted to reflect the realities of this study.

Figure 4.1: Three dimensions and ten indicators of poverty



Source: Alkire & Robles, 2016

4.3.2 Food Security

Like poverty, food security is a complex and multidimensional concept. Measuring food insecurity has been a challenge for both researchers and practitioners. In the early 2000s USAID partnered with eight research institutions and five universities and began the FANTA project which works “to improve the health and well-being of vulnerable individuals, families, and communities in developing countries by strengthening food security and nutrition policies, programs, and systems,” (FANTA, 2016). Building from the U.S. Household Food Security Survey Module and its focus on “access” to food as a measure of food security, and based on successes other researchers had in applying it to developing world contexts (Melgar-Quinonez, 2004; Perez-Escamilla *et al.*, 2004), they devised the Household Food Insecurity Access Scale (HFIAS), which had more global applicability (Coates *et al.*, 2007; Web *et al.*, 2006). The HFIAS consists of nine questions that represent an increasing level of severity of food insecurity, each with a follow up frequency question, all with a recall period of four weeks. An advantage of this tool is that it is minimally intrusive and brief, taking only a few minutes to

conduct. It has also been validated in a variety of regions, including South America (Swindale & Bilinsky, 2006; Vargas & Penny, 2010), and Bolivia (Melgar-Quinonez *et al.*, 2006). Researchers in Latin America however, have modified the HFIAS to more accurately reflect different social and cultural contexts. This led to different versions being applied in Brazil, Venezuela, and Columbia (ELCSA, 2012). In an effort to standardize a Latin American food security assessment tool that would facilitate comparisons across regional and national contexts, the FAO and EU sponsored a working group that in 2012 produced the *Escala Latinoamericana y Caribena de Seguridad Alimentaria* (ELCSA) (ELCSA, 2012).

The ELCSA was one of the two food security assessment tools used in this study. It follows the format of the HFIAS by asking questions that fall into either one of three domains: anxiety about access to food, changes in quality of food, and changes in quantity of food. The scale consists of fifteen questions; the first eight pertain to adults in the household and the last seven to children. Only the first question; “In the last three months, due to lack of money or other resources, have you worried that food could run out in your home?” is considered to be subjective. The fourteen others are more objective as they ask about specific situations occurring or not. All of the questions are yes/no, and one point is given for each “yes” response. The sum of the points indicates the severity of food insecurity in the household (ELCSA, 2012). Table 4.1 demonstrates how points are allocated.

Table 4.1: ELCSA food security scoring

Type of Household	Classification of Food Security			
	Food Secure	Mildly Food Insecure	Moderately Food Insecure	Severely Food Insecure
Households containing only adults	0	1 to 3	4 to 6	7 to 8
Households containing both adults and children	0	1 to 5	6 to 10	11 to 15

The inclusion of questions regarding children was one of the key departures of the ELCSA from the HFIAS. Another was the removal of the follow-up frequency questions, which simplified the tool for respondents. The recall period of the ELCSA was also extended from the HFIAS's four weeks to three months. This allowed the tool to better capture seasonal variability and socioeconomic inconsistency that can be common in Latin America.

The choice of food security assessment tool was reviewed with partners in Bolivia prior to fieldwork. It was agreed that the ELCSA was likely to be the most effective, most socially and culturally appropriate, and most easily understood by participants. While concerns over memory and recall periods have been outlined by academics (Neuman, 2006; Schacter, 2001), and is acknowledged by the authors of the ELCSA, the tool's three month recall period was reasonable given the research context. During fieldwork no respondents said they had difficulty recalling their food security condition over that time. The gravity of being in a food insecure situation caused it to be easily remembered. The ELCSA is the only comprehensive and region specific experience-based tool to have been developed to date. It has been shown to be valid and comparable across Latin America, and is widely used in the region, making it an ideal tool to use in Bolivia (Jones *et al.*, 2013; Pérez-Escamilla *et al.*, 2009; Bermudez *et al.*, 2010).

The second food security assessment tool that was used during interviews was the Household Dietary Diversity Score (HDDS). Like the ELCSA, it provides an indicator of access to food, but unlike the ELCSA, it serves as a proxy for the utilization of food by estimating dietary quality. It can also be used to investigate a food or food group of interest, such as those that are beneficial for macro and micro nutrient adequacy. The data are representative of both the household and individual respondents. The HDDS was initially developed by FANTA (Swindale & Bilinsky, 2006) and then modified by the FAO (Kennedy *et al.*, 2011). It asks respondents to detail everything eaten in the household during the previous day. Each food or ingredient is placed into one of twelve equally weighted food groups. The total number of food groups that is represented in the diet gives the Dietary Diversity Score. The advantages of the HDDS are that it takes relatively little time to

conduct, is easily administered, and is low cost (Kennedy *et al.*, 2011). These characteristics are particularly important given that collecting and analyzing data on nutrition and consumption using other methods can be time, skill, and cost prohibitive for many researchers and agencies because they may require extended observation, anthropometric and physiological tests, and/or laboratory facilities (Jones *et al.*, 2013). A limitation of the HDDS is that it does not provide a clear indication of the individual's or household's habitual diet, but it does provide such data at the population level. It also does not distinguish between what is typical and what is atypical consumption (Kennedy *et al.*, 2011). This problem can occur during festivals or holidays, but since surveying for this study was not carried out during such times, it is unlikely to have had an effect. The Dietary Diversity method has been validated in a number of developing world contexts (Arimond *et al.*, 2010; Hoddinott & Yohannes, 2002; IFPRI, 2006; Kennedy *et al.*, 2010).

Limitations of the ELCSA and HDDS as they were applied are that they do not fully capture seasonal variability and they do not capture other forms of food security stability/instability such as susceptibility to economic, social, or natural shocks. However, other socioeconomic measures that were gathered during this research such as income, vulnerability, and capacity address this shortcoming, and generally bolster the overall food security profile of participants.

4.3.3 Aquaculture Participants and Participation

During the initial baseline survey producers were asked if they were indigenous and all said that they were. Self-identification as indigenous has been problematic in Bolivia with extremely varied results from census to census (see chapter 3). This has been blamed on perceived incentives for being or not being indigenous, lack of clarity in the definition, and changes in prevailing social attitudes. The variance was predominantly attributed to people of indigenous descent not acknowledging their ancestry. Such variation was less extreme in the study area, especially amongst those who live rurally, for there was historically little European presence and indigenous culture remains relatively strong. For these

reasons, indigeneity was not explicitly asked but is assumed of all study participants with the exception of some key informants.

The primary method for analyzing the role of women in the aquaculture value chain was by capturing gender-disaggregated data. Such data was applied to gender participation throughout the aquaculture value chain. In particular, women's roles in household based production was analyzed because there is speculation that aquaculture integrates well with traditional household work (Kelkar, 2001). Furthermore, analysis of women's participation was expanded to include elements of empowerment such as autonomy, decision-making, and responsibility. Key informants were asked about the current and potential role of women in aquaculture. This combined approach helps to capture the complexity of women's participation in aquaculture, which is often underestimated or hidden (Williams *et al.*, 2010; Weeratunge & Pant, 2011). Investigating beyond what women simply "do" in aquaculture is important for understanding the nuance of gendered activities in aquaculture, and by extension for developing more effective management and development activities (Weeratunge *et al.*, 2010). Analysis of women's participation in aquaculture is based in part on the Women's Empowerment in Agriculture Index (Alkire *et al.*, 2012) and the Feed the Future Gender Integration Framework (Hillesland, 2015).

4.4 Research Instruments

This study utilizes four research instruments; aquaculture producer household interviews, non-aquaculture producer household interviews, chain-actor interviews, and key-informant interviews. Each instrument gathers information from key groups of actors in the aquaculture value chain. Taken together, they provide a comprehensive picture of the aquaculture value chain and the associated social, gender, economic, governance, and environmental effects on farmer livelihoods.

The four research instruments were designed as semi-structured interviews. Interviewing is an effective way to gather opinions, beliefs, perceptions, and attitudes, as well as more objective information such as facts, practices, and descriptions of processes (Harrell & Bradley, 2009). The use of semi-structured interviews is ideal for mixed-methods research because it accommodates the collection of specific quantitative data but also leaves room for respondents to provide context to that data through qualitative questions and responses. It also allows for the capture of information that may not have been known at the time the interview script was being prepared, and would therefore not be collected if the questions were rigid and closed to follow up comments by respondents or probing questions by the interviewer (Bernard, 2013).

University of Victoria Human Research Ethics Board approval for this research was received in January 2016 (Appendix 6). All interviews were carried out during fieldwork in Bolivia over February and March 2016. All participants were read a consent script approved by the ethics board (Appendix 7). Research activities were discussed with relevant local officials prior to being carried out so as to foster community awareness and involvement, and to acquire local permission and support for data collection. The numbers of each type of interview conducted are presented in table 4.2.

Table 4.2: Number of interviews conducted with each respondent group

Respondent Group	Quantity
Aquaculture Producer	40
Non-AQ Producer	40
Chain Worker	26
Key Informant Total	17
AQ Association Leaders	3
Fingerling Producers	2
Feed Producers	3
Market Managers/Leaders	4
General Experts	1
Restaurant Owners	4

4.4.1 Aquaculture Producer Household Interviews

Household level semi structured interviews were carried out with aquaculturists of the Southern Amazonian region of central Bolivia. They were chosen as a target group because they are the largest group of actors in the aquaculture value chain and are the intended primary beneficiaries of the research findings. Forty surveys were gathered in total from twelve communities across the three target municipalities (table 4.3).

Table 4.3: Breakdown of producer surveys by municipality and community

<u>Yapacani</u>		<u>Entre Rios</u>		<u>Puerto Villarroel</u>	
Community	Number	Community	Number	Community	Number
El Chore	2	Gualberto Villarroel	3	Dos de Agosto	8
Arboleda	6	Eñe Lauca	2	Tres Pozos	5
Puerto Chore	5	Sajta	3	Ucuchi	2
Challavito	2	Nueva Estrella	1	1ro de Mayo	1
Total	15		9		16

The aquaculture producer household interview was developed to gather enriched information from participants that were previously interviewed for the PPV2 project baseline. The project baseline was carried out by a Bolivian consulting firm during September and October of 2015 and was supervised by CEPAC. The baseline was constructed as a survey that gathered data on elements of aquaculturist’s livelihoods such as farm activities, income, assets, social capital, and human capital. The baseline was conducted with 100 aquaculture producers who were selected through convenience sampling. Random sampling was not possible since no lists of producers or their locations existed. Despite the convenience sampling method, approximately 22% of producers in the area were surveyed; therefore there is a high degree of confidence that the responses are representative of the population. Professional data collectors were sent to areas where

aquaculture production was occurring, identified by satellite maps and discussions with regional aquaculture leaders, and walked from house to house soliciting participants. Their target was thirty surveys per municipality and they were successful in achieving that target in the three municipalities that are the focus of this study¹⁷. A simple random sample of forty participants for this study was then selected from the 90 participants in the baseline who were from the three target municipalities. This approach allowed for the gathering of more data than would have otherwise been possible with one survey. It also allowed for more contextually accurate and relevant questions since insights from the baseline were used to build the interview questionnaire.

The baseline collected the names and phone numbers of participants. These were used to locate them again for follow-up interviews. Local aquaculture association leaders, local governmental agriculture workers, and neighboring aquaculturists were helpful in locating participants. Participants were usually interviewed at the time of contact, but some made arrangements for a time that better suited them. The location of interviews was also up to them, and was usually at their farm. Farmers who were randomly selected from the baseline but could not be found, or who had ceased fish farming, were removed from the target list and a new farmer was randomly selected from the baseline to fill their place. Interviews lasted an hour or more. Fatigue due to the length of questionnaire had been a concern prior to surveying but turned out not to be a problem. No aquaculture farmers who were approached for an interview declined to participate and no producers ended the interview once it began. The aquaculture producer questionnaire can be found in appendix 2.

¹⁷ The baseline targeted five municipalities in total but only a combined ten surveys were collected from two of the municipalities as they had very low numbers of aquaculture producers. Therefore, those two municipalities with the very small populations of producers were not included in this study.

4.4.2 Non-Aquaculture Producer Household Interviews

A non-aquaculture producer is defined as an agriculturalist (a person who owns land and produces at least one food commodity) who does not produce fish. They were chosen as a target group for this research so as to gain insight into the barriers to aquaculture participation and the spill-over effects of local aquaculture production, as well as serve as a group that can provide a socioeconomic comparison to aquaculture producers. A semi-structured household interview was conducted with forty participants who were selected from the three municipalities: 15 from Yapacani, 9 from Entre Rios, and 16 from Puerto Villarroel. These numbers equal the number of aquaculture farmers selected from each municipality. Non-producers were selected based on having close proximity to clusters of aquaculture activity within each municipality. An initial plan to obtain an equal number of producers and non-producers from each community was abandoned as some communities that have “bought in” to aquaculture have a large majority of their population as producers and therefore do not have enough non-producers to balance the number of participants¹⁸. Non-producers were recruited to participate by a research assistant who would make contact with a person and confirm that they were indeed farmers who did not engage in aquaculture. Contact was usually made at the homes of farmers and occasionally at public places such as outside local agriculture extension worker offices (who gave us permission to do so), making this a convenience sampling method. No preference for male or female respondents was made so long as the person was a head of the household and could speak authoritatively about the household’s agricultural activities. Refusals to participate were usually due to potential respondents being busy, but overall they were infrequent. Interviews tended to last approximately thirty minutes. The non-producer questionnaire can be found in appendix 3.

¹⁸ See chapter 3 for an explanation of communities and their relative size and scale.

4.4.3 Value Chain Worker Interviews

Value chain workers are people whose livelihoods directly benefit from aquaculture production, marketing, or consumption but are not producers themselves. They were chosen as a participant group due to their importance in analyzing the socioeconomics of the aquaculture value chain, and because they are an often-overlooked yet important group in the development dynamism of the aquaculture system (Reardon, 2015). Table 4.4 outlines the different types of work of the 26 participants interviewed using a semi-structured interview.

Table 4.4: Value chain workers by occupation

Occupation	Number
Restaurant worker	9
Aquaculture farm laborer	3
Fish market worker	8
Fish food production worker	3
Fingerling production worker	3
Total	26

Chain workers were located throughout the three municipalities and in the city of Santa Cruz, depending on their occupation. Most workers are urban, working in either of the small primary cities of the study region (Yapacani City and Ivirgarzama) or in Santa Cruz, but some, such as farm labourers, work in rural areas. All interviews were conducted at their work locations, after receiving permission from their supervisor. Interviews typically lasted about 20 minutes and were done in privacy. All aquaculture production related businesses that could be identified were approached to find chain worker interview participants. They were then selected at random from the workplace population there that day. Most aquaculture related businesses were small, therefore their workforces were small as well, and with the exception of markets in Santa Cruz, we regularly interviewed 30-50% of the workforce. Rejection rates were very low, and were due to workers being busy

at the moment of contact. If they were available a little later than this was usually accommodated. The value chain worker interview questionnaire is in appendix 4.

4.4.5 Key Informant Interviews

Key informant participants are people who are lead actors in the aquaculture value chain and are knowledgeable about the chain beyond their own activity.

Seventeen such people were interviewed for this study; their respective occupations and locations are outlined in table 4.5.

Table 4.5: List of key informant organization and location

Occupation	Organization	Location
Aquaculture Association	Asociacion Piscicultura Entre Ríos	Municipality of Entre Rios
Presidents	Asociacion Piscicultura Norte Integrado (APNI)	Municipality of Yapacani
	Asociacion Piscicultura 5ta. Sección	Municipality of Puerto Villarroel
Fingerling Producers	Granja La Pira	Municipality of Entre Rios
	Granja Vallecito	City of Santa Cruz
Fish Food Producers	Planta Alimento MISTERFISH	City of Ivirgarzama
	Planta Alimento Vallecito	City of Santa Cruz
	Planta Alimento NUTRIPEZ	Municipality of Yapacani
Market Association Presidents	Asoc. Comerciantes Aguas Marinas	City of Ivirgarzama
	Asoc. Comerciantes Los Bosques	City of Santa Cruz
	Asoc. 8 Dic Pescadería Florida	City of Santa Cruz
	Asoc. Comerciantes Pesc. Yapacaní	City of Yapacani
Restaurant Owners	Restaurante Doña Betty	Town of Entre Rios
	Restaurante El Jacal	City of Ivirgarzama
	Restaurante Yapacaní Grande	City of Yapacani
	Restaurante Tambaquí	City of Yapacani
Professor	Universidad Autónoma Gabriel René Moreno	City of Santa Cruz

Key informants were interviewed using a semi-structured interview script. The first 13 questions in the script were asked of all key informant participants. A sub section of questions relevant to their specific activities in the value chain was then asked. This was critical for carrying out the value chain research method as these people held specific economic and social data related to the different nodes of the Bolivian aquaculture value chain. Key informant interview scripts can be found in appendix 5.

Key informant participants were identified using a “snowball” approach. Research participants and project partners would identify businesses and actors in the aquaculture value chain that they dealt with or knew of and we would approach them for an interview. The leaders of all businesses and organizations that were identified were interviewed and there were no refusals to participate. Participants were usually contacted by phone prior to the interview to arrange a time and place to meet. The interviews usually took place at the participant’s place of work or, on occasion, at a public place that suited them. Interviews typically lasted between 30-45 minutes.

4.5 Development of Research Instruments

The choice of instrument type and construct was driven by the informational needs of a value chain analysis that incorporates the livelihoods approach. The development of individual questions was based on current literature, project partner knowledge, and an initial exploratory visit to the study region in April and May of 2015. The visit provided considerable insight into the Bolivian aquaculture context and provided important exposure to the opportunities and challenges that producers and chain actors faced. Several measures were taken to minimize the problems that can arise when working in a cross-cultural context (Maclean, 2007; Temple *et al.*, 2006). Once draft research instruments were developed, committee members and project partners, specifically IMG and CEPAC, reviewed them and suggested alterations for more effective and culturally appropriate data collection.

The PPV2 bilingual on site Canadian research coordinator, whose first language is English, then translated the research instruments into Spanish. Another bilingual Canadian project worker, whose first language is Spanish, then reviewed the instruments. Finally, the author's local Bolivian research facilitator reviewed the instruments to ensure that the language was clear and relevant to local people. Two pilot surveys were done with aquaculture producers to search for language, comprehension, or redundancy problems, or ineffective questions within the questionnaires.

4.6 Research Logistics

It is widely understood that conducting research in the global South can be quite challenging. During fieldwork, problems with inconsistent information, road closures, and tracking people down were common. The long distances that needed to be travelled between towns, aquaculture operations, and scheduled meetings tended to exacerbate such problems. There were also some security concerns that emanated from the coca activities in the region. However, the close working relationship with project partners, IMG and CEPAC in particular, had a mitigating effect on these problems. They helped to open doors by creating connections with local government officials, association leaders, and agricultural workers. They were also able to spread the word to many aquaculturists of the research, its importance, and its relevance to them. The most important asset during fieldwork was the research facilitator, who was hired to provide transportation and logistical support, help seek out participants, and to conduct the interviews. He was from a small community in the research area, was well known in the study region, was of a mature age (mid 40s), and was well educated in a field relevant to the research (food security). He also spoke both Spanish and Quechua fluently. Speaking Quechua proved to be a particularly useful skill. Several participants were more comfortable doing the interview in Quechua, as it was their first language. The research facilitator's knowledge of Quechua also put participants at ease as it was a

firm demonstration of his connection with the region. This was likely a significant contributing factor to the zero rejections from producers and key informants, and the very low rejection rate amongst non-producers and chain workers.

During fieldwork the author and research facilitator stayed in the cities of Yapacani and Ivirgarzama and would make day trips by truck to surrounding communities. Information on the precise location of participants was gathered from a variety of sources including aquaculture association leaders, local government workers, and neighbors. Interviews were carried out throughout the day and early evening, usually with a break for lunch. The research facilitator recorded interview responses onto paper copies of the survey while the author kept notes and occasionally asked follow-up questions or for clarification of responses. Some interviews with producers carried on for well over an hour. Usually in these cases there is concern for participant fatigue and interview termination, but it was usually the participant who would drag out the survey by wanting to talk more about their activities. The combination of cultural views of time and socializing, along with a sense of pride in their activity, led to willing and interested participants. It was common for them to offer refreshments, food, and tours of their property and operations.

4.7 Data Analysis

All data were collected using paper surveys and responses were pre-coded to the extent that potential responses could be estimated. Additional codes were added for responses that were overlooked but nonetheless common. One example of this was questions asking whether the male or female head of the household was responsible for a certain task or decision. Initially male head, female head, male child, or female child were choices (respondents were not prompted) that were pre coded, but “both of us” became a common response, and therefore received its own code. Once coding was finished the data was entered into Excel. An assistant in Bolivia was hired to do the data input and the work was reviewed by the project’s

in-country Canadian project coordinator. Data analysis such as finding means and tallying scores was carried out in Excel. The data was then migrated into SPSS for more advanced statistical analysis. Short qualitative responses were grouped into similar answers and also given a code. For more extensive qualitative responses, such as those from key informants, data was summarized in narrative form and were used to provide context to related quantitative responses, to articulate the functioning of the aquaculture value chain, or to provide insight on a topic that was not captured by the other research instruments.

Chapter 5: Research Results and Analysis

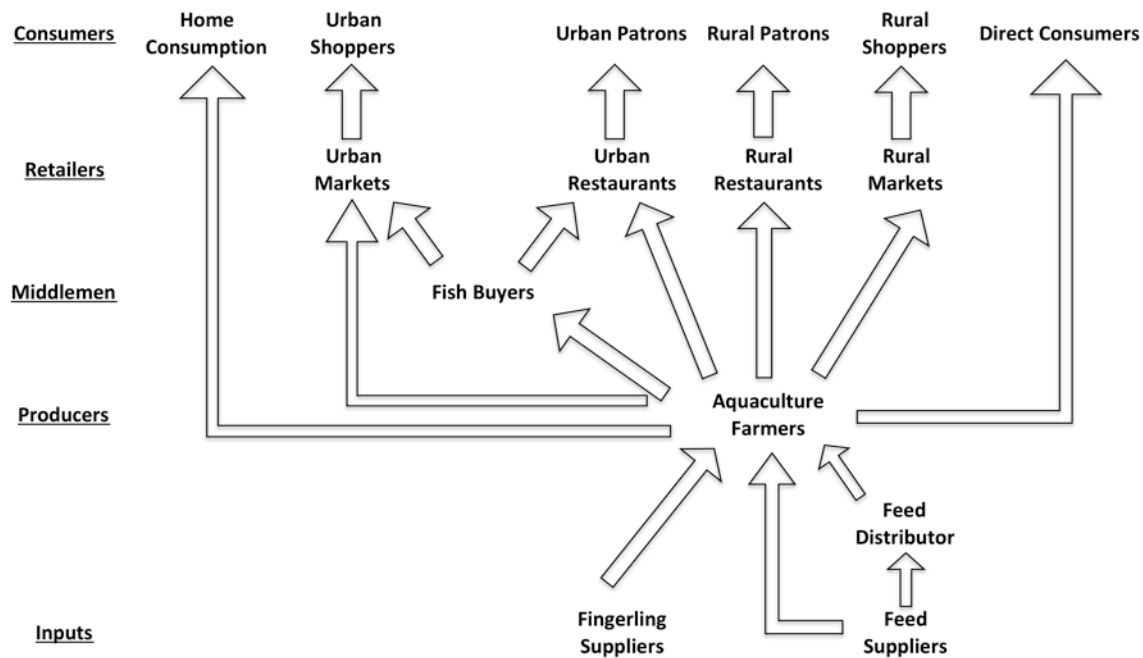
This chapter begins by presenting the central Bolivian aquaculture value chain (CBAVC) and its actors. It goes into detail about the chain of processes that are undertaken to transform aquaculture inputs into a consumed fish. In the second section the aquaculture production opportunities and challenges to increasing the supply of fish are analyzed. The third section outlines the limits and potential for the CBAVC to be economically sustainable across actors. The fourth specifically analyzes dimensions of food security. The fifth section looks at the social sustainability of the CBAVC. These three sections combined address the second problem associated with the triple challenge: reducing rural poverty. The sixth section presents the environmental impacts of the CBAVC. This addresses the third problem of the triple challenge: reducing the environmental footprint of food production. The last section of this chapter outlines how locality and food sovereignty do, and could, impact the CBAVC.

5.1 The Bolivian Aquaculture Value Chain

The Central Bolivian aquaculture value chain (CBAVC) is short and relatively simplistic compared to aquaculture value chains in other developing countries (see Ponte *et al.*, 2014, p55-56 for visual examples of aquaculture value chains from Bangladesh, China, Thailand, and Vietnam). The primary reason is that the CBAVC is local (highly territorially fixed) with very little distribution to other regions of the country and no foreign exports. A secondary reason is that the small size of the sector does not provide a sufficiently large market to support many intermediary businesses such as processing, transport, or brokerage. Therefore, key nodes in the chain tend to interact directly with one another instead of being mediated by institutions, firms, or middlemen. The CBAVC has also historically received minimal involvement or interest from governmental actors and agencies such as regulators, development initiatives, and agricultural or rural support programs. NGOs also do

not have a regular or recurring presence in the chain, although NGO activity does occasionally drive bursts of producer recruitment or capacity building in some geographical areas. The basic value chain layout is presented in figure 5.1.

Figure 5.1: The central Bolivian aquaculture value chain



The CBAVC starts when a producer purchases fingerlings from a fingerling supply business and places them in his/her pond. After feeding them for eight to ten months they are large enough to sell. They are harvested and processed by the farming household and informal labourers such as neighbors and friends, and occasionally with the help of a hired hand. The farmer, using his/her own vehicle, or a local bus or taxi, then transports them, usually immediately, and usually on ice, to the retailer. Retailers are usually either a restaurant or a market. Occasionally a middleman will act as a broker and transporter between producers and restaurants or markets. The fish is then sold to consumers who are either restaurant patrons or market shoppers. Most producers will also sell some fish directly to consumers. Such consumers are usually local friends, family, or neighbors. The odd producer or re-seller will also occasionally sell raw fish at the side of a highway to commuters.

The CBAVC can be divided into three functional stages, namely provisioning of input supplies, grow-out production, and retailing activities. Along with the actors associated with each of these stages are workers, who operate throughout the chain, and consumers, who are the final actors. This section looks at each of these stages and actor groups and presents a detailed account of their functioning and activities within the chain. It then outlines how they interact with one another to generate value-adding activities at each node.

5.1.1 Demographic Overview

Of the 40 producers interviewed, 12 were female and 28 were male. For non-producer respondents the number was 15 females and 25 males. For chain workers it was 16 females and 10 males. The average age of producer interviewees was 41.8 years, for non-producers it was 44.6, and for chain workers it was 35.5. The lower average age of chain workers is due to the fact that they were selected based on their occupation whereas producer and non-producer interviewees were usually household matriarchs or patriarchs. The average number of people living in producer households was 4.6 (182 total), in non-producer households was 4.3 (173 total), and in chain worker households was 4.04 (105 total). This is much higher than the regional average of 2.6 people per household according to the 2012 national household census (INE, 2013). Producer households averaged 1.3 school aged children (6-17 years of age), non-producers averaged 1.1 school aged children, and chain workers averaged 1.2 school aged children. Despite chain workers having a lower average age, which would lead one to expect them to have more school aged children, 19% were in fact single and lived alone, unlike producers and non-producers, none of who were alone or single.

Demographic information such as education levels and livelihood occupations is included in the descriptions and analysis in the following sections. With respect to ethnicity, all participants could be visually identified as indigenous, and this is in keeping with high rates of indigeneity across Bolivia, especially in rural areas, and the study area in particular. As for which specific indigenous group

respondents belonged to, it is likely that they were Quechua. The history of the region as outlined in chapter 3 explains the migration of Quechua people to the study region and how they became the largest cultural group. According to the national census Quechua is the main language spoken at home in Puerto Villarroel and Entre Rios (Spanish is second), and is the second most common language after Spanish in Yapacani (INE, 2013). This was corroborated by the fact that many survey respondents spoke Quechua.

While producers, non-producers and chain workers are highly demographically homogenous, key informants vary. In general, key informants can be divided into two different groups. The first group shares a similar socioeconomic profile with other research respondents. These are the market leaders and association leaders who despite their positions of authority, are often voted into the position by their peers and receive little, if any, remuneration for the added responsibility. The second group consists mostly of business owners who enjoy a higher social, and in particular, economic standing as compared to aquaculture producers, non-aquaculture producers, and chain workers. These people tend to be better educated on average (have university degrees), and in one case at least, are born to very wealthy land owning families.

5.1.2 Input Suppliers

The chain starts with input suppliers. These are small to medium sized businesses that have developed to serve aquaculture farmers in the aquaculture-growing region. There are two primary inputs required for Bolivian aquaculture; fingerlings and feed. Producers acquire inputs either directly from the input producer or through an intermediary. For-profit distributors are uncommon for fingerlings due to the complexity of transporting and handling small live fish, the cost of the equipment required to do so, and due to the fact that fingerlings are typically purchased only once a year by producers. When there are fingerling intermediaries, they are usually local governments or associations who facilitate distribution. In contrast, some for-profit middlemen do exist for feed. Such activity

is more economically viable as feed is easy to store, has a long shelf life, and enjoys more consistent demand throughout the year. These middlemen are often aquaculture producers themselves looking to make a little extra money and serve as a storage and distribution point in smaller towns and rural areas (photo 5.1).

Photo 5.1: Fish feed distributor



There are two companies that produce the majority of fingerlings and feed in the study region. The largest is Vallacito, a privately owned company based in Santa Cruz that has been operating for over ten years. Their feed is produced in a small factory in the city, which also has a storefront that retails Tambaqui and other fish products to urban consumers. Fingerlings are produced at a large farm on the outskirts of the city. The company employs ten people in feed production, three in fingerling production, five in transportation, and two in sales. The owner and all employees are men, with the exception of the two women who work in sales. Its workforce is 56% of the combined workforce of all the input companies that were interviewed. Vallacito has significant influence in the Yapacani region but serves the Carrasco province as well. He also claims to sell to outlying producers in neighboring departments such as Beni, Tarija, and Pando.

Vallacito estimates that he has invested about \$400,000 USD¹⁹ into his fingerling operations and that their annual operating cost is approximately \$72,000 USD. The investment includes ponds, labs and buildings, production and transportation equipment, and freshwater wells (photos 5.2 & 5.3). Operating costs include labor, fuel, utilities, maintenance, and various other incidentals. This level of investment has made his operation more sophisticated than those of other input companies. For example he claims to be the only fingerling supplier in the country with specialized transport equipment with the capacity to move 100,000 fingerlings, and also claims to own microscopes that are superior to even those at the University of Santa Cruz.

Photo 5.2: Fingerling production equipment



Photo 5.3: Brood stock ponds and production facility



Vallacito produces and sells approximately 1.5 million fingerlings annually. He estimates the cost of production to be \$0.50 BOB (\$0.07 USD) per fingerling and he sells them on average for \$1.50 BOB (\$0.22 USD) per fingerling. However, this price includes transportation to the pond, which cuts into the profit margin. He also varies his prices somewhat if large orders are placed or if it is a loyal customer. He

¹⁹ Large purchases in Bolivia tend to be in United States Dollars (USD) while small purchases are usually in Bolivian currency (Bolivianos or BOB). When responses are in BOB, USD will also be provided, as it is more relatable for the reader. Bolivia has a managed float system for controlling its currency, and has kept it at \$6.9BOB = \$1USD for the past several years. Therefore, all figures in this study reflect this exchange rate.

claims that fingerling prices have dropped a lot. This is due to increasing competition, but also also due to his business strategy. As the largest and most established regional provider, he has been able to make substantial re-investments in his business and establish economies of scale. This has allowed him to contribute to the lowering of the price while also maintaining market share. It has also allowed his company to remain attractive to new producers and supply the increasing demand. He has around 100 clients, some of whom are individuals and some are groups (such as associations, municipalities, etc.). Vallacito sold fingerlings directly to 30% of interviewed producers but also sold to intermediaries that supported distribution such as local governments and producer associations.

Vallacito's investment in feed production is estimated to be another \$400,000 USD and they are also undergoing an expansion that is expected to cost \$500,000 USD. The annual operating costs for feed production are estimated at \$87,000 USD. From this they produce and sell approximately 60,000 bags of feed that weigh 25kg each, annually. Vallacito's production cost and sale price for a bag of feed varies according to what type of feed it is. They produce three different varieties that correspond to fish size. The first two are similar in composition but the pellet size is either small for fingerlings, or of a medium size for fish that are near the halfway point of their growth trajectory. The third variety has a little more protein and fats that are intended to fatten the fish prior to harvest. In general the average bag costs \$80 BOB (\$11.59 USD) to produce and is sold for \$110 BOB (\$15.94 USD), a profit margin of 37.5%. He sets the price based on his interpretation of the market for feed. He considers the production and sale costs to be high, but claims that it is because the ingredients are superior. He considers other feed manufacturers who sell for less to not be competitors because he classifies them as being in a different market with a different clientele. He also argues the same for his fingerlings. Overall they have about 100 clients for their feed, but like the fingerlings, the feed is sold to both individuals and groups, sometimes in bulk. They do not deliver feed themselves but have a well-established arrangement with a transportation association that delivers throughout the South and East of the country directly to producers or distribution outlets. Payments by

producers are made through direct deposit at the same time as orders and Vallacito works out the distribution logistics. 12.5% of surveyed producers bought their feed directly from Vallacito but it is likely that more used his feed and acquired it indirectly through a distributor.

The other relatively large company, Milton Crespo, is also privately owned and is based in Ivirgarzama. The company has been running for less than two years and is a husband and wife team. Together they own a fingerling production facility, a feed production facility, and also sell agricultural and livestock inputs from an urban store. Milton has a veterinary degree from a regional university.

Milton employs two permanent and four part time workers at his fingerling operation, all men. He has invested approximately \$116,000 USD into fingerling production through the construction of ponds and a laboratory, and the purchase of land (photos 5.4 & 5.5). The annual operating costs for his fingerling operation is about \$36,000 USD. He produces and sells 450,000 fingerlings annually and estimates the cost of production to be \$0.10 BOB (\$0.014 USD) per fingerling. This is significantly less than Vallacito's cost per fingerling and the full reason for this is unclear. One factor is likely that some fingerling production costs are less for Milton as his operation is less sophisticated. For example he does not have the same quality or quantity of equipment and infrastructure, notably transport tanks and vehicles, hatchery tanks, and instruments such as microscopes and various other specialized tools. He is also more rural, making labor and land cost much lower. The difference can also be somewhat attributable to differing interpretations of what is included when assessing costs. Milton says that he sells fingerlings for between \$1 and \$1.5 BOB (\$0.14 - \$0.22 USD) per fingerling. This too is a little lower than Vallacito, likely for similar reasons as previously mentioned. The price tends to be set through negotiation and is affected by purchase volume and customer loyalty. Milton says that he sells to both individuals and groups and that he has approximately 150 clients in total. It is likely that the higher number of clients claimed by Milton (50% more than Vallacito) is due to more, but lower volume sales. Milton provides delivery to ponds using a basic truck mounted water tank. He sold fingerlings directly to 10% of producers in the survey. Milton Crespo's region of

operation is much smaller than Vallacito's. He is almost exclusively concentrated in the Carrasco province, although he is looking to expand.

Photo 5.4: Fingerling production facility



Photo 5.5: Rearing ponds



Milton and his wife Elsa also run a feed production operation called Mister Fish as well (photos 5.6, 5.7, 5.8 & 5.9). They have three employees that run the feed production machines and five (two of which are part-time) who are responsible for loading, unloading, and delivery. Their investment in the feed production business has been \$113,000 USD and their annual operating cost is \$29,000 USD. They produce 18,000 bags of feed annually, each bag of feed costs \$65 BOB (\$9.40 USD) to produce, and they sell it for between 85-90 BOB (\$12.32 - \$13.04 USD), a 31 – 38% gain. They set the price based on market conditions and they sell primarily to individual farmers, but also occasionally to groups. They have approximately 60 feed clients, 6 of which are intermediary distributors. 12.5% of surveyed producers bought their feed from Mister Fish, but it is likely that more acquired it indirectly.

Photo 5.6: Mister Fish feed bags



Photo 5.8: Feed Manufacturing Machines 1



Photo 5.7: Mister Fish bag of feed



Photo 5.9: Feed Manufacturing Machines 2



A third company, Nutripez, was also interviewed, although they only produce feed (photos 5.10 & 5.11). They are based in Yacapani and the owner had an exclusive arrangement with aquaculturists in a Japanese colony near Montero who purchased all of their production. Despite this, one surveyed producer claimed that he acquired his feed from Nutripez, indicating that they may sell to individual farmers on occasion. The company has only two employees, both men, who operate the machines. The investment is estimated at \$100,000 USD and the annual operating cost at \$29,000 USD. They produce 9000 bags annually at a cost of \$85 BOB (\$12.32 USD) per bag, and sell them for \$105 BOB (\$14.93 USD) per bag, a 24% gain. They only have 8 large individual customers, all seemingly on the Japanese colony, and their prices are negotiated.

Photo 5.10: Nutripez feed factory



Photo 5.11: Nutripez feed machinery



There are other fingerling and feed suppliers but they tend to be smaller and do not have the same presence in the Yapacani and Ivirgarzama regions as the companies that were interviewed. According to key informants and project partners, some farmers have been experimenting with fingerling rearing, but have had inconsistent results and thus do not regularly occupy a spot at the input supplier node of the value chain. Some farmers have also experimented with feed production as well, the approaches to which have varied significantly. Some have invested in small-scale feed production equipment and some have tried to invent or discover other feeds and/or methods of feed production. Reports indicate that these have largely been ineffective, and in some cases so much so that it has caused significant fish losses. This experimentation is driven by a desire to reduce production costs or in the hopes of establishing side businesses. Their tendency to fail is likely due somewhat to a lack of capital, but more significantly due to a lack of skills and technical knowledge.

While there are other aquaculture inputs beyond fingerlings and feed, such as equipment (aerators, nets, etc.) and chemicals (water treatment, fish medicine, etc.), they are rarely purchased due to their cost and the fact they are infrequently needed. As such, they do not have a significant presence in the chain. There are also earth moving machine operators who dig the ponds for producers, but no

businesses on this front have yet to be formed to exclusively serve the needs of aquaculture producers. Operators either dig ponds as an occasional side job, or a municipality and/or province will lend out their workers as a show of support to the sector.

Overall, inputs for aquaculture will face some challenges as the sector grows, but are not significantly constrained. Increasing competition and growing input businesses are keeping prices relatively stable. This is allowing current businesses to expand based on increasing demand from new and expanding producers rather than from increasing prices. As the aquaculture system grows, new business opportunities outside of feed and fingerlings, such as transport, equipment sales, and pond construction, are likely to emerge. New, more specialized feed and fingerling supply arrangements, such as futures contracts and exclusive supply contracts, may also emerge and offer more value creation opportunities for the CBAVC.

5.1.3 Producers

Aquaculture producers begin their annual participation in the CBAVC by purchasing fingerlings and placing them in their ponds. The vast majority of aquaculture farmers produce Tambaqui, and most do exclusively, with only a few also growing Pacu, Carp, or some fish they caught from the river. Stocking typically occurs during Bolivian summer (December to March) as it provides the best weather for the vulnerable fingerlings. Some larger producers will also stock fingerlings at later points in the year to take advantage of production lulls and to provide year round supply. Fish are usually fed on a daily basis until they reach market weight. The rearing period typically lasts for eight to ten months, depending on the degree of expertise and care on the part of the producer. The grow-out of the fish is primarily affected by the frequency, volume, and quality of feed they are given. Farmers must also take care to minimize the impacts of occasional weather events such as cold snaps, which can push a Tambaqui's body temperature out of optimal range and cause sickness or death, or hot windless days, which can reduce

oxygen levels in ponds to critical levels. They must also keep an eye out for other hazards to their fish such as sickness, disease, or problems with the pond such as bank erosion, high sediment accumulation, or water seeping into the ground.

Once the fish reach 800 grams harvesting begins. This is the point at which markets and restaurants will begin to accept fish and they will do so up to roughly 1200 grams, depending on buyer preference and availability. The size of harvest depends on the arrangement with the buyer. If an order is large enough, and all the fish in a pond are of sufficient weight, then a harvest can be carried out in one day. In most cases, however, orders are smaller and harvests are carried out multiple times over several weeks until all the fish are sold. Temporary workers are often hired to help with harvest, as it requires multiple people. The exact number needed varies according to the number of fish that will be pulled out, the size of the pond being harvested from (larger ponds tend to require more workers to properly drag the net), and how many friends and family are available to help. Workers are often neighbors and friends who may or may not have experience harvesting fish but this is of minimal consequence since harvesting is not a skill intensive job. Numbers of hired workers tend to vary from 4 to 14 according to the producers who were interviewed. Most hired workers are men since they tend to be more comfortable getting into the ponds and are more common in the general agricultural labour force. That said, women participate in harvesting and processing as well (photo 5.12 & 5.13). Although some are occasionally employed, they are usually members of the household or are friends of the family.

Photo 5.12: Family and neighbors harvesting fish



Photo 5.13: Women and men harvesting fish



At harvest time all producers said that they processed their fish and they all did so by gutting them and cleaning them. Not one producer prepared their fish in any other way. This cleaning activity occurs near the pond usually on a make-shift cleaning table (photo 5.14). Cleaning fish does not require much skill so workers will often share the task to break up the monotony of processing several hundred fish at a time. Food safety standards and procedures are quite low but not entirely absent. Efforts are made to clean all the fish within a few hours of being pulled out of the pond, they are wiped down with water and a rag, and they are kept somewhat on ice. However, there are many health and sanitary problems. Processing usually occurs outdoors on an old wood table and fish are kept on a tarp or in a bin in the shade. Temperatures outside during processing are often over 30° Celsius. The rags used are rarely changed or washed, and the water that is used is kept in a bucket and drawn from the ponds. Workers do not wear any protective clothing and the knives and other tools used are not specialized or disinfected before use. The ice that is placed on the fish is more of a token gesture rather than an effective method of preserving the fish. The quantity is not sufficient for the number of fish it is meant to keep cool. It is also usually in one large block that is broken into chunks rather than in small cubes that could be more effectively packed between the fish. Furthermore, the ice does not last long in the tropical heat once it has been broken up (photo 5.15).

Photo 5.14: Harvested fish being gutted and cleaned



Photo 5.15: Harvested fish with a block of ice waiting to be cleaned



Once fish are processed they are then packaged into tubs, Styrofoam coolers, or old feed bags (photos 5.16 & 5.17), sometimes with and sometimes without a small amount of ice, and are sent on their way to the buyer. Whether a producer uses ice and how much depends on the price of the ice, the ease of acquiring it and transporting it, and the standards for transport demanded by their buyer (most markets and regional restaurants do not require fish to be on ice, but some urban restaurants may require a small amount). When all of the fish have been removed from ponds the production cycle is effectively over. Although farmers will continue to interact with buyers and may undertake various other maintenance activities, the bulk of their work is finished once the fish are cleaned and on the road to a market or restaurant.

Photo 5.16: A sack full of fish arriving at a market



Photo 5.17: A cooler full of Tambaqui



The last step in the CBAVC that producers may be involved with, but only occasionally, is distribution. Fish produced through aquaculture in Bolivia does not go through an extensive distribution network since the value chain is short and fish is typically transported directly from the producer to the buyer. It is also not subject to complex shipping and handling procedures due to a lack of regulations and fish specific transportation infrastructure. Usually fish is transported in a car or on a motorbike, either of which can be operated by the producer, buyer, or a non-specialized transporter. Since most producers sell to buyers in the closest regional town, the distance fish travels is typically between 5-30km but if it is destined for an urban area it may travel 200km or more. Once the fish arrives at a retail location, the role of the aquaculture producer in the fish chain is effectively finished.

5.1.4 Retailers

There are two primary pathways that fish produced through aquaculture in the study region reach consumers; restaurants and food markets. Both of these retailer types exist in rural and urban settings; however, rural markets and restaurants tend to be more focused on aquaculture fish than their urban equivalents. Of the two retailers, restaurants handle much more volume. Producers sell significantly more fish directly to restaurants than to markets. During the last

harvest, 67% (77,560 KGs) of fish produced by respondents was sold directly to restaurants. Only 8% was sold directly to markets. The second largest buyer of fish from farmers were middlemen or “fish buyers”, who account for 23% of fish sold. These buyers turn around and sell fish to markets, restaurants, or informally through such outlets as roadside stands. They tend to sell to urban rather than rural markets and restaurants, and often double as transporters for these outlets. Relationships between rural retailers and producers are usually managed directly due to proximity and convenience, but urban retailers who can be 250 or more kilometers away tend to rely much more often on fish buyers. The degree to which these fish buyers work exclusively with fish is unclear. It is likely that many also trade in other agricultural commodities and therefore are more opportunistic towards trading fish than they are regular established traders.

Markets

Four market managers were interviewed as key informants knowledgeable about the aquaculture value chain generally and fish market retailing specifically. Table 5.1 provides details about these markets.

Table 5.1: Characteristics of studied markets

Name	Location	Approx. number of vendor stalls	Average daily quantity of fish sold ²⁰
Aguas Marinas	Ivirgarzama – Puerto Villarroel	8	1320
Association of Fish Traders (AFT)	Yapacani	12 weekdays 18 weekends	2700
Los Bosques	Santa Cruz	14	4367
La Florida	Santa Cruz	20	4267

²⁰ Fish is either sold as a single whole fish or by kg depending on species. This estimate considers 1kg to equal 1 fish. Also, these figures should be accepted cautiously as no records of fish sales are formally kept. Numbers are generated by market leaders estimates.

Fish markets are typically located amongst a larger food market and consist of simple stalls from which people sell fish. Two or three people, almost always women, who sell a full range of fish products, occupy each stall. There is not usually any stall specialization towards a particular type of fish. The four markets where aquaculture fish is predominantly sold can be divided into urban and rural. Aquas Marinas and Association of Fish Traders (AFT) are located in relatively small towns that serve the surrounding rural region whereas Los Bosques and La Florida are located in Santa Cruz city.

The two rural markets differ in some ways from their urban counterparts. They are smaller, handle smaller volumes of fish, have a smaller selection of species, and their health and sanitation standards are lower (photos 5.18 & 5.19). Also, they tend to sell more aquaculture fish (Tambaqui) relative to their size and for less money. Aquas Marinas sells approximately 200 per day and AFT sells approximately 840 per day, which constitutes 15% and 31% of their total fish sales respectively. Their purchase and sale prices, however, differ. Aquas Marinas buys Tambaqui for \$23 BOB and sell it for \$28 BOB while AFT buys for \$25 BOB and sells for \$35 BOB. Despite the popularity of Tambaqui at these markets, it is still only the second most popular fish at AFT and the fourth most popular at Aquas Marinas. AFT has an advantage in that it is on a major highway and is less remote, and this is represented in its relatively larger volume of sales compared to Aquas Marinas. While there are other fish markets in various small towns in rural areas, the commonness of Tambaqui seems to diminish as distance from the production region increases.

Photo 5.18: Rural market where fish is sold (AFT – Yacapani)



Photo 5.19: Rural market where fish is sold (Aguas Marinas – Ivirgarzama)



Urban markets are much larger than rural markets, and play a much larger role in the overall fish and food systems of Bolivia. Since Santa Cruz department is the heart of food production in the country, and Santa Cruz city is the primary processing and distribution hub, the fish markets in the city are key distribution points for sales to the rest of the country. They are also the point at which imported fish is distributed from. However, the two markets in Santa Cruz differ considerably. Los Bosques is located on the periphery of the city and is a sprawling open-air market. Not only are there fish stalls for fish vendors, but also it is a popular place to eat with the working class, with approximately 16 open-air restaurants serving barbequed fish (photo 5.20). It also serves as the primary hub through which imported fish is redistributed throughout the country. The most popular fish to eat in Santa Cruz department, and possibly in the country, is Sabalo²¹. Twelve to sixteen large freezer semi-trailers of fish from Argentina arrive with 92 tonnes of Sabalo and 18.2 tonnes of other fish types each month. The Sabalo alone constitutes 70% of total fish sold at the market and imported fish in total constitutes 84%. Sabalo is so prevalent in Los Bosques that it is often piled in corners with little regard for temperature or sanitation standards (photo 5.21). It is also the fish that is almost exclusively sold at all 16 restaurants at the market. As for

²¹ La Paz department and neighboring areas may be an exception due to the regional popularity of trout from Lake Titicaca.

aquaculture fish, the volume of Tambaqui sold at Los Bosques is larger in real terms compared to rural markets, but much smaller relative to overall sales. Los Bosques averages 307 Tambaqui a day, which is 7% of their total, and is tied for third in popularity. It is bought for \$20-22 BOB each and sold for between \$30-35 BOB each. It is available at the market restaurants, but is rarely ordered, likely due to its price being almost twice that of Sabalo, \$50 BOB per plate of Tambaqui compared to \$25-30 BOB (depending on size) per plate of Sabalo. There does not seem to be any other reason Sabalo is preferred, it is just as bony as Tambaqui and is similar in flavor and texture (in fact it is actually a little less fatty and therefore less flavorful in the author's opinion).

Photo 5.20: Restaurant at Los Bosques urban outdoor fish market



Photo 5.21: Sabalo piled at Los Borques fish market



While Los Bosques is the working class, high volume basic fish market, La Florida is the high-end urban market. It is located near the city center, is indoors, has relatively high quality infrastructure, and serves a wider variety of fish (photo 5.22). The health and sanitation standards are thus much higher than any other market studied. Workers have uniforms and wear gloves and hairnets, fish is stored in freezers rather than coolers, and the stalls are ceramic tiles with access to running water and are kept clean (photo 5.23). It is important to note that this degree of health and safety is high by Bolivian standards, but would likely be unacceptable by Western standards. Much of the fish and seafood that is sold in

higher end restaurants and hotels in Santa Cruz is bought from La Florida. They not only have a broader selection of fish than other markets, but they provide different sizes of fish and different cuts. The most popular fish sold is the freshwater Surubi followed by Pacu and then Tambaqui. At this market Sabalo is only the fourth most popular fish. Even though a lot of Pacu is sold, almost none of it comes from aquaculture, it is wild caught, and therefore Tambaqui is the only aquaculture fish sold at La Florida. Between 400 and 667 Tambaqui are sold daily, which means it represents between 9% and 16% of total fish sales. Tambaqui is bought for \$25 BOB and sold for \$30-35 BOB.

Photo 5.22: La Florida indoor urban fish market



Photo 5.23: Uniformed worker at La Florida selling a variety of fish



All four markets tend to sell the same variety of fish, with the two urban markets having a slightly higher number of species available. The most popular fish are Surubi, Sabalo, Pacu, and Tambaqui. Other species that are sold in some places include Blanquillo, Dorado, Muturu, and Paiche. All species, with the exception of Tambaqui, are acquired through fisheries, and, with the exception of Sabalo, are domestic. All the species tend to be processed the same across the markets, with the exception of La Florida, which has a slightly larger variety of cuts and preparation styles. A transporter (likely a generic, non-fish specialized transporter) is usually responsible for bringing fish to markets. Their cost ranges based on distance. The fish can be transported with or without ice in grain sacks, on tarps in the back of

cars, or in Styrofoam coolers. The one exception to this is the large semi-trailers with built in freezers that haul fish frozen and packaged in boxes, the cost of which is approx. \$10,000 BOB (\$1,449 USD) per load. The fish is sold from coolers with ice, with excess product sometimes stored in freezers. Market workers are almost all women, and transporters almost all men. Associations, which are formed by the workers, and who elect a president, run the markets. There is a combination of cooperative activity coupled with private enterprise. Associations and semi-cooperative organizational structures of similar livelihood activities are ubiquitous in Bolivia. It is therefore no surprise that markets have adopted such a model.

Restaurants

Four restaurant managers were interviewed as key informants knowledgeable about the aquaculture value chain generally and fish restaurant retailing specifically. Table 5.2 provides details about these restaurants.

Table 5.2: Characteristics of studied restaurants

Name	Location	Average number of customers per week	Average number of fish sold per week
Restaurant Betty	Entre Rios	226	101
El Jacal	Ivirgarzama	361	219
Grande Yapacani	Yapacani	617	203
Palacio Tambaqui	Yapacani	1531	264

Restaurants that serve primarily fish from aquaculture (Tambaqui) were selected for interview. They were all in rural towns in proximity to aquaculture production. Restaurants in the area are extremely homogenized, with very little variation in size, décor, approach to marketing, or types/ethnicities of food served. They also have small menus with very similar dishes. In fact, restaurants that focus primarily on fish seem to be the only alternative to restaurants that serve local customary (but not necessarily traditional) food. Due to this situation, restaurants that serve fish tend to do so almost exclusively. While there are some others that

will perhaps offer a fish dish, if it is not their primary food type then it is not sold often. All four sell a couple types of freshwater fish, but Tambaqui is the most popular. It is usually split in half and barbequed, or occasionally deep-fried. One fish provides two plates, and rice, yucca, and a few bits of salad are included. The cost of a plate is between \$30-35 BOB and costs between \$20-25 BOB to make. The fish is stored in freezers with little lost to spoilage. Restaurant owners did mention experiences with spoilage in the past but indicated it is not a large problem now. They were also asked if there was demand from customers for new or different menu items or dishes. They all said that there wasn't really, but one is planning to grow and sell tilapia and another has offered fish soup and de-scaled fish.

These restaurants generate employment by hiring cooks, servers and occasionally cleaners. All purchase fish directly from aquaculture farmers, but how many supply them varies. Palacio Tambaqui (photo 5.24) is the largest and has connections with APNI producers in Yapacani. Grande Yapacani (photo 5.25) purchases from APNI as well, but also from other unaffiliated producers. Restaurant Betty (photo 5.26) is somewhat smaller than the others and purchases fish from local farmers in the Entre Rios area. El Jacal (photo 5.27) is the second largest restaurant but unlike the others it relies on fish from one relatively large farmer who has eight ponds and year round production. The owner of El Jacal said that he used to purchase from a few farmers but reliability and quality were issues so he made an arrangement with the one farmer who could mitigate those problems. All of them set the price of fish through negotiation with the farmer, and pay between \$25-30 BOB per fish. Although all the restaurants primarily sell Tambaqui, they all also offer other fish, particularly Surubi. All the other fish is acquired by dealing with individual fishers.

Photo 5.24: Restaurant Palacio Tambaqui



Photo 5.25: Restaurant Grande Yapacani



Photo 5.26: Restaurant Dona Betty



Photo 5.27: Restaurant El Jacal



Source: Google Maps

Grande Yapacani and Palacio Tambaqui are both to a certain extent vertically integrated in their operations as they produce, process, and transport their own fish. Palacio Tambaqui sources about 10% of their fish from themselves (they have 10 ponds) whereas Grande Yapacani self produces 15% of the fish they sell (from 8 ponds). There are other restaurants in the region that do this as well, but they tend to be rather small, only opening on weekends and holidays. Since there are minimal government licenses and health certifications required to open a restaurant, some producers simply set up a cabana roof with some plastic chairs and tables and then barbeque fish for customers on weekends as a means to provide an easy outlet for their fish. Makeshift weekend restaurants are highly common in the study region.

5.1.5 Workers

There are workers operating at all nodes in the CBAVC. At the start of the chain are employees of input supply businesses, at the production node there are general labourers, and at the retail node there are either restaurant workers or market workers, depending on the outlet. Some local people will enter the chain for certain tasks such as transport or harvesting, but such people do not work full-time and year-round. In all, the population of workers who participate full-time in the CBAVC is estimated to be at least 237. There are also an unknown number of part-time workers who are hard to count because of their inconsistent participation in the chain. In fact, not even all the workers interviewed for this study are employed solely due to aquaculture as not all restaurants completely rely on aquaculture fish, and market workers in particular depend on a broader list of fish products. The most common forms of employment in the aquaculture chain (outside of production) were restaurant and market workers. They were interviewed accordingly (table 5.3). This is because there are few aquaculture input supply businesses and their work is not very labour intensive. There are also few aquaculture farm workers because most aquaculture production in the study area is small-scale and carried out by households.

Table 5.3: Frequencies of chain worker occupation of respondents

Occupation	Frequency	Percent
Restaurant worker	9	35%
Aquaculture farm laborer (full time)	3	12%
Fish market worker	8	31%
Fish food production worker	3	12%
Fingerling production worker	3	12%

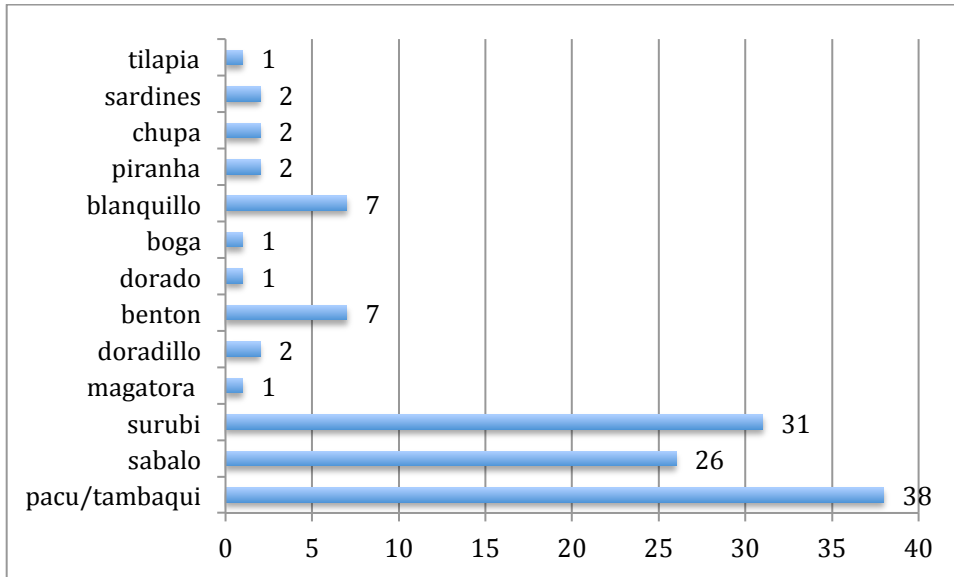
5.1.6 Consumers

The consumption of fish produced through aquaculture is the final node in the CBAVC. Most consumers purchase fish at either restaurants or in markets. In some cases they also get fish through roadside vendors or directly from aquaculture producers in their area. They also can, although it is quite infrequent, acquire aquaculture fish from commercial retailers. Aquaculture fish is not usually sold in urban supermarkets. This is likely due to a combination of it lacking popularity and the high health, safety, and packaging standards of supermarkets that most producers would have a difficult time meeting. But the large fingerling and feed producer mentioned earlier also owns a small retail fish store that sells frozen Tambaqui in Santa Cruz. He also says that a few other small specialty food stores in Santa Cruz are beginning to carry some frozen Tambaqui as well.

Data on consumption habits and preferences was collected from non-aquaculture producers since they can serve as proxies for consumers generally, and rural aquaculture production region consumers specifically. Every non-producer surveyed said that their family ate fish. Twenty seven (67.5%) said that they had eaten fish in the last week, and the average number of times they did so was 1.8, with two outliers having eaten it 6 and 8 times. They were also asked to name all the places where they consumed fish. At home was by far the most common answer with 95%. The second most common place was at a restaurant according to 22.5%, and two (5%) said they would eat fish at friend's homes. Nine respondents stated more than one location where they ate fish. Non-producers were also asked about where they acquired the fish that they ate at home. Nineteen said that they got it directly from a local producer and sixteen said they purchased it at a market. Interestingly, twenty-two said that the fish that they ate at home came from the river, but only five said that this was their sole source of fish. Fishing is a popular recreational activity in rural Bolivia and there are many rivers in the study region, so this is not an unexpected source. However, it does point to a certain degree of rarity of fish consumption for some people since most do not likely fish regularly.

The respondents were also asked what species of fish they consume, and this information is presented in figure 5.2.

Figure 5.2: Frequencies of consumed fish species

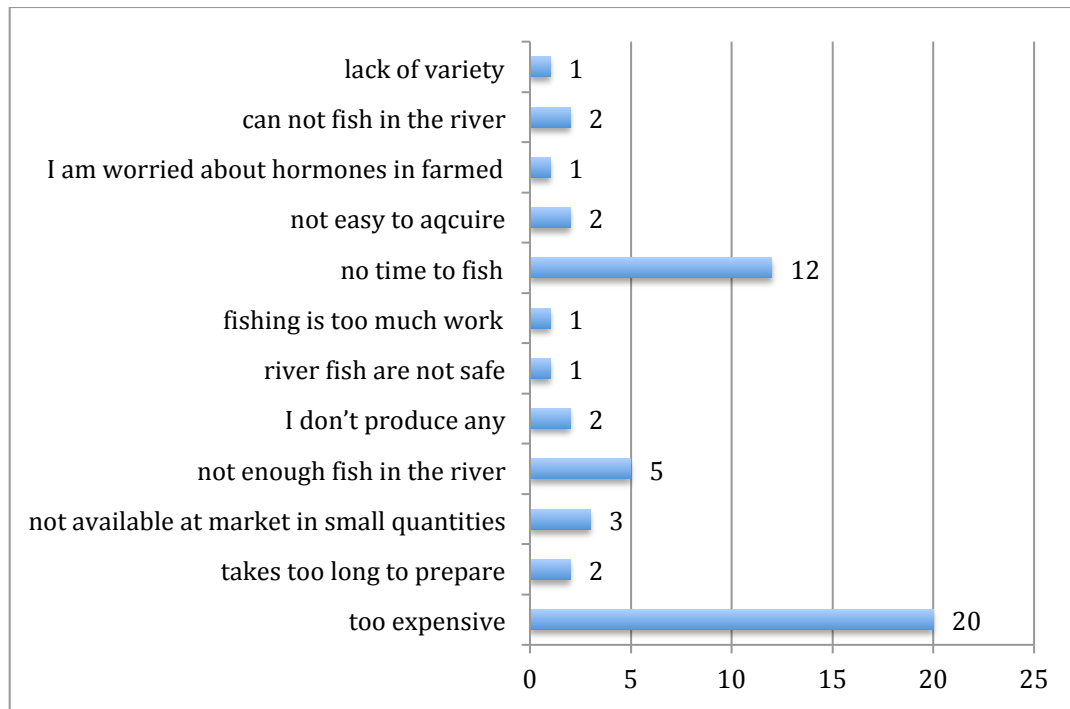


The top three most popular fish are Pacu/Tambaqui, Surubi, and Sabalo. Pacu and Tambaqui are combined because many people use their names interchangeably in the study region, and both are primarily sourced from aquaculture. Surubi is second likely because it is a common river fish and is widespread in markets and restaurants of the region. Sabalo is also ubiquitous. Reasons for the low frequency of other types is not fully known, but is likely due to specific individual characteristics of each fish such as bones and flavour, as well as the degree of difficulty in obtaining them.

Non-producers were also asked what they like and dislike about eating fish. Almost all (38) said the taste and twelve said that it was easy to cook. One person added that they liked that it was nutritious. As for dislikes, 34 said they didn't like the bones, four said that there was nothing they didn't like, three said it was difficult to find and buy, two said the price, and one said they didn't like the scales. It should be noted that the interviewer often led the respondent on this question by reading some of the answers as examples, specifically bones. Therefore many of the people

who said they didn't like the bones in fish were saying so as an afterthought, it didn't seem to be a significant issue for most. Respondents were further asked if they would like their family to eat more fish and thirty-six said yes. They were then asked what is stopping them from eating more fish. The responses are in figure 5.3.

Figure 5.3: Frequencies of responses for why families don't eat more fish (n=36)



The two most common responses were that fish is too expensive (56%) and that there was no time to fish (33%). The first response points to a potential challenge to the growth and spread of the CBAVC. The second points to the fact that a lot of people rely on their own fishing for fish to eat at home. Of the four respondents who said their family doesn't want to eat more fish, two said it was because of personal health issues, one said that farmed fish is unhealthy, and the third said that the family already eats a lot.

5.1.7 Non-Participants

To understand the economic and social effects of the value chain it is important to understand alternatives to aquaculture production. Therefore, farmers who theoretically could be aquaculture producers but are not were interviewed. This section provides an overview of non-participant agriculturists and their relationship to the chain.

Methods for selecting farmers who are not aquaculture producers is laid out in chapter 4, but as a general recap, they are fellow community members (often neighbors) of aquaculture producers who own land and have farm-based livelihoods. These criteria were chosen so as to avoid selecting participants who had an obvious reason for not engaging in aquaculture such as being landless or having no farming experience. Forty interviews were conducted to match the forty that were carried out with aquaculture producers.

The number of livelihood activities amongst non-aquaculture producer households totaled 98 (81 were farm-based), and ranged from 1 to 4 per household, with a mean of 2.45 and a median of 3 per household. Fifteen households had one member who worked outside of agriculture at a blue or white-collar job and one household had two such members. The agricultural livelihood that was claimed most often (by 52.5%) as the household's primary source of income was coca, while for 1 in 5 it was claimed as rice. However, when the claims were compared to income calculations for each individual farm product, which were derived from respondent statements about sale quantities and prices, 13 (32.5%) respondents inaccurately reported their primary income source. Of those 13 who made an inaccurate claim, 11 had claimed that coca was their primary source of income when in fact the calculation revealed it was something else, usually pineapple or citrus. Table 5.4 provides this information. The discrepancy may be explained by the fact that gross income was calculated and farmers are making their claims with net income in mind. Coca requires almost no inputs and therefore is almost all net-income whereas most other crops require at least some investment. But this is only mildly plausible because pineapple and citrus, the two crops that were most often

the actual income earning crops when coca was claimed as the primary earner, are not terribly investment intensive and the much higher incomes they generated would likely outweigh the added costs. In some cases the difference in income between their coca income and their true primary income source was in the thousands of US dollars. The likely reason for the discrepancy is that farmers can misrepresent, with varying degrees of intent, their occupation, and by extension their sources of income because there are social connotations associated with being identified as one type of farmer or another.

Table 5.4: Frequencies of stated and actual primary income sources of non-aquaculture producers

Activity	Stated Primary		Actual Primary	
	Income	Percentage*	Income	Percentage
Cattle-dairy	4	10.3%	4	10.0%
Poultry	0	0.0%	1	2.5%
Rice	8	20.5%	8	20.0%
Coca	21	53.8%	10	25.0%
Pineapple	2	5.1%	7	17.5%
Beans	1	2.6%	1	2.5%
Citrus	1	2.6%	5	12.5%
Passion fruit	0	0.0%	1	2.5%
Cattle-beef	2	5.1%	3	7.5%

* Based on n=39 as one respondent forgot to answer this question

Average annual gross household income of agriculturists from all sources ranged widely from \$739 USD to \$39,626 USD. The average was \$11,161 USD and the median was \$9,276 USD. The most lucrative farm-based livelihoods were dairy cattle followed by poultry rearing, rice growing, and pineapple growing (see table 5.5). It should be noted that the net income from these activities may change the ranking. For example, dairy farming and rice cultivation require a range of potentially high cost equipment such as milking machines and tractors respectively. On the other hand coca, avocados, bananas and some other crops are usually harvested by hand from permanently planted trees, making them labour, but not

necessarily cost intensive. Therefore, even though dairy cattle, poultry and rice seem to be more lucrative, it is possible that once production costs are accounted for they may be far less profitable in real terms.

Table 5.5: Average incomes from individual farm activities

Activity	Number of respondents with this livelihood	Number of years doing this activity	Average Gross Annual Income (USD)
Cattle-dairy	4	20.0	\$19,922
Poultry	1	3.0	\$12,391
Rice	11	14.4	\$7,614
Coca	23	14.7	\$2,009
Yucca	4	3.8	\$806
Pineapple	9	5.4	\$7,050
Beans	1	5.0	\$739
Citrus	10	7.7	\$4,486
Papaya	2	2.5	\$1,142
Banana	4	9.5	\$947
Avocado	1	?	\$870
Watermelon	1	1.0	\$797
Passion fruit	1	2.0	\$2,870
Beef cattle	9	18.7	\$1,639

Included in the table above was also the number of years on average that farmers had been producing each commodity. This alludes to the history of each crop in the region and sheds light on the frequency of change that agriculturists undertake in their livelihood activities. It also suggests that farmers are searching for diversification and that there is a willingness, to a certain extent, to take risks on new activities.

The income generating possibilities of farm-based livelihoods vary greatly. Some seem to hold potential while others generate a measly return, making the risk and volatility inherent in agriculture quite apparent. However, off-farm employment may present a mitigating opportunity. Average annual gross income

across the fifteen households that had at least one member with an off-farm job was \$5,424 USD. This placed it above the average of \$4,520 USD that a farm-based livelihood can provide. Furthermore, it is far less subject to input costs, is likely generated through the work of one person rather than multiple people in the household, as is usually the case with agriculture activities, and is also likely to provide a more stable and reliable income. This means that more of the gross income from off-farm employment is likely to be kept than that of income grossed from agriculture activities.

5.1.8 Economic Output

Understanding the total economic output of a food system is important as a measure of the value of the system and provides some context on the impact it is having. This may be particularly valuable and/or persuasive for regional and federal governments that are considering if and how investments in the sector should be made.

The total economic activity generated by the aquaculture sector during the last production cycle is estimated to be at least \$6,435,412 USD. This is derived from the following equation:

$$\sum \text{gross input provider income} + \{(\text{mean net producer income}) \times 375\} + \sum \text{net market incomes} + \sum \text{net restaurant incomes} = \text{total economic activity}$$

This estimate can be assumed to be low as there are various firms and actors that were not captured by the research and therefore not included in the calculation. For example, urban restaurants and restaurants that serve aquaculture fish, but not as their primary product, are not accounted for. Markets too are under represented, as there are likely many in small towns that do sell small amounts of aquaculture fish but were not interviewed. Roadside sellers are another retail group who make money from aquaculture fish but were not included in this research. Input suppliers as well are not fully represented in this calculation. Although the largest fingerling

and feed suppliers are captured in this research, there are some that were not included. This is primarily because they were too small or too far afield to be identified, but they do nonetheless exist. Informal discussions with local farmers and experts indicate that they are growing both in number and output. Also, 375 was chosen as the total population of producers based on the mean of stated claims of the total expressed by locals and experts. Those claims ranged from 250 to 500. It is possible that the higher claims are more accurate, and it is worth noting that with the current rate of adoption of aquaculture occurring in the region, it is likely that at the time of completion of this research the number of producers is larger than 375.

Overall, the \$6,435,412 USD figure should be considered somewhat conservative. With missing suppliers, producers, and retailers from the calculation, it is likely that the total economic output of the system is higher, potentially much more so. It is also important to note that this economic activity is highly territorially fixed. The benefits of the system are not dispersed throughout the country or even a department, but rather are mostly confined to a small group of communities and the people within. Aquaculture is a strong generator of economic activity, but within a small space.

5.1.9 Value Adding

The value added to a product as it transitions from one node in the chain to another is calculated. The simplified chain below (figure 5.4) shows the prices actors at each node buy and sell the fish for, and the costs of adding value. Figure 5.5 shows the portion of the final sale price of a fish that is captured by each actor. All prices are in Bolivianos.

Figure 5.4: Value adding through the aquaculture value chain

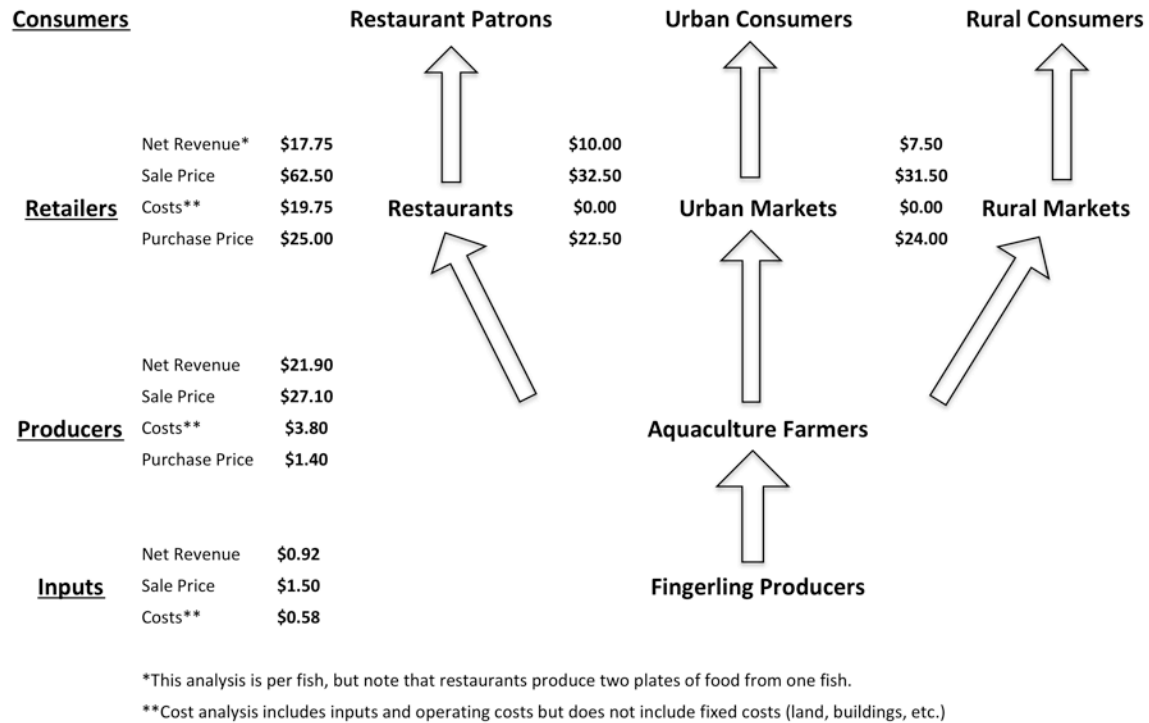
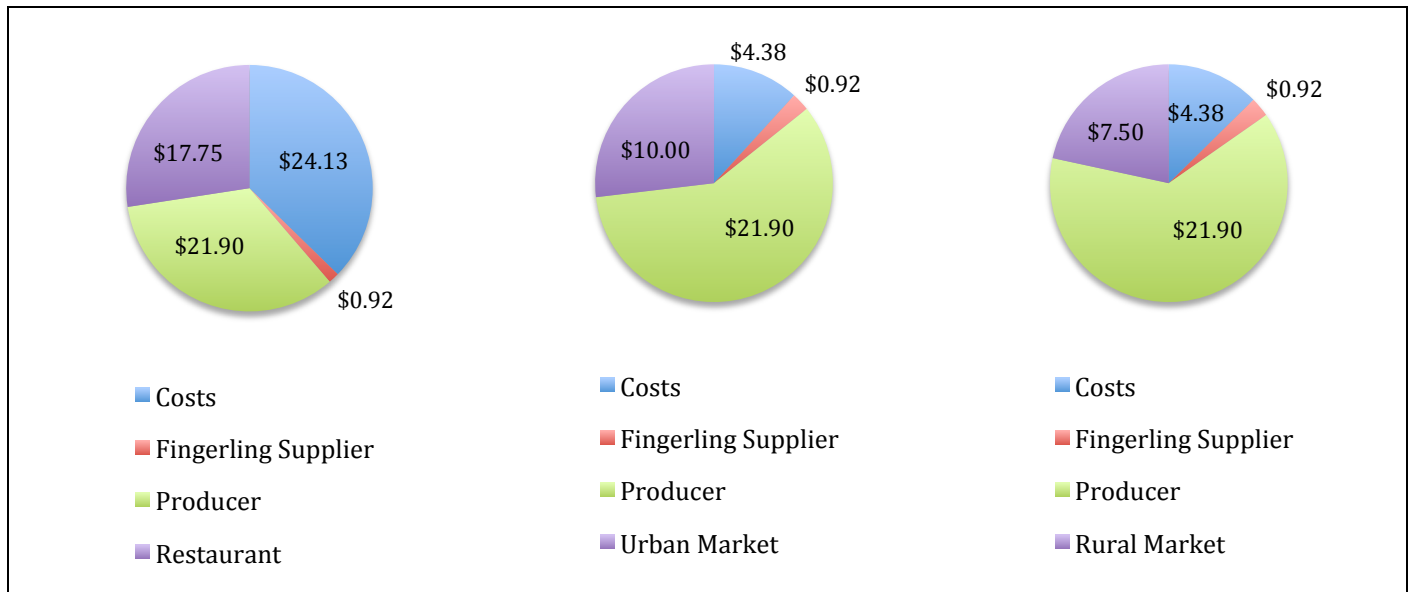


Figure 5.5: Portions of value added to final sale of fish in different outlets



The above two figures demonstrate that aquaculturists receive the highest portion of the final sale price of fish, regardless of which outlet fish is sold through. The above figures also show that the value adding that occurs at restaurants may

have higher costs, but yield higher net income per fish for those outlets. This demonstrates that further processing or preparation of fish could lead to more economic activity being generated and robust incomes for businesses that connect such products to consumers.

5.1.10 Governance

Typically there are two types of governance at play in a value chain. The first type is formal, which represents the institutions and organizations and their associated rules, norms, and influence. This may include governments of various scales, associations that represent groups of chain actors (producer associations, unions, etc.), NGOs, and labeling organizations, among others. The second type is informal governance, which are the less obvious but just as important influences that are rooted in the nature of the power dynamics present between actors in the chain. Here both types are explored as they apply to the CBAVC.

Formal Governance

There are a number of governments, agencies and organizations that are involved or take an interest in aquaculture in Bolivia, but their impact tends to be minimal. However, in some cases, such as in providing subsidies for aquaculture adoption and continuation, they can be important drivers of system growth and development.

The vast majority of aquaculture producer interaction with the Bolivian national government is through the two agencies of IPD PACU and SENESAG. IPD PACU is the national agency responsible for the development and promotion of fisheries and aquaculture. Currently they have various plans for the system, but have yet to have a direct impact or engagement with producers. SENESAG, on the other hand, is active in the aquaculture system. Aquaculture producers who wish to sell their fish to certain institutions affiliated with the government such as schools, national industries, hospitals, etc. are required to obtain certification for their fish from the national food health and safety agency SENESAG before they can be sold.

However, how this certification is obtained, and the processes and infrastructure needed to obtain it, varies according to who you ask. During informal discussions with producers, one mentioned that they would like to sell to the large cafeteria at the nearby natural gas plant, but that she couldn't because of the strictness and high standards of SENESAG. She said that to do so would require a clean room, air-conditioning, protective clothing, freezers, running water, specially cleaned tools, and various other pieces of infrastructure. Such a set up would be a considerable technical and costly upgrade from the outdoor cleaning and informal transporting using simple tools, chunks of ice, and buckets of water typical of most aquaculture processing. This made SENESAG accreditation nearly unattainable for her. Such a barrier posed by SENESAG was alluded to or mentioned outright by a number of other producers and chain actors as well, and seemed so prohibitive that most wouldn't even consider attempting to overcome it. But during another interview with a producer, he mentioned off-hand that he had received SENESAG accreditation. This was surprising since his operation, fish handling, and transporting was not different than that of others; it was undertaken with minimal consideration for health and safety and with no special tools or infrastructure (the author observed all of these stages first-hand). When pressed for how he received certification he alluded to how it was a "simple" process (pers. comm., 2016), the insinuation being that he bought the certification rather than undertook the steps necessary to receive it. He mentioned that it wasn't a big deal and that you just have to know how to go about doing it. It is difficult to uncover exactly what the truth is, and what pathways do and do not exist, as well as how, without further research. Nonetheless, it is clear that there are significant inconsistencies in how SENESAG operates. There is the dual problem of unattainable standards that preclude producers from accessing lucrative markets and customers on the one hand, and corruption that undermines the value and efficacy of these standards on the other. This dual problem clearly complicates and constrains the CBAVC.

Aquaculture producers were asked if they had ever received subsidies from a government agency for their fish farming and twenty-three said they had, with eight of them having received two subsidies. The total number of subsidies received

by respondents was thirty-one, with twenty-four meant for pond construction and seven to purchase fingerlings. When asked about which level of government provided the subsidies, twenty-eight came from the municipal government and three came from the departmental government. The subsidies ranged from 1200 BOB (\$174 USD) to 12000 BOB (\$1,739 USD) and averaged \$6,168 BOB (\$894 USD). The mean of municipal and departmental subsidies was \$6,304 BOB (\$914 USD) and \$4,900 BOB (\$710 USD) respectively, though the departmental figure is a little misleading as one subsidy was \$1,200 BOB and another was \$1,500 BOB while the third was \$12,000 BOB and skewed the average higher. It is therefore unclear what is typical and atypical for departmental subsidies, but what is clear is that they are not administered nearly as often as municipal subsidies.

As evidence of the unevenness of local government involvement in aquaculture, all twenty-three producers who received a subsidy were from either Entre Rios municipality or Puerto Villarroel municipality. In Entre Rios seven of nine producers received at least one subsidy and five had received two subsidies. In Puerto Villarroel all producers (16) received at least one subsidy with three receiving two subsidies. Respondents mentioned a total of twenty-nine subsidies, which indicates that they were not only available, but also well known and widely implemented in Entre Rios and Puerto Villarroel. In contrast, not one producer from nearby Yapacani municipality received a subsidy from any level of government.

Subsidies have been undoubtedly helpful for farmers, but they are unevenly administered over time and space. Moreover, the subsidies and general interest paid to aquaculture farmers by governments is minimal according to many respondents compared to the support provided for other agricultural activities.

Not only are there layers of formal governance from different levels of government, but there is also a layer that is manifested from producers themselves. Twenty-one producers belong to an aquaculture growers association. Such activity specific associations are common in Bolivia, particularly in impoverished rural regions. The degree to which the aquaculture associations are active is highly variable. At one end of the spectrum is APNI in Yapacani, which (with the help of the NGO CEPAC) provides training for farmers, negotiates for purchasing inputs, and

is in the process of building a feed plant. At the other end of the spectrum are a number of associations that simply act as a voice for the farmers in seeking projects or engaging with government. The size of these organizations varies, and interestingly the smaller organizations are more active than larger ones. Three key informants representing the aquaculture associations APNI (in Yapacani), Aquaculture Association of the 5th section of Puerto Villarreal (AAPV), and Entre Rios Fish Farming Association (ERFFA) were interviewed. According to the leaders, APNI has 30 members while AAPV has 123 with 50 active, and ERFFA has 270²². However, despite its size, APNI is more diversified and in-depth with its activities as compared to the other two. Whether the smaller size gives it an advantage, such as engendering greater producer engagement and ease of coordination, or if other factors independent of size are at work, is unclear.

Another interesting finding is that there is an inverse relationship between the presence of subsidies and the capacity of associations. While no producers in Yapacani received subsidies, eleven of fifteen producers in the area belong to APNI. In contrast, all the reported subsidies benefited producers in Entre Rios and Puerto Villarroel (twenty-three out of twenty-five producers in the combined region received a subsidy). However, only nine of the twenty-five in the combined region are members of an association, none of which are the same association. It may be that associations form and/or enjoy higher degrees of participant engagement when there is little governmental handouts or support. In the same vein, it may instead be that governmental engagement reduces the relevance of associations.

There is also regional overlap in associations that may occasionally generate tension. In Yapacani there is APNI, which most producers are a part of, but also Asociacion de Piscicultura la Chonta (APC). One respondent who is part of APNI was aware of APC but said “no es bueno” (it is not good). A producer with APC said APNI “no se motivan” (they are not motivated). Such tensions seem to be rooted in political alliances, leading to a degree of conflict not only between associations, but

²² It is difficult to confirm these numbers or how they are reached. APNI counts participant households but whether this is how the Puerto Villarroel and Entre Rios associations count, or whether they count all members of households or people that show interest, or if these numbers are simply ballpark estimates, is all unclear.

also between certain associations and government. The leader of APNI has said that the government should take a greater lead in improving the aquaculture system in Bolivia, but that it discriminates against them (APNI), and that IPD PACU doesn't provide any help. The producer who is a member of APC by contrast, says that APCs primary activity is working with the national government to develop projects. Such tensions likely exist between other associations as well. In the study region, which consisted of only three municipalities, the twenty-one producers with association memberships that were interviewed were spread across eleven different associations. It is therefore hard to believe that with so many associations in one region that they wouldn't find themselves at odds on a frequent basis.

While considering these findings, it is important to be aware of the fact that the NGO CEPAC from Santa Cruz supports APNI. CEPAC is a relatively high capacity NGO with numerous highly knowledgeable and skilled employees that secures funding for rural development activities in Bolivia from all over the world. The above-mentioned strengths of APNI in relation to other associations may be due in large part to CEPAC's support. However, it is unlikely that CEPAC's presence accounts for the differences altogether, and further research would have to be conducted to fully understand the nature of the producer – NGO – association dynamic and how it affects the aquaculture system.

Looking beyond subsidies and association activities, producers were asked if there are any formal rules created by any organization governing aquaculture. Of the 40 producers interviewed, 37 said that there were no rules or regulations for fish farming at all. But three did say that there were rules, and two pointed to SENESAGs health rules. The third mentioned national environmental rules, but didn't elaborate on how they affected fish farming. Despite the existence of governmental agencies and producer associations concerned with aquaculture, they do little in the way of affecting production systems and approaches. While this freedom may allow aquaculture to grow without disruption, it also likely cements producers into certain forms of production and market participation. Specifically, health and safety regulations exist and are enforced in certain situations. These include sales to government institutions or some urban restaurants. But most

producers made no mention of these regulations, which indicates that not only do they not follow them, but in fact give them no thought at all. The regulations are such a large barrier that the pathway they block is completely ignored by producers. Unfortunately that pathway may be critical to sustainable aquaculture system growth and to improved population nutrition derived from fish.

5.1.11 Chain Entrance and Upgrading

Aquaculture producers were asked questions about the opportunities and barriers they faced to chain entrance and upgrading. Non-producers were also asked about their perceptions regarding entering into the aquaculture value chain as producers. Chapter 6 provides a discussion of the various opportunities and barriers that other chain actors face when trying to enter or upgrade in the CBAVC.

The adoption of aquaculture in the study region occurred recently. One household started in 2003 making them the longest running producer, but 2014 was the most popular year with 12 starts. All new producers started small, building only one or two ponds, although one respondent started with three. Today 68% of respondents have increased the number of their ponds since starting, with two respondents now managing 11 ponds. Growth in pond construction over the entire group went from an average of 1.5 ponds when they started to an average of 3.6 ponds today. This represents a growth rate of 240%. Also, between the time of the PPVII baseline which was conducted in September 2015 and this research which was carried out in February-March 2016, a span of approximately six months, 17 interviewed producers had increased the number of their ponds by an average of 1.4 ponds. This situation indicates that aquaculture production is growing rapidly in the study region and suggests that barriers to entry into production are not significant.

To confirm that obstacles to entering aquaculture were minimal, farmers who could become involved in aquaculture but do not were asked about their perceptions of aquaculture. Thirty-nine of 40 non-producers who were interviewed said that they knew aquaculture was occurring in their region. The ways that they

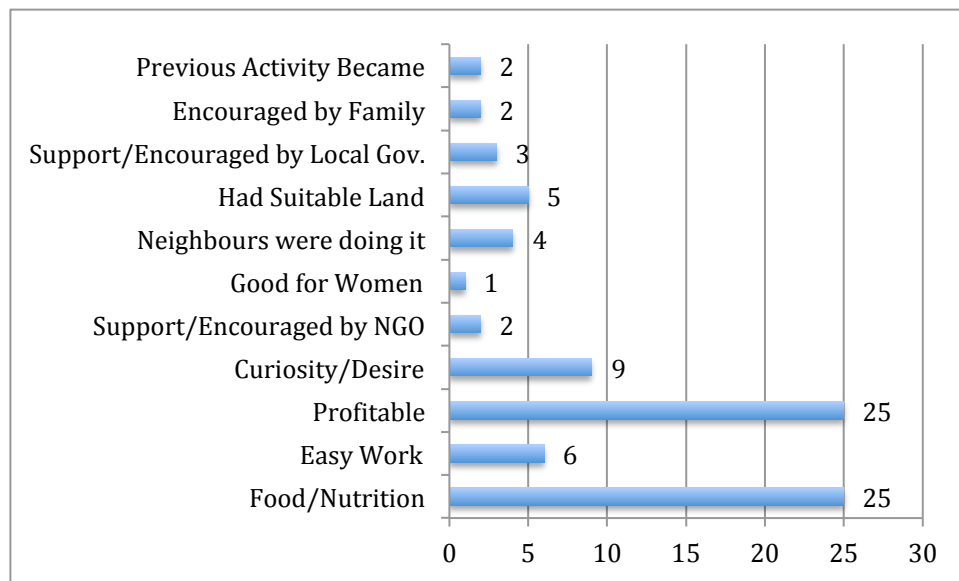
had become aware of fish farming varied. More than half either had a friend or neighbor who were producers, or could see the ponds from a nearby road (16 and 7 respectively). Two people were told by their friends, three heard about it at a local agriculture meeting, two had been approached by an extension worker, one found out about it at a local fish fair, and eight said that it was being promoted by the local government. Non-producer respondents mostly viewed the growth of aquaculture as a positive thing in their community; with 35 saying so and only three saying that it was not. The three negative opinions were that the land in the area was not good for building ponds, that fish die too easily, and that the market is too saturated (one response each). Positive opinions of aquaculture in the community were more numerous and varied. The most common answer was that fish is good for health and nutrition (21), the second most common was that it is profitable for households (12), and the third most common was that it is affordable for consumers (5). Other answers included that it was good for the economy (4), created jobs for young people (2), and created jobs for women (1). Generally the perception of aquaculture amongst conventional farmers was positive and that it held potential as a livelihood, which indicates that adoption is not significantly hindered by public perception.

Non-producers were then asked if they had considered adopting aquaculture, and why they had not. Only five respondents said that they had not discussed the possibility of starting to farm fish with their family. Non-producers were then asked if it was something they, or another member of their household would like to do. Fifteen said no, giving a variety of reasons, the two most common being that it isn't profitable enough (5) and that they don't have access to capital (4). Other reasons included no family support, focused on current livelihood, terrain is not suitable, don't want to have to feed fish daily, and there is no information or training available (each had one response). The 25 that said that they would like to start aquaculture were asked why they had not yet started. Eight said that it was due to a lack of capital, five pointed to a lack of government and NGO support, four thought it wouldn't make enough money, four thought they lacked the skills and knowledge, three thought they lacked the proper terrain, two decided to stay focused on their current livelihood, and one said that predators are too much of a problem. They

were also asked what support they would need to get started. Fifteen said financial support, ten said governmental support, three said support with pond construction, two said training, and one said land analysis and another said support for inputs. Financial support was expected as a stated barrier to aquaculture adoption, so non-producers were asked if they would be willing to start aquaculture if they had access to a loan, and if so, what the highest annual interest rate they would be willing to pay would be. Twenty-nine respondents said that they would be willing to start if they had access to a loan. The highest percentage that they would be willing to accept ranged from 3 to 15, and averaged 8.2. Key barriers to aquaculture adoption are a lack of finance and technical skills.

Current aquaculture producers were also asked about the circumstances of their adoption of aquaculture. They were first asked where they learned about fish farming, to which five said their neighbor, eight said a friend, one said a family member, one said university, eleven said an NGO, two said an aquaculture producer association, two said a business, and ten said from their local government. They were then asked why they started farming fish, the answers to which are in figure 5.6.

Figure 5.6: Frequencies of reasons for adopting aquaculture



The results show that fish farming is commonly viewed as a profitable livelihood activity that also benefits household nutrition. There was also recognition that it can be a relatively easy farm-based livelihood activity. One response that is lower than expected is its benefit to women. Only one respondent indicated specifically that they got into fish farming because it was good for women, which indicates that this benefit is not as widely known or appreciated amongst producers as it is amongst academics and development practitioners. All but one respondent gave two or more reasons for why they adopted aquaculture, indicating that decisions to adopt are based on complex and thoughtful consideration rather than one specific generic benefit. Organizations looking to increase aquaculture adoption should consider this when crafting their message of aquaculture benefits.

Aquaculture producers were also asked if there was a program or incentive that helped them to decide to adopt aquaculture. Thirty-three said that there had been. Seven said that it was due to NGO support, which varied from training, to finance, to provision of inputs. Six of those seven had participated in a CEPAC project and were located in Yapacani municipality. The other one was a USAID project from long ago in Puerto Villarroel. Two respondents said that they were incentivized and helped by family and friends. The most frequently cited incentives were from local governments (23). The specific help ranged across pond building, finance, training, and input provisioning. Almost all of these responses came from producers in Puerto Villarroel and Entre Rios. While incentives may be varied, local governments are key enablers of adoption. Projects to increase adoption should look to coordinate closely with local governments.

Producers were asked about what upgrading they have undertaken. Only five respondents have diversified into other related activities. One has become a part time transporter, another a feed distributor, and another rents ponds to other farmers. Two respondents have opened restaurants as an outlet for their fish production. Two other respondents said that they offer *pesque y pague* (fish and pay – a side business where people pay the farmer to use poles to fish in the ponds), and several more were observed. Their incomes varied, one received \$500BOB (\$72.46USD) per month and the other received \$2000BOB (\$289.85USD) per

month. While these two producers offer this to the general public, many others offer the same service informally to family and friends.

Producers were also asked if they planned to increase their production. Thirty-two said yes and eight said that they don't. Those who don't plan to increase production were asked why. Five said that there was becoming too much competition and that the price was starting to go down. The other three were focused on other livelihood activities. Those who said that they did plan to expand were also asked why. Responses from this group were more varied, specific, and personal. They mentioned a growing market, growing government interest and support (both local and national), plans to diversify into a restaurant or pesque y pague, availability of capital, interest in feed and/or fingerling production, and interest in diversifying cultured species. Producers were also asked if they planned to start aquaculture activities other than production. Fifteen said that they were planning to diversify activities and engage in some form of vertical integration. Ten planned to open a restaurant, three planned to start a fish transport business, and one was looking at starting a feed production business. All respondents said that they needed capital to start these projects, and a few mentioned the need for specific machinery and infrastructure. One thought his restaurant would be a hit if he could get the president to visit it.

The likelihood of these ventures actually happening, and whether they would be successful, is hard to predict. Opening restaurants is relatively easy in the study region, especially the low volume, part-time, on farm type of restaurants that some aquaculturists have already established. Due to these characteristics and the continuing rise in popularity of eating fish, the risk of market saturation would exist but is not extreme. Opening a transport business would be a bit more difficult since they do not yet exist and being a first adopter comes with trial and error risks. However, being a first adopter can also generate high rewards associated with being able to capture a large share of the market and develop name recognition. Opening a feed production operation is the riskiest of the vertical integration plans. Technical knowledge and capital barriers are high, and a new entrant would have to

compete with well-established businesses that are effectively meeting demand for feed.

5.2 Aquaculture Production

Producers were asked about their most recent full production cycle. A production cycle comprises all the steps and activities a producer takes to produce fish. Although production cycles only last between 8 and 10 months, most producers initiate one production cycle per year so that stocking is timed with ideal weather conditions and/or so harvest occurs at a time when prices are expected to be high. Only the most efficient and sophisticated producers, those who manage to grow all their fish to market weight within eight months and then quickly prep their ponds for the next stocking, could potentially achieve three production cycles in two years. None of the respondents indicated that they maintain such a pace, and given the difficulty of reliably achieving such a rate of grow-out, not to mention the various climatic, market, and maintenance factors that must all perfectly align, it is unlikely that any average producers in the region maintain such a rate of production.

5.2.1 Record Keeping

Producers were asked about their record keeping habits. Good record keeping can provide useful information for stocking, feeding, and marketing decisions that can improve production and profitability. Unfortunately, less than half of respondents (17) said that they keep any records of their fish farming activities. All seventeen keep records of their feed and fingerling purchases, twelve keep records of labour expenses, six record transport costs, and two keep track of marketing and sales activity. Producers, on average, have been keeping records for about half the time that they have been operating, but some have been doing so the whole time and some only started that cycle. This indicates that although record keeping is not a popular activity, it is growing in prevalence. However, all but one producer says

that they keep their records for only one year. This is regrettable as a historical record provides the most effective information for decision-making. Women are either the sole or collaborative record keepers in thirteen of the seventeen producer households that keep records, making them an ideal target for improving this element of their aquaculture livelihoods.

There are four reasons that producers either keep poor records or don't keep them at all. The first is that producers in Bolivia do not pay income tax, which removes the most conventional reason to keep records. The second is a lack of skills and knowledge about how to keep records. The third is a certain degree of apathy amongst producers. This is because for some, aquaculture is a secondary livelihood and therefore not taken as seriously as their primary livelihood. The fourth reason is that record keeping is viewed as tedious and the benefits are not widely recognized and understood. Training that teaches how to keep records and highlights the tangible benefits of doing so would be beneficial. This would be an effective pathway to better decision-making and ultimately higher revenues.

A lack of record keeping is common amongst small-scale producers in the global South (eg: Girma & Gardebroek, 2015), including aquaculturists (Marschke & Wilkings, 2014; Tran *et al.*, 2013). The lack of record keeping indicates that producer recollection of specific details related to production and marketing may be occasionally inaccurate to some degree. When conducting interviews steps were taken to minimize such inaccuracies, but they are nonetheless a reality of such type of research. Such reality should be kept in mind as the reader interprets the results.

5.2.2 Acquisition and Costs of Inputs

There are three primary expenses necessary for producing fish: fingerlings, feed, and ponds. These three inputs combined constitute the vast majority of the startup and operating costs of aquaculture production. However, the cost of these inputs was not the same for all producers, making it important to understand these variations and why they occur.

The most significant cost when starting aquaculture is pond construction, which varies from as low as \$725 USD to as high as \$3900 USD, with the average being \$1,408 USD and the median being \$1000 USD. This variance is due to the size of the pond, whether the construction was subsidized by a development project or government organization, and/or if the producer coordinated with others to receive a group discount. For a better snapshot, the cost of building 1 square meter of pond was calculated²³. This cost ranged from \$0.43 to \$2.32 USD with a mean of \$0.95 USD and a median of \$0.90 USD, indicating that once variation in pond size is corrected for it becomes clear that the cost of building a pond is usually within a narrow range. A farmer could expect to pay around \$1900 USD for a 20m x 100m pond.

The next major production cost is the purchase of fingerlings to stock the pond. The price of fingerlings is quite uniform, with the mean at \$1.6 BOB (\$0.23 USD) and the median at \$1.5 BOB (\$0.22 USD) per fingerling. Fingerlings can cost as much as \$3 BOB (\$0.44 USD) each but in that case their size is larger in accordance with the extra cost. The consistent price of fingerlings is likely due to the limited number of relatively small suppliers, the lack of economies of scale in fingerling production in the region, and price norms that have emerged over time. Producers were asked whom they purchased their fingerlings from. Although a variety of responses were collected, some of which were difficult to track down, 27 of them purchased fingerlings from one of the two relatively large suppliers outlined in the previous section, or a local association or government (who likely acted as an intermediary for one of the two large suppliers). This left 13 sources that are likely composed of producers experimenting with fingerling production (three such producers were met but not formerly interviewed during field research) and intermediaries of the aforementioned suppliers. In three quarters (30) of cases prices were simply set by the supplier, in 9 cases it was set through group negotiations with the supplier. Only one respondent reported receiving a price for

²³ Cubic meter was not used since pond depth does not vary much. In general, a common sized pond of 20m X 100m is approximately 2.5 meters deep at one end and slopes up to 1.5 meters at the other. This of course varies by pond size, water levels, construction style, and amount of sediment accumulation on the bottom.

fingerlings that s/he managed to negotiate alone with the supplier. Table 5.6 shows how the different ways of obtaining a price affected that price.

Table 5.6: Fingerling price variation according to way that the price was set

	<i>n</i>	Average price	Percent different from the mean
Sample	37	1.468	0
Set by supplier	28	1.482	+0.95%
Negotiated as a group with supplier	8	1.388	-5.45%
Negotiated as an individual with supplier	1	1.7	+15.80%

*Three producers had bought larger fingerlings than are normally sold and thus paid more accordingly. They were therefore removed from the sample for this table.

As the above table shows, there was some advantage to negotiating with fingerling suppliers as a group. Those that did so were able to save 5.45% on average compared to the group and 4.5% compared to when the supplier sets the price. Although there was only one incident of a farmer negotiating a price with a supplier, it turned out worse than either negotiating with a group or going with the stated supplier price.

Producers were also asked if the latest price they paid for fingerlings had changed since they started aquaculture. Most (24) said that it has stayed the same while twelve said that the price has gone down. Only four felt that the price for fingerlings has risen. They were also asked if fingerling prices changed based on the time of year, to which 21 said no, 17 said yes, and 2 didn't know. It is unclear why this is split. Fingerlings tend to be produced by suppliers in time for the summer stocking, and then, by the larger suppliers, in batches afterward to meet off-peak demand. Perception of seasonal price variation is likely connected to the producers experience with, and frequency of, stocking in the off-season.

The third cost an aquaculture farmer faces is feed. The average cost of a 25kg bag of feed was \$105.7 BOB (\$15.32 USD), but ranged from \$90 BOB (\$13.04 USD) to \$120 BOB (\$17.39 USD). The variation is primarily due to different types of feed associated with the growth phase of the fish. Fingerlings are given feed with higher quantities of high value inputs (protein & nutrients), making the feed more

expensive. The second phase feed has less of such inputs and therefore costs a little less. The cheapest is the fattening feed that is given near the end of the growth cycle. Despite the variation, the difference in cost per type is small, only \$5 BOB (\$0.72 USD) to \$7 BOB (\$1.01 USD) per bag.

Feed was purchased from a community agricultural association in 19 instances out of 40, the largest source for feed. These organizations typically act as intermediaries for larger feed producers. Feed intermediaries are more common than fingerling intermediaries as feed is much easier to transport, handle, and store. It is also in demand year round rather than at specific times of the year like fingerlings. This means that transport costs are more of a concern and the feed needs to be readily available and easy to access, making it important for feed companies to have intermediaries and purchase points in smaller towns. Nonetheless, feed producers do still sell directly to producers. Four interviewed producers bought directly from Vallacito and another four bought directly from Milton Crespo. The remainder of feed sellers (13) consisted of small private producers or small companies. These exist in greater number than fingerling companies because feed is relatively easier to produce, is a safer business to be in (much less spoilage, steadier demand, etc.), and can be transitioned into more easily by companies or individuals who produce feeds for other sectors. Such companies often already have the necessary feed manufacturing machinery and can therefore shift into fish feed production with minimal additional cost. Feed manufacturing seems to be a fast growing segment of the CBAVC.

Producers were asked if the price for feed has changed since they started fish farming. Twenty-nine said that it has stayed the same, nine said that it has decreased, and only two said that the price has increased. Although prices in the CBAVC are affected almost as much by norms and tradition as by the basic economic principle of supply and demand, this finding hints at a downward trend, and does support the notion that feed supply for fish in Bolivia is expanding. Producers were also asked how prices were reached on their feed, and 33 said that it was simply set by the company, four said that it was set by them negotiating a price themselves, and three said that the price was set through negotiations as a group of farmers.

The nature of feed as a commodity is more akin to a typical item that you would go to the store and buy, whereas fingerlings are a more specialized product for the reasons outlined earlier. Most producers found feed prices to be something that is simply set by the seller. This analysis is corroborated by the fact that 87.5% (35) of producers said that feed prices do not vary throughout the year.

Like any agricultural operation, there are various other costs involved with aquaculture, some relatively substantial and some incidental. One significant cost can be labour, but the degree of its significance varies by size and type of aquaculture operation. Almost all producers seek help from friends and/or neighbors to help with harvesting fish, but they are not always paid, or if they are it may be through an in-kind reciprocation of help or a gift of some fish. Placing a value on this type of co-operation is difficult. However, not all production labour in the aquaculture sector is informal. Almost half (19) of producers said that they hire workers to help with some aspect of their operations. Production workers can be broadly divided into two groups: caretakers and temporary labourers. Caretakers work year round, usually live near the ponds and are paid monthly. Their responsibilities span the entire gamut of aquaculture activities, but they are primarily focused on the day-to-day tasks of feeding the fish, pond maintenance, fish monitoring, etc., but they also do help with harvest, processing, and transport. Eight producers had a caretaker working for them, whom they paid on average \$3625 USD annually, and for most they also gave room and board. The room is usually a small wood house next to the ponds and the board consisted of some fish and staples such as rice and vegetables. Six of the eight caretakers were employees with no connection to the producer while one was a family member and another was a friend, only one was a woman. For the producers who hire regular caretakers, the cost of labour represents a significant addition to their total production costs.

The other group of workers is the temporary labourers who are hired for short-term specific tasks, mainly pond cleaning and harvesting. The number of labourers hired for pond cleaning (draining water and mud, adding lye) is one or two, and their task lasts only one or two days. The number of people hired for harvesting on the other hand, varies a lot depending on how large of a harvest will

be undertaken on a given day, how many friends and family members are already available to help the producer, and the size of the pond that needs to be harvested. Typically between one and three people are hired, but four producers say they hire as many as six. A harvest usually only lasts one day and producers typically harvest around five times per production cycle. Labourers are paid between \$80 and \$100 BOB (\$11.59 - \$14.49 USD) per day. Thirteen producers said that they hired temporary labourers; eleven hired forty-two for harvesting and two hired one each for pond cleaning. The average annual cost to producers who hired temporary labourers was \$294.09 USD. Unlike caretakers, labourers tend to be friends of the producer rather than workers who have no initial connection. Nine of the thirteen producers hired their friends, two hired family members, and only one hired a person that they did not have a specific connection with. Also unlike caretakers, women had more presence amongst temporary labourers with eight producers saying that the labourers they hired consisted of both men and women, only three producers hired exclusively men. This situation is best explained by the fact that harvesting requires a number of people and is a more random activity, therefore making it necessary for producers to rely on their social circle to find workers.

Despite the activity of aquaculture production workers within the CBAVC, 52.5% of producers said they did not hire any workers at all. This makes calculating labour into the overall production costs complicated. For some producers the cost is high, for some it is minimal, and for others it is non-existent. Therefore when production costs and income are outlined later, the role of labour in those calculations will be explicitly outlined. This situation indicates that employment generated by chain producers can yield mixed results and is dependent on several factors, particularly the nature of producer participation.

As mentioned above, there are also some incidental costs associated with aquaculture production. Nets are required but were not asked about because they are relatively inexpensive, are usually a one-time cost, can be easily shared, and are ubiquitous in the study region. Water pumps were asked about as they can be quite beneficial (16 producers have one), but they are not included in any cost calculations because they are difficult to value and are often shared. Other items

such as water testing kits and various tools (wheelbarrow, mower, etc.) are also advantageous to have, but are not necessary, hard to value, and are usually of negligible value anyway.

A final potential cost is that of distribution. Producers were asked how their fish reached their buyers. In twenty-two cases producers arranged transportation, while in the eighteen other cases the buyer arranged it. Of the twenty-two producers who arrange transportation, nineteen are doing so to sell to a restaurant. In two cases it was to transport to a market, and in one case it was a delivery to family. When producers arrange transportation to take fish to their buyers, it is the producer themselves who usually do the transporting with the exception of one producer who relied on their hired worker, and in two cases where they relied on friends to do the transporting. Thirteen of the producers used their own vehicle, seven rented a vehicle, one borrowed a vehicle, and one used his motorbike. Fifteen of the producers transported their fish on ice, while the other seven transported their fish raw without any refrigerant. The distance they had to travel to deliver their fish ranged from 2kms to 250 kms, with the average being 55 kms. Transportation costs are relatively small, with the highest payment being \$600 BOB (\$94.20 USD) for a distance of 250 kms, but the average being \$138 BOB (\$20 USD).

5.2.3 Ponds

During the last production cycle the 40 interviewed farmers stocked 95 ponds in total, despite collectively owning 145 ponds. Only sixteen producers stocked 100% of their ponds, seven of whom only owned one pond to begin with, which indicates that it is common for farmers with multiple ponds to leave some fallow (an average of 28% across the sample). Some reasons for not stocking a pond during a production cycle include the need to drain and clean it, it was recently built and needs to be filled (often by rain which can take a long time), or a simple lack of interest in maximizing production. Also possible but less frequent is that household financial problems made it difficult to finance fingerlings for all ponds.

The size of ponds that are owned by the producers varies a lot (photos 5.28 & 5.29). The smallest pond owned by a producer was 20m x 40m and the largest was 30m x 130m with the most common size by far being 20m x 50m. The overall average size of a pond is 1590m². Figure 5.7 shows the frequency of each size of pond.

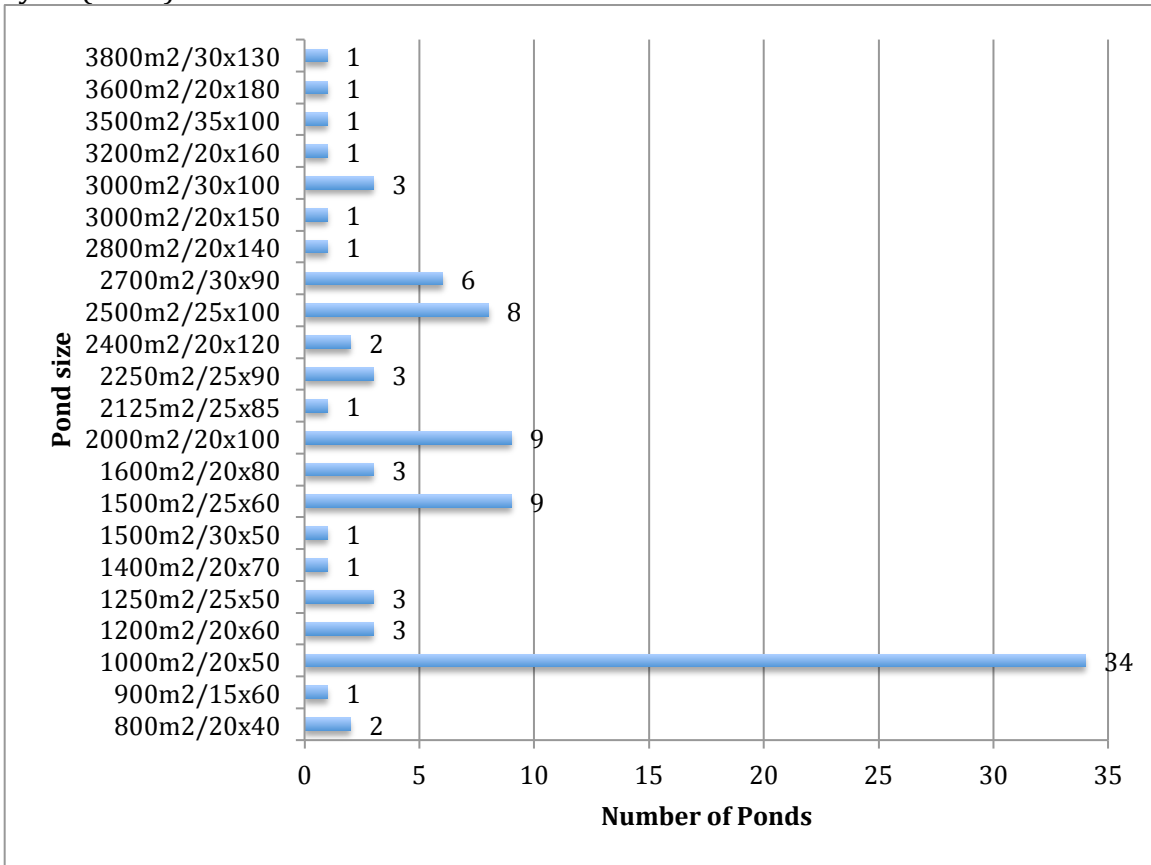
Photo 5.28: A relatively small pond



Photo 5.29: A relatively large pond



Figure 5.7: Frequency of sizes of ponds that were stocked during last production cycle (n=95)



The average number of square meters of pond stocked per farmer was 4122m² and the median was 3170m². Square meters are used rather than number of ponds because the size of ponds can vary significantly as demonstrated above.

5.2.4 Current and Potential Cultured Species

Most (32) farmers started their aquaculture production growing Tambaqui, while 5 started with Pacu and 3 started with Tambacu (a local hybrid of Tambaqui and Pacu). Very little change in produced fish has taken place since they started; all Tambaqui producers continue to produce it today. Of the 9 others who started with something else, two of the Tambacu farmers have now switched to producing Tambaqui. One said he switched because it took up to 15 months for the Tambacu to reach the sale weight of 1kg. The other producer said that he initially started with Tambacu because mixed fry was cheaper to buy. This comment points to the varying types and qualities of fry that is available to farmers. It also hints at the experimentation that aquaculture farmers sometimes go through to find ways to reduce costs. Such a theme emerges in feed procurement and pond construction as well.

Aquaculture farmers were asked if they have thought about farming any other species and if so, why. Twenty-four of them said they had thought about other species. The species that was most often under consideration was Sabalo²⁴ (mentioned by 13 producers) primarily due to its popularity in the market and amongst consumers, and also its perceived ability to be polycultured with Tambaqui and generate benefits such as cleaner ponds with fewer algae. There was also interest in Surubi, Carp, Boga, Doradillo, and Tilapia, mostly for similar reasons as the interest in Sabalo. Farmers who said that they had not thought about farming other species and were asked why not pointed to several challenges with taking on new species. Finding fry was frequently cited, as was a concern for a lack of market demand, or in the case of Sabalo, having to compete with low prices due to their

²⁴ Refer to appendix 1 for pictures of commercial Amazonian fish.

importation from Argentina. These farmers were also concerned about their capacity to rear fish they were not familiar with and one farmer used the example that Tilapia dig holes in the side of ponds, eventually ruining them. The responses to this question made clear that there is interest amongst producers to culture other species, but both technical and market knowledge is lacking, as are the necessary inputs.

Despite the challenges and limitations that farmers face with culturing new species, fifteen are nonetheless experimenting with polyculture. The most popular fish to add to tanks is Sabalo, which twelve farmers have added as a means to help with keeping ponds clean and as an additional product that can be sold or consumed at home. Most are caught from the river and placed in the pond, and the numbers per pond range from 7 to 200. One farmer said that his Sabalo range in size from 0.5kgs to 3kgs. Six producers have also added Tilapia, Doradillos, or Bogas (each is being reared by two different producers) in small numbers. The only fish to be polycultured with Tambaqui or Pacu in relatively large numbers is carp. Two farmers claim to have 500 carp each. They, along with possibly the three who have 150 or 200 Sabalo, are the only farmers that seem to be practicing polyculture explicitly for income purposes. For most of the other farmers the addition of another species of fish in their tank is more of an informal experiment or lark, rather than a consciously made decision based on technical knowledge and a consideration of market potential.

The twenty-five aquaculture farmers who do not engage in polyculture were also asked why they do not. Their answers ranged from being quite specific to quite general. One believed that Sabalo tend to eat the tails of Tambaqui, and two stated that they had tried to culture Sabalo but had poor results. The most common answers however were that fry for fish other than Tambaqui is simply not available (8), or that they did not have the technical skills or knowledge to handle different fish (14). The interest in culturing other fish is something that a government agency or NGO may seize upon to create other aquaculture value chains and expand the system's benefits to rural development.

5.2.5 Stocking Density and Feed Conversion

All but five producers stocked Tambaqui last cycle while four stocked Pacu and one stocked Tambacu.²⁵ Stocking density ranged from 0.66 to 1.6 and averaged 1.04 fingerlings per square meter of pond. Based on stated grow-out time (averaged to 9 months/274 days) and sale weight (averaged to 1kg), the average daily weight gain for the fish $[(\text{final weight} - \text{initial weight}) / \text{culture period}]$ was 3.64 grams. The feed conversion ratio $[\text{weight of daily feed} / \text{daily weight gain}]$ was also calculated and it averaged 1.15, although this fluctuated significantly, between a low of 0.50 and a high of 2.19. Some of this variation can be attributed to the fact that farmers tend not to accurately recall or keep records of the amount of feed they give their fish. Also, the calculation of the weight of daily feed was made using the number of harvested fish, not stocked fish, meaning that for some producers with high fish losses, feed was wasted due to mortality. However, this still provides evidence that there is room for improvement in technical knowledge about feeding. In figure 5.8 an association between number of fingerlings stocked and number of bags of feed used is presented. In this calculation there are two outliers (circled) who claimed to have used almost double the number of bags of feed than other producers with similar numbers of stocked fingerlings. A review of the data did not point to a data entry error (although this is possible) or any other clear explanation for the anomalies. The most likely reason for the extremely high numbers of bags of feed used is the combination of inaccurate and poorly considered recall on the part of the interviewees. Another possible reason is that those two respondents had been exceptionally poor at managing their feed or had faced some significant feed losses (possibilities are many and could include thievery, rain damage, loss during transport, etc.). However, these explanations seem unlikely. The numbers are so high that it is hard to believe farmers would be so inefficient (especially since they both have relatively large aquaculture operations). As for feed losses, farmers were

²⁵ This information should be taken with a grain of salt. While most producers are quite clear on the differences between fish species, their similarities and the fact that their names are occasionally used interchangeably by some means that it is possible that a respondent or two who said they stocked Pacu or Tambacu could actually have stocked Tambaqui.

explicitly asked about the amount of feed that was used, not how much was purchased generally, and neither respondent told a story at the time or while answering other questions (such as those about production problems and challenges) about having faced feed problems or losses. For these reasons the two outliers were removed and a new regression calculation was done (figure 5.9). The result of the regression without outliers shows a positive relationship between feed and fingerlings stocked, indicating that the use of feed is fairly consistent.

Figure 5.8: Regression between feed and fingerlings including outliers

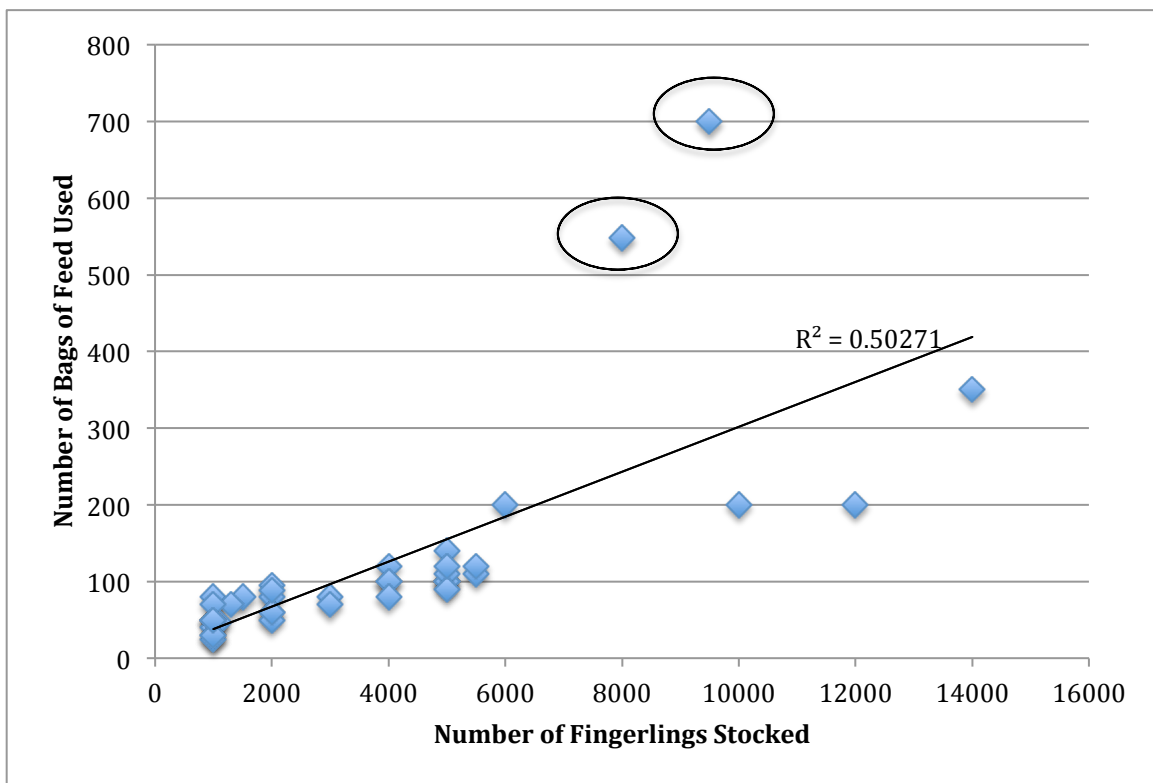
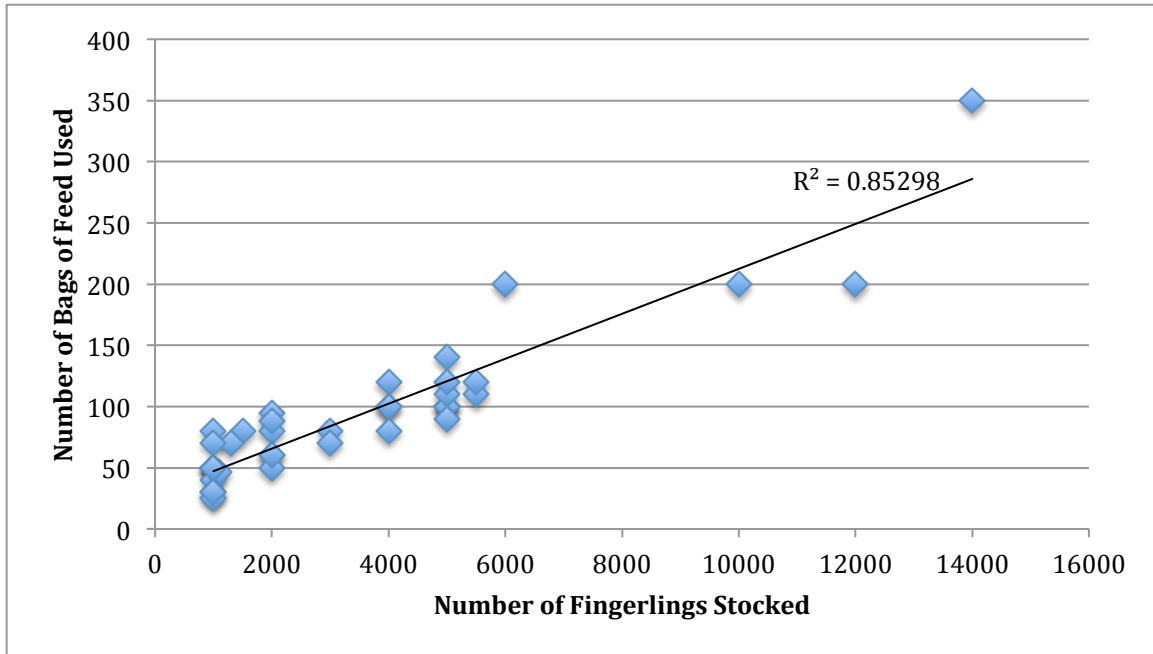


Figure 5.9: Regression between feed and fingerlings with outliers removed



Of all the fingerlings that were seeded into ponds, an average of 80% across the producer sample were harvested. However, there was a lot of variation in how many fingerlings were lost over the course of the production cycle. One producer managed to retain a high of 95% of fingerlings, while another lost 50%, the lowest in the sample. The relative standard deviation ($=\text{st.dev}/\text{mean}$) for the sample was 51.69%, indicating a wide spread in the data. Losses are caused by a number of factors and can have significant consequences.

5.2.6 Producer Co-operation

Aquaculturists were asked if and how they cooperate with other fish farmers on different aspects of their production. Understanding such forms of collaboration is helpful in identifying strengths and weaknesses in production techniques as well as the sustainability of the system. Amongst the producers in the sample, cooperation was common but not universal. Thirteen producers said that they did not cooperate with any other fish farmers on any activity involved with fish

production. Despite this, it is unlikely that those thirteen did not receive any help, but rather did not cooperate with any other producers in an explicitly formal way.

As noted earlier, nine producers said they established the price they paid for fingerlings through group negotiation, and that such an approach can generate financial benefits. However, when asked explicitly about cooperation on stocking fingerlings, only one farmer said that they did so. Since fingerlings are typically delivered right to the pond by the supply company, it comes as no surprise that there is not a lot of cooperation during stocking. Once the fingerlings are in the pond, the task is more or less over, meaning that with the exception of what the fingerling supply workers do, there is not much else that needs to be done during the stocking phase.

Feed on the other hand seems to be the reverse situation as fingerlings. While prices for feed were rarely established through group negotiation, cooperation amongst farmers on the logistics of acquiring feed through the year is very high. Twenty-two farmers said that they cooperated on aspects of feed, usually in sharing, exchanging and transporting. This is likely due to the distance some producers need to go to re-stock on feed when it runs low. Farmers help each other out by loaning and borrowing feed when they are running low but have not been able to make a trip to buy more. When they do go to buy more, they coordinate the transportation, as it requires a reasonably large vehicle.

There is also a fair deal of cooperation involved with harvest and acquiring the necessary number of workers. Fifteen producers said they cooperate with other producers at harvest time. It is common for producers and their households, and even their hired caretaker at times, to support the harvest of a neighboring producer. In return that producer tends to do the same when the time comes. This was further confirmed by observations of harvests while conducting fieldwork. Photo 5.30 & 5.31 shows the number and variety of workers who tend to get involved during a harvest.

Photo 5.30: Workers, friends, neighbors, and owners harvesting fish



Photo 5.31: Vehicles of people who have come to help harvest



Cooperation also occurs on other things. Three respondents said that they cooperate with other producers on tank building and maintenance, two said that they lend and borrow water pumps amongst themselves, and one mentioned that s/he has a group amongst whom they share information such as on fish health, input prices, and potential buyers.

5.2.7 Knowledge and Training

As a measure of access to technology that can help with obtaining aquaculture information, producers were asked about owning a computer, household internet, and a cell phone. Only 13 producers have a computer, and of those only 6 have home internet. However, all but one producer had a cell phone, and many were smartphones with access to the internet. The degree to which producers use these features, or whether they have sufficient cell coverage at affordable prices to access them, are unclear, but they nonetheless represent an opportunity for information dissemination.

Producers were asked specifically about where they get information that helps their fish farming activities, how often they seek such information, and what they consider its quality to be. The most notable result was that twelve (30%) respondents said that they did not seek out information about their fish farming.

Unfortunately this points to a certain degree of willful disinterest and/or ignorance on the part of some fish farmers and may prove to be hurdle for sector development. Despite this, 28 producers did seek information on fish farming. Eighteen got their information from one source, nine relied on two different sources, and one utilized three sources. The reasons for seeking information ranged from general tips and instruction on everyday management to specific inquiries into low oxygen, algae, water quality maintenance, pest control, pond cleaning, and dealing with fish maladies. As for the sources themselves, the most popular were the Internet, input suppliers, and extension workers, each with eight producers relying on them. Also, not only were the Internet and input suppliers relied upon by the most producers, they were also accessed with the most frequency. Although many producers had engaged with extension workers at some time, they did so with the least frequency. Extension workers also received the lowest rating for perceived quality. Their average was 2 (adequate), which isn't bad, but the average quality from all sources was 2.5, almost halfway between adequate and good. Table 5.7 outlines how many producers sought each form of information, the frequency that they sought it, and their rating of its quality.

Table 5.7: Sources of information for aquaculture information

Source	# of times each source was used by a producer	The mean frequency that info was sought from each source*	% from the mean	The mean perceived quality of this information**	% from the mean
Mean		2.5897		2.4872	
Internet	8	2.25	+13%	2.5	+0.51%
Input Suppliers	8	2.25	+13%	2.625	+5.54%
NGO	6	2.5	+3.50%	2.667	+7.23%
Friends/ Family	5	2.6	0%	2.6	+4.53%
Other fish Farmers	4	3	-15.80%	2.75	+10.57%
Extension Workers	8	3.125	-20.70%	2	-19.59%

*1-once a week 2-once a month 3-once per six months 4-once a year 5-less than once a year

**1-poor 2-adequate 3-good

Aquaculture producers were asked about any formal training in aquaculture that they had undergone. Most (35) had participated in some form of formal training, but the duration and contemporaneity tended to vary. The mean number of years since producers had received any training was 2.5, but ranged from quite recently (within the past year) to 9 years ago. The total number of days of training that producers have received was not a lot, with a mean of 4 days. However, the range causes the mean to be a little misleading. Almost half (49%) of respondents who have received some training have had only one day or less of training over the course of their entire tenure as aquaculture producers. The mean is skewed by four outliers on the high side that range from having 14 days of training up to, in one case, 25 days of training.

Training topics that were covered varied across the entire spectrum of fish farming and included maintenance, technology, maladies, tank construction, and on occasion financial management. Almost all of the training had been provided by either an NGO or a governmental agency (either municipal, departmental, and one time, national), but others involved included universities, input suppliers, and aquaculture associations. Table 5.8 indicates how many training sessions each type of organization offered, the number of days they lasted, and producers' perception of their benefit.

Table 5.8: Aquaculture training session lengths and participant satisfaction

Training provider	Number of training sessions	Average number of days	Difference from the mean	Average level of producer satisfaction*	Difference from the mean
Mean		2.5		3.75	
NGO	18	3.8	+52%	4.1	+9.30%
Government	28	1.1	-56%	3.5	-6.60%
Universities	3	3.7	+48%	3.3	-12%
Input Supplier	2	0.75	-70%	4.5	+20%
Aquaculture Associations	5	5.7	+228%	4	+6.6%

*1-very poor 2-poor 3-adequate 4-good 5-very good

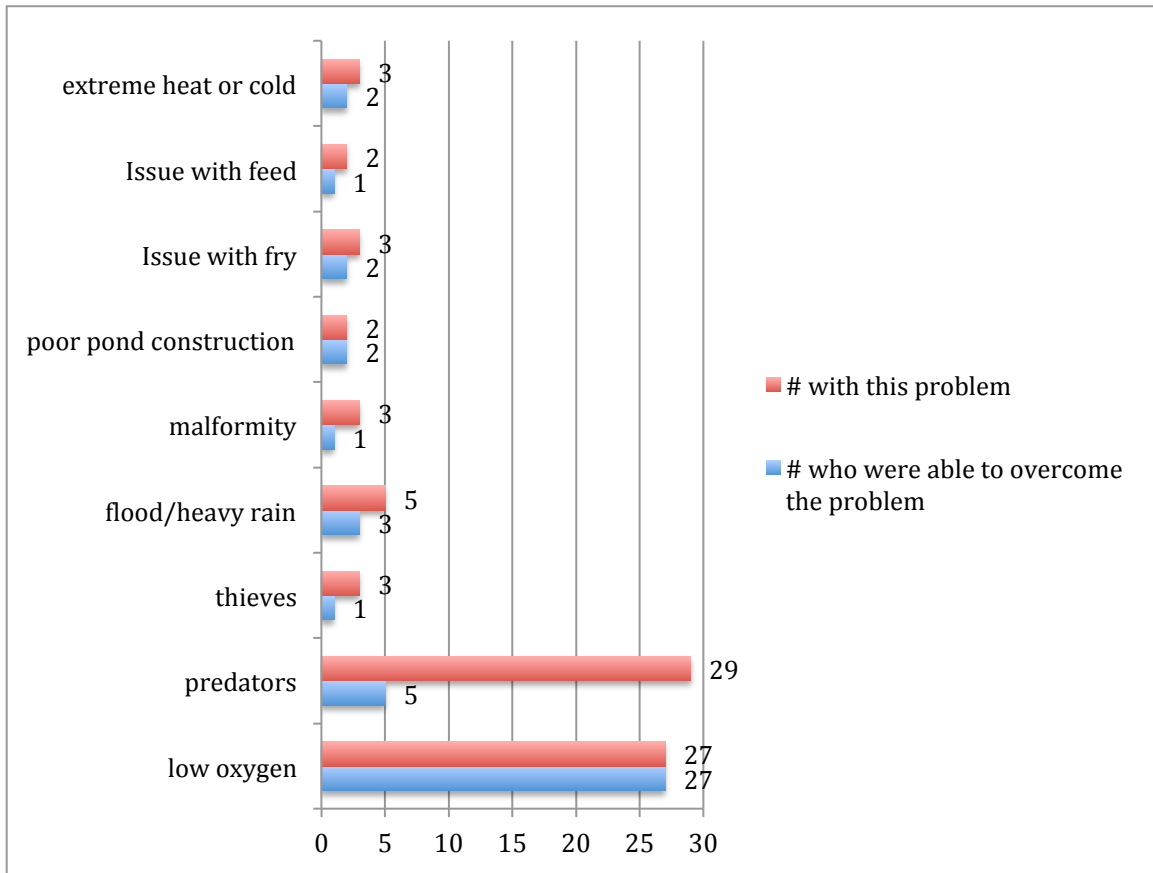
Between the two main providers of aquaculture training, NGO sessions tend to last more than 1.5 days longer than government run sessions. NGO sessions are also rated higher, averaging 15.9 percentage points more than government. However, of all the training providers, aquaculture associations offer the longest (and therefore possibly the most comprehensive) training, and input suppliers offer the most satisfying training, although given their low sample numbers, this should be accepted cautiously. Overall, this data indicates that there is inconsistency in the quality of training that aquaculturists can undertake.

5.2.8 Production Challenges

Although a number of challenges have been mentioned so far, producers were asked to comment on the specific challenges they have faced in their production and marketing. They were also asked about the consequences of these challenges, if they did anything to overcome them, and if so, how.

All but two of the forty producers surveyed said that they experienced some challenges or problems with fish production. The total number identified by the entire sample was 77 with the most being four and the average being about two each. Problems were grouped and are presented in figure 5.10 below.

Figure 5.10: Producer production challenges and number who successfully overcame them



The two most common problems are low oxygen levels in the water and predators eating fish. However, a key difference between these problems is that producers have a means of addressing low oxygen, whereas few producers have been able to effectively cope with the predator problem. When faced with low oxygen, pumps are used to circulate and oxygenate the water. Some add dolomite and/or salt and one said that they add urea. While not all producers own a pump, many do, and they are often shared amongst themselves, therefore providing not a perfect, but a relatively high degree of capacity to respond to the oxygen problem. The predator problem on the other hand continues to challenge producers. The main predators are birds (two types in particular, see photo 5.32) and to a lesser extent alligators. While alligators can enter a pond at any time and eat any size fish, they only eat a few before becoming full and therefore are found and shot by the

farmer before they can inflict large losses. Birds have nearly the opposite effect. They can only prey on the fish when they are small, but can arrive in large numbers and inflict huge losses in a very short period of time.

Photo 5.32: Two types of birds regularly blamed for predation of fingerlings



Recall that farmers were asked about how many fingerlings they stocked last cycle and how many they managed to harvest at the end. As a group they lost 20% of stocked fingerlings, with 4 (10%) losing more than 40%. They were then asked a follow up question of what caused the losses, and the leading response was predation by birds. Several producers recounted stories of how sometimes birds would come in flocks and land on ponds to feed. If this happened when fingerlings had been recently stocked the losses could be very high and would even force the producer to order more fingerlings to re-stock the pond. Only five producers said that they had managed to get the problem under control, and when asked how they did so, the innovations they employed included building a pond covering wire net (photo 5.33), spreading cow manure around the edge of the pond, and using scarecrows. During informal follow up discussion the farmer who used the net felt it had worked very well against birds but that alligators remained a problem. Several producers used scarecrows but only one said that they had much effect. He said that they would work for several days but the birds would eventually come to

disregard them. His strategy included moving them around every few days and making small changes to their clothes. He said that this helped but that it was still a less than perfect solution.

Photo 5.33: Wire net covering a pond to keep away predatory birds



The third most common problem is flooding from either heavy rains or overflowing rivers. Being in the rainforest, heavy rain is common, but can be particularly inundating at times. When it is severe enough in both quantity and length of time, ponds can overflow leading to species escape. The pond's banks can also erode which can fill the pond with mud that chokes the fish and/or compromises its structural integrity. Three producers said they overcame the problem by setting up nets around the perimeter to avoid fish escaping, repairing the banks as they needed, and in the case of mitigating the effects of mud, they would add salt and dolomite. Two producers said that their ponds were built poorly, but they addressed it by shoring up the sides and making necessary repairs. Three had issues with extreme temperatures, two too cold and one too hot. Nothing was done about it being too hot but the two farmers battling the cold did so by building fires in makeshift ovens and circulating water through the furnace. See photo 5.34. Three producers had issues with small numbers of fish with deformities, but only one felt it was effectively addressed. He removed them from

the pond and believed the problem originated from poor handling of the fry during stocking (this may have been a fry producer issue).

Photo 5.34: Furnace constructed to heat ponds



Not all problems and challenges faced by producers originated in nature. For three producers thieves were a regular problem. Small groups of people would occasionally drag a net through their ponds in the middle of the night and steal fish. Only one farmer felt that he successfully addressed the issue, and did so by “looking after the ponds in a calm manner,” the implication being that a combination of increased vigilance and some sort of social engagement was the remedy. For two producers, feed provisioning had created a problem. In one case it was simply that the farmer neglected or improperly fed his fish. In the other case, the one where a solution was reached, the wrong feed had been in the bag and he returned it, exchanging it for the proper feed. Three producers also had issues with fingerling suppliers. In one case the supplier sold the producer less fingerlings than he paid for. That producer now diligently counts his fingerlings. In a second case the supplier provided damaged fingerlings in bags. The producer sorted the issue through a conversation with him. In the third case, 20% of the fingerlings that the

supplier sold to the producer were white bellied, and therefore could not be sold. That producer said that he was unable to overcome the problem.

Producers were also asked if they had any problems with the health of their fish. The only health problem reported was “hongo” or fungus, which caused scales to fall off as well as discoloration, rash, and fins to deteriorate. Thirteen producers experienced this problem. Eleven responded by adding salt to their ponds and all but one avoided losing any fish. The one who added salt but still lost fish said that the losses amounted to 5000 fingerlings. Of the other two who did not add salt, one did nothing and lost 500 fish, and the other moved fish into a new tank and lost 150 fish in the process.

5.2.9 Marketing Challenges

Producers were asked if they had any important problems or challenges related to selling their fish. Twenty-five indicated that they had. The reasons they gave were all very similar; fifteen said there was now too much competition, six said that the price has been going down, and three said it was getting harder to sell. One respondent said that the sector is disorganized and another said they had poor access to ice. When asked what they attributed these problems to, seventeen said that there was too much production. Three specifically mentioned that there were too many subsidies that helped boost production and encouraged new entrants. One also mentioned the increasing competition from imported fish from Argentina and also river fish. The person who mentioned difficulties with getting ice said that roadblocks and inconsistent supply was often the culprit. When the producers were asked if they were able to overcome these challenges, only one said he had. His strategy was to sell at a lower price, but also to sell to the urban market of Los Bosques.

The overall result is that there is a sense amongst some producers that supply is starting to exceed demand. However, it is worth remembering that 15 producers said they had no marketing issues. Also, despite the fact that over production, and by extension falling prices, was the overwhelming concern, the

prices that producers received for their fish after last harvest matched the historic mean almost exactly (this can be reviewed in section 5.3.6). Therefore, while there is reason to monitor the situation closely and marketing problems may emerge in the future, current producers system wide do not yet seem to be experiencing significant marketing problems. Having said this, it is important to note that this situation points to the need for a greater degree of organization by producers as well as concerted efforts to expand the consumer base and retail avenues.

5.3 Economic Sustainability

A critical element needed for a food system to be sustainable and productive is economic sustainability. CBAVC actors were asked a variety of questions regarding their incomes, the profitability of their activities, and their conditions, or lack thereof, of poverty. Non-producers were also asked similar questions to establish a comparison. The results are presented in the following sections.

5.3.1 The Farming Livelihoods of Aquaculturists

All but one aquaculturist had sources of household income beyond just aquaculture. The most frequently stated primary source of income was coca, with fish farming second and cattle farming a close third (table 5.9). In some cases the stated primary income source and the actual income source may not be the same. Agriculture producers in the study region tend to identify themselves as one type of farmer or another but usually undertake two or more livelihood activities. The income from these activities can fluctuate year to year based on a wide variety of factors. Self-identification with a certain activity is also often socially driven. Farmers will sometimes identify as a particular type of producer, and hence claim that as their primary source of income, because of its social connotations. This commonly occurs with coca farming, which can have a degree of social prestige and thus engenders a prideful sense of identity for some farmers.

Table 5.9: Frequencies of stated primary income sources of aquaculture producers

Income source	Frequency	Percent
Fish farming	8	20.0
Cattle	7	17.5
Rice	3	7.5
Coca	14	35.0
Pineapple	3	7.5
Store owner	1	2.5
Equipment operator	1	2.5
Honey	1	2.5
Government employee	1	2.5
Private business employee	1	2.5

Of the eight producers who indicated that aquaculture is their primary source of income, six also have a blue or white-collar income source and the seventh also produces cattle. This means that of the 40 producers interviewed, only one relies solely on aquaculture for household income (she also happens to be the second longest running producer in the sample). The eight who stated that aquaculture was their primary source of income were also asked what their source of income had been previously. Six said it was cattle farming, one said it was a combination of cattle farming and rice farming, and the eighth couldn't recall. Six of the seven who recalled their previous activity said that fish farming was a little more profitable than what they had done previously, with the seventh person saying that it was a lot more profitable. They were also asked if fish farming was easier than their previous activity, to which five said that it was a little easier and two said that it was a lot easier.

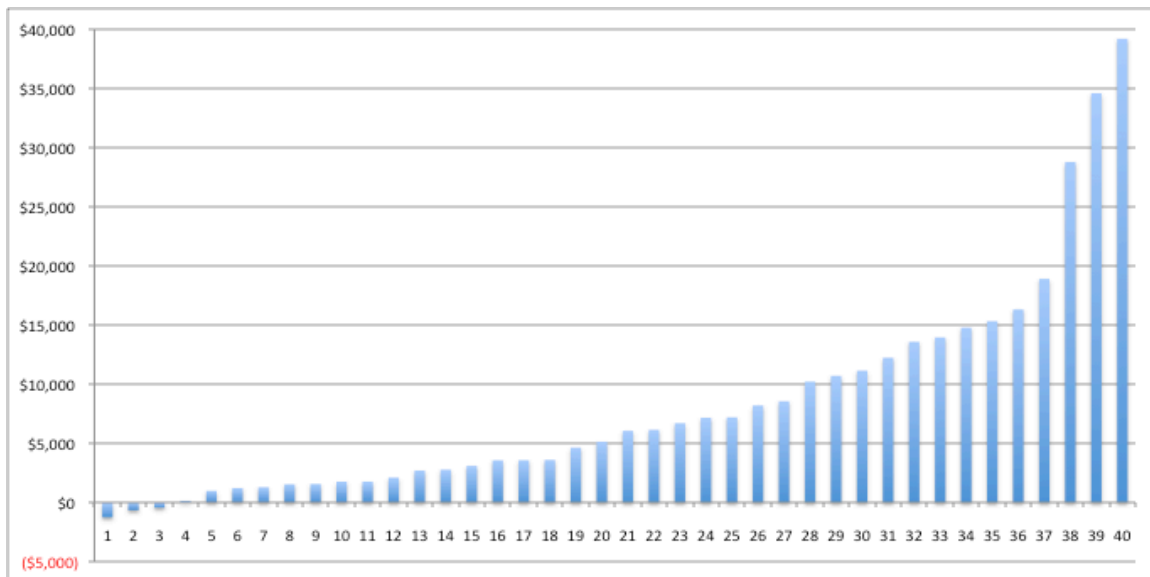
5.3.2 Aquaculturist Income

Gross income from the last complete aquaculture production cycle ranged from \$2,217 USD to \$42,434 USD, and had a mean of \$11,692 USD and a median of \$8,507 USD. Net income was also calculated using the following formula:

$$\begin{aligned} & \text{gross income} - \text{cost of fingerlings} - \text{cost of feed} - \text{cost of hired labour} \\ & = \text{net income} \end{aligned}$$

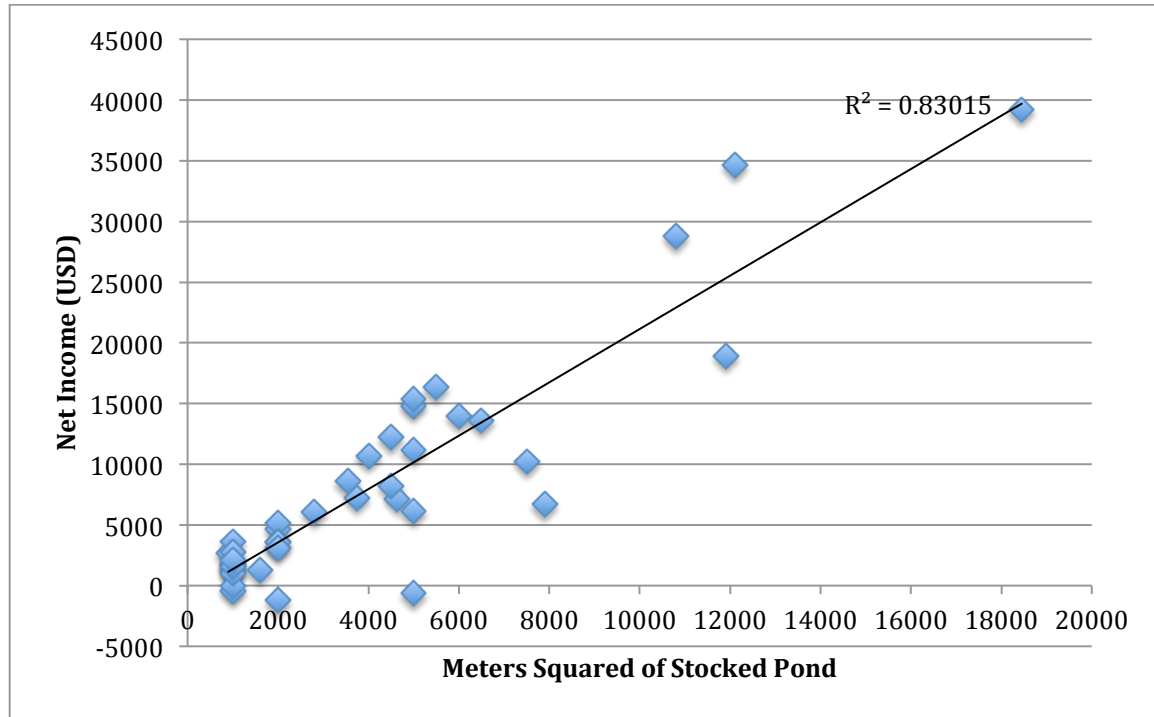
Cost of hired labour included both full-time workers, and workers who were hired temporarily for harvests. In the latter case, they were hired for an estimated 5 harvests per cycle. The cost of pond construction was not included in the calculation as it is a one-time cost. Net incomes from aquaculture ranged from a loss of \$1,254 USD to a profit of \$39,204 USD. The mean was \$8,219 USD and the median was \$5,594 USD. Figure 5.11 shows the distribution of net incomes.

Figure 5.11: Distribution of net income of surveyed producers



There is a clear variation in the profitability of aquaculture across surveyed producers. The primary reason is variability in the size of aquaculture operation. Figure 5.12 demonstrates the relationship between amount of stocked pond area and net income. 83% of the variation in income is explained by pond size.

Figure 5.12: Regression between net income and m² of pond stocked



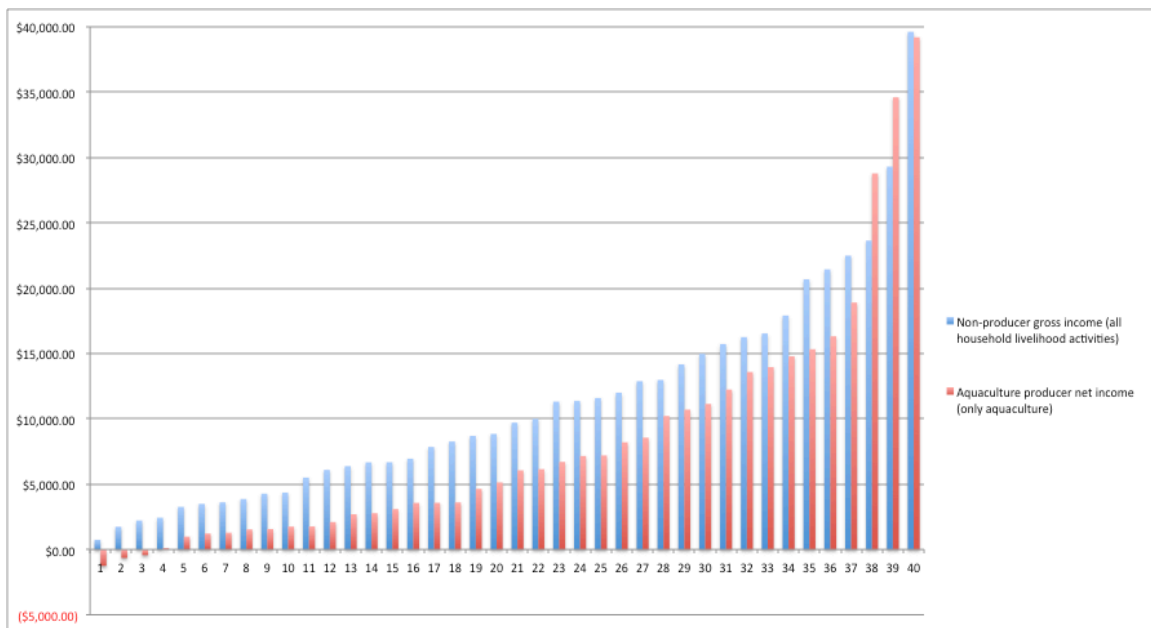
The profitability of aquaculture is strongly related to size of operation (represented by number of meters squared of pond area). Net income per m² of stocked pond ranged from \$-0.63 USD to \$3.60 USD, and had a mean of \$1.84 USD and a median of \$1.87 USD. To a certain extent this can be accounted for by the tendency of producers to inaccurately claim income and costs because of poor record keeping and accounting. But this is only a partial explanation as this tendency is common across all producers. Also, measures were taken during interviews to ensure that input and output numbers matched and that claims about costs made sense. While this is not foolproof, it does increase data accuracy. Therefore, some variation in farmer skills and capacity are a likely explanation for why some farmers can make more money than other farmers from the same size of pond.

Despite the variation in aquaculture income, there is ample evidence that it can be profitable, even at relatively small scales. A producer with one 20m x 100m pond who meets average levels of management can expect to earn \$3680 USD

annually. This is an average of just over \$10 USD per day, well over the national poverty line for rural areas of \$2.65 USD per day. Furthermore, as outlined earlier, all but one producer said that their household relied on more livelihoods than just fish, meaning that all the above figures represent only a portion of overall household income.

To further emphasize the profitability of aquaculture and its potential for economic development, it is worth comparing producer and non-producer incomes. There are some caveats that should be pointed out first. Due to time and logistical limitations, producers were not asked detailed questions about the economics of their other livelihood activities. For the same reasons, non-producers were not asked questions regarding the input costs associated with their livelihood activities. What is available is accurate figures for the net income of aquaculturists derived from aquaculture, and accurate figures on the gross income of non-producers derived from all of their livelihood activities. While these are not directly comparable, they do provide interesting insight into aquaculture as an income generating activity (figure 5.13).

Figure 5.13: Distribution of aquaculture net income and non-aquaculture total livelihood gross income.



As the above figure demonstrates, the net income from aquaculture alone that aquaculturists receive is close to the gross income that non-producers receive from all household livelihood activities. If the input costs of non-producer livelihoods were accounted for it is very likely that aquaculture would generally be more profitable alone than a combination of other livelihoods. For farmers, this makes incorporating aquaculture into their livelihood portfolios a strong economic development opportunity.

Producers were asked if fish farming has been profitable for them every year since starting. Only three said no. Interestingly, last harvest three producers were calculated to have lost money, but all three responded to the above question in the affirmative. This can be explained by either poor disclosure of income and costs, poorly keeping track of net income, generally positive outlook on the profitability of the activity, or some combination of the three. The producers who said that fish farming has not been profitable for them every year since starting were asked why not. Two said that the market for fish went down along with the price, and the third said that he had lost most of his fish one year due to robbers.

5.3.3 Aquaculture Producer and Non-Aquaculture Producer Poverty

The total household income of aquaculture producers was not established because of time and logistical limitations. However, income information was gathered for their non-agricultural production livelihood activities. Nineteen aquaculturists had income coming into their home from an activity that was not agricultural production. Their total annual gross income from these activities ranged from \$723 USD to \$135,200 USD, with a mean of \$18,343 USD. There are two outliers on the high end, and the larger one is likely inaccurate. The person who makes \$135,200 USD is a car mechanic and claims to make \$65 USD an hour. His actual net from that is likely much less, and the claim is likely bogus anyway since mechanic rates for car repairs in the study region were less than half of that. The

other outlier, which was a gross of \$72,000 USD, is potentially accurate as that person owned a restaurant.

Due to the lack of information on the total household income aquaculturists receive from all sources, it is not possible to accurately determine where they are situated relative to poverty lines. If only aquaculture was considered, the number of households below the national poverty line of \$2.65 USD per person per day (calculated as gross income divided by number of people in household) would be 14 and the number below the international poverty line of \$1.90 USD per person per day would be 10. While these figures have little value on their own since all but one producer has other sources of household income (the one producer that only makes money on aquaculture supports a five member household and generates \$13.54 USD for each of them per day), they become interesting when compared to non-producers. When the per person per day income of non-producer households was calculated, 6 were revealed to be below the national poverty line and 4 were below the international poverty line. Although these are better numbers than those for producers, the non-producer numbers reflect the true total household income and are therefore a relatively accurate indicator of that household's absolute poverty. The producer numbers on the other hand neglect other household livelihood activities that, if they were calculated, would likely reduce the number of households identified as below poverty lines significantly. It is worth remembering too that all but one producer household relied on more than just aquaculture, and for many, aquaculture wasn't even the most important source of income. The implication is that aquaculture-producing households are likely less poor than non-producing households on average, but poverty is nonetheless widespread in the study region.

A further measure of poverty was taken as a means to get a more rounded understanding of the nature of its presence in the research area. The Progress out of Poverty index (2015) that was designed for Bolivia was used to calculate the poverty of producer and non-producer households. The index utilizes ten social and asset factors to arrive at a score between 1 and 100. The lower the score the higher the likelihood that the household in question is poor. Scores for producer

households ranged from 16 to 73, and had a mean of 45.5. Scores for non-producer households ranged from 16 to 75, and had a mean of 51.9. The scores are useful in demonstrating the multidimensional nature of poverty in the region, and also show that it affects people regardless of livelihood activity.

Producers were also asked how they perceive their wealth before adopting aquaculture and how they perceive it today relative to others in their community. Non-producers were asked a similar question about how they perceive their economic situation relative to the community. The results are in table 5.10.

Table 5.10: Producer and non-producer perceptions of wealth relative to other community members

Group	Question	Mean	Median
Producers	Thinking about how much money you had before starting to farm fish, would you say that you were 1-a lot worse off, 2-a little worse off, 3-the same, 4-better off, or 5-a lot better off than the other people in your community?	2.58	3
Producers	Thinking about the money you have today, would you say that you are 1-a lot worse off, 2-a little worse off, 3-the same, 4-better off, or 5-a lot better off than other people in your community?	3.55	4
Non-producers	Thinking about the money you have today, would you say that you are 1-a lot worse off, 2-a little worse off, 3-the same, 4-better off, or 5-a lot better off than other people in your community?	2.85	3

Producers generally believed that their wealth had increased relative to other community members after adopting aquaculture. Producers also tended to believe that they were a little better off while non-producers tended to believe they were a little worse off. Producers were also asked about their economic situation before and after adopting aquaculture, and non-producers about their perception of their current economic situation. The results are in table 5.11.

Table 5.11: Producer and non-producer perceptions of personal economic condition

Group	Question	Mean	Median
Producers	Before you started to farm fish, would you have considered yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?	2.98	3
Producers	Today, do you consider yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?	3.75	4
Non-producers	Today, do you consider yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?	3.75	4

Producers perceive an improvement in their economic situation since adopting aquaculture. Producers who perceived an improvement (24 in total) were then asked to what degree the change was due to fish farming. They chose from 1-not at all, 2-a little, or 3-a lot. The mean response was 2.3 and the median was 2, indicating that they attributed some of the improvement in their economic condition to aquaculture. Two further points are worth noting. First, not one producer respondent gave a response of “not at all”, most responses were “a little” with a few that said “a lot”. Second, although only 24 producers perceived an improvement in their economic condition over the period that they had been undertaking aquaculture, no respondent indicated that their economic condition declined over that period. As for non-producers, although they perceive themselves to be a little worse off than other people in their community, when asked about their current economic situation, they consider themselves to be at a similar level as aquaculture producers.

There is a perception amongst producers that aquaculture reduces poverty. This was supported by chain workers, who were asked if they thought fish farmers were very poor, poor, not so poor, well-off, or rich. The average of their responses was that they viewed fish farmers as being well-off. Aquaculture thus seems to act as a positive force for reducing poverty.

5.3.4 Worker Income and Poverty

Although there are a variety of jobs for workers in the CBAVC, few require formal training or a particularly unique skill set. Worker average education was between having finished primary school and having finished secondary school. By extension, they did not have very high incomes. Average monthly income was \$1,857 BOB (\$269 USD, or \$3,228 USD annually). This income is approximately 3.4 times the national poverty line for rural people (\$2.65 USD/day) and 2.5 times the national poverty line for urban people (\$3.60 USD/day). It is approximately 4.7 times the new international poverty line of \$1.90 USD/day. While this employment provides income above poverty lines, it would quickly become a poverty wage if it were needed to support other people in the household. This is not common as many workers are single and childless, or are married to someone who also has an income. But there are nonetheless those who do not fall into one of these two groups, and for them it would be difficult to support their household with a job in the aquaculture chain.

The average number of hours workers work per week was 60, and ranged from 12 to 98. This meant that hourly rates of pay ranged from \$1.80 BOB to \$25 BOB (\$0.26 – \$3.60 USD) and averaged \$8.60 BOB (\$1.25 per hour). However, the standard deviation was only 5.4, indicating that both the high and low scores were outliers. Regardless of work type, the pay is quite uniform. The only positions that may pay more are supervisory positions in feed and fingerling businesses (two workers interviewed there made \$8-10 BOB more than the sample average) where some degree of skill and experience is required. Some workers receive perks such as a place to stay (5) and meals (12). These are most common for restaurant workers and fulltime aquaculture labourers. Most full-time workers are paid on a monthly basis while temporary workers such as harvesters and transporters are paid by day or by trip respectively.

The length of time that chain worker respondents had been at their job ranged from only a month to, in one case, 20 years, with the mean at 5 years. Three of the workers had a second, part-time job. Seventeen had other sources of income

for their household, usually from their spouse. Workers' employment previous to working in the CBAVC was quite varied, but was almost always something similar to what they do now. For example, market workers usually worked at the market previously but simply sold fruit or another commodity instead of fish, and aquaculture production labourers had typically been agriculture production labourers previously.

Workers were asked about how they perceive the money they make relative to their previous job. They were asked if it was 1-a lot less, 2-a little less, 3-the same, 4-a little more, or 5-a lot more. The average was 3.4 and the median was 4, indicating that it is between being about the same and a little better. They were then asked about the overall quality of the job relative to their previous job, with options of 1-a lot worse, 2-a little worse, 3-the same, 4-a little better, or 5-a lot better. Here the responses were similar with a mean of 3.4 and a median of 4. Workers were also asked about their economic condition relative to community members, and as compared to before and after working in the CBAVC. The results are in table 5.12.

Table 5.12: Workers perceptions of their economic condition

Questions	Mean	Median
Thinking about the money you have today, would you say that you are 1-a lot worse off, 2-a little worse off, 3-the same, 4-better off, or 5-a lot better off than other people in your community?	3.08	3
Before you began this job, did you consider yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?	3.72	4
Today, do you consider yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?	3.85	4

The results indicate that working in the CBAVC is viewed positively, but only slightly. The conclusion is that jobs in the CBAVC are similar to other agriculture chain jobs. Thus, the aquaculture system generates employment and in this sense has a positive effect on poverty if people who could not otherwise find work are taking positions. However, the nature of the work, although not laborious, is very

time consuming and not terribly lucrative. Therefore its impact on poverty is only modest.

5.3.5 Finance and Aquaculture Production

Producers were asked if they had taken out loans for their aquaculture operations. Eleven producers obtained one loan for their aquaculture operation, and three obtained two separate loans, for a total of fourteen producers having obtained seventeen loans for aquaculture. Other producers mentioned having received loans for other agriculture activities but these were not recorded, as they did not pertain to aquaculture specifically. Producers were asked if the money they received for aquaculture was a grant, gift or loan that they obtained and all said that the money they received was a loan, none mentioned obtaining a grant or a gift. The average loan size was \$8,593 USD and ranged from \$3,478 USD to \$20,290 USD²⁶. Despite some variation in loan size, ten of the seventeen loans granted were for either \$8,696 USD or \$9,420 USD (60 or 65 thousand Bolivianos). Loans were usually used for aquaculture operations in general, which included tank construction, buying fingerlings and feed, and other incidental costs (one producer mentioned purchasing a pump). Four producers mentioned that although they obtained the loan primarily for aquaculture, some of the loan went to support other livelihood activities. This indicates that the loans were likely generic agricultural or personal loans rather than loans explicitly designed for aquaculture activities. This is supported by the fact that eight of the loans were given by commercial banks and the other nine were given by the large development bank BDP (Banco de Desarrollo Productivo – Productive Development Bank). BDP’s mission is to “Support the productive development of the country through the granting of financial and non-financial services to increase and improve production, income, and employment of productive actors, while seeking productive diversification, food security with food sovereignty and value added, (BDP, 2017).” For this reason they

²⁶ Loans are granted in Bolivianos and in that form are given out in round numbers.

receive favour from many agricultural producers, which is perpetuated by their tendency to have lower interest rates. The average interest rate on loans from BDP was 8%, much lower than the average from commercial banks, which was 12.4% (the mean of interest rates from all loans was 10%). BDP is also more reliably lower, with the lowest rate charged having been 6% and the highest rate having been 9% whereas commercial bank rates started at 9% and went as high as 18% (the median was 11%).

5.3.6 Aquaculture Producer Marketing

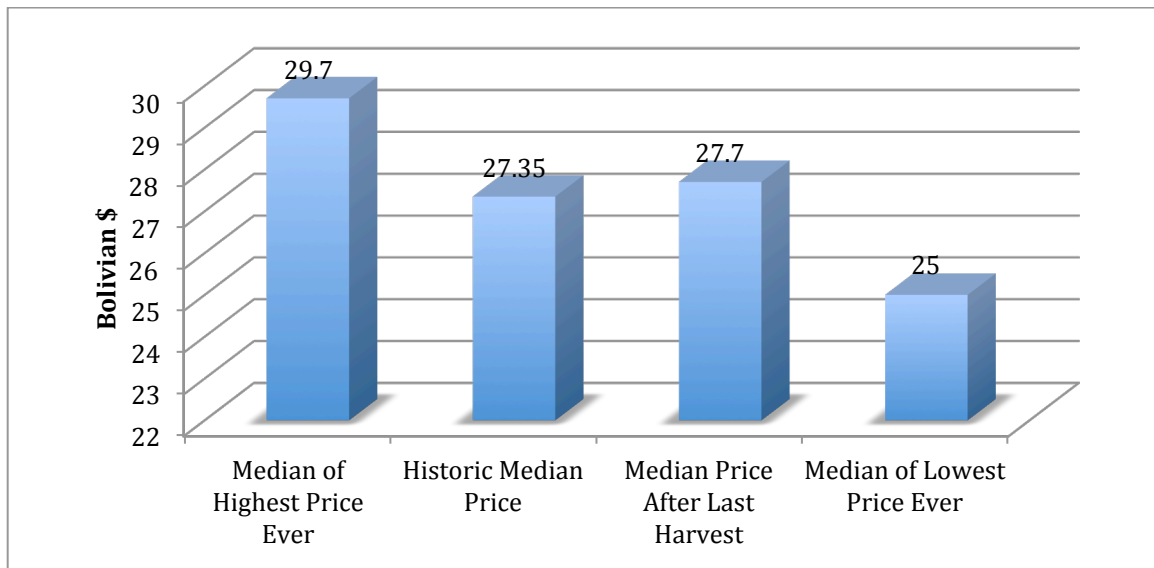
The marketing aspect of aquaculture production is important as it presents a key point at which producers can maximize their incomes and therefore contribute to increasing the wellbeing of the people in their household. It also is an important point in the CBAVC as it reveals some of the power dynamics that govern the chain.

Producers averaged almost three (2.95) buyers each last cycle, with the lowest having only one buyer (one producer) and the highest having six buyers (also only one producer had this). Almost three quarters of producers arrange fish sales through a combination of phone and in-person interaction, which points to phones as a technology with exploitable potential, as has been the case in Africa (Aker & Mbiti, 2010) and Southeast Asia (Labonne & Chase, 2009). The other typical way that fish sales are made is through the buyer coming to the producer's pond to make a purchase (seven cases). Only two producers exclusively go to their buyers, and one producer incorporates email into his sales negotiations. The buyer and seller reach a price through negotiation 31 times out of 40, with the other nine either simply going along with the purchasers price, or following a price that has been set by the local association. Almost half (19) of producers are aided in their negotiation by knowledge of what other producers in the region are getting for their fish. This is predominantly gained through communication with fellow fish farmers, either over the phone or in person, and occasionally through asking at markets or restaurants. The fact that over half of producers do not know what others receive

for their fish points to the need for an improved system of information dissemination amongst producers.

Despite the gaps in price knowledge and the various forms through which negotiation occurs, fish prices have been remarkably stable. Producers were asked what the highest and lowest prices that they had ever received for their fish had been. Twenty-six said that \$30 BOB (\$4.35 USD) per fish was the highest and only four claimed a higher rate. This indicates a potential ceiling to the price of fish. On the low end there was a little more variation, with prices ranging from \$20 BOB to \$29 BOB, but averaging out at \$25 BOB (for comparison sake, the standard deviation was \$1.88 BOB for the high price and \$2.33 for the low price). Figure 5.14 below shows the historical prices as well as most recent price. The historic median price in the graph is calculated as the median of the high and low price, and therefore does not reflect the volumes of fish that were sold at different prices.

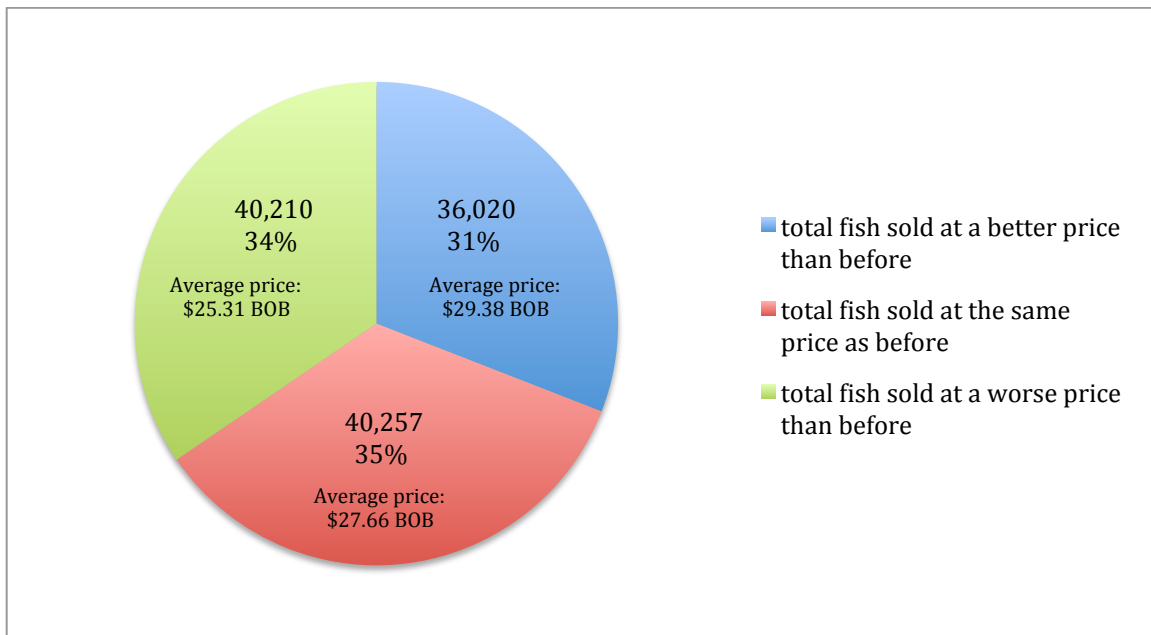
Figure 5.14: Historic and current average farm gate fish prices



To shed more light on the historical nature of prices and how they compare to prices received during last harvest, producers were asked if each price for each batch of fish they sold was higher, lower, or the same as the price that they received the previous time they sold fish to that buyer. Figure 5.15 shows how farmers

perceived the recent harvest prices as compared to previously received prices from the same buyer. It also shows the quantity of fish, as well as the average price, that was sold for a worse, same, or better price.

Figure 5.15: Aquaculturist perceptions of prices received during last harvest

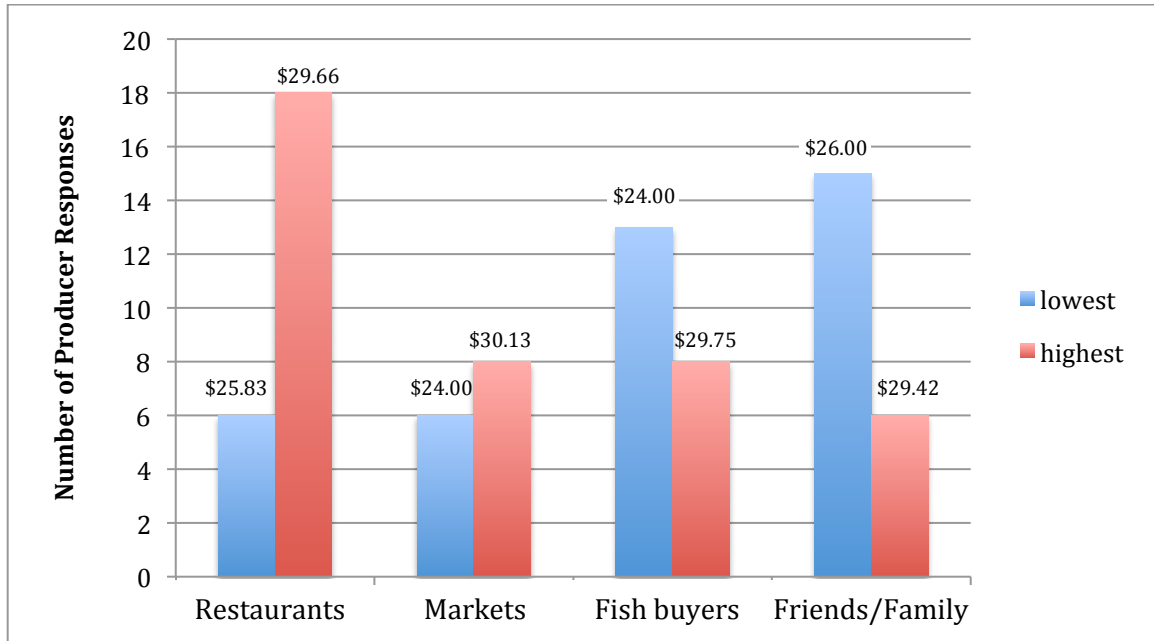


Perceptions of prices received during last harvest are nearly evenly split, although perceptions of higher prices were a little lower than same or lower prices. As the average prices show, the price of fish does not vary much, fluctuating only by about +/- \$2 BOB from the mean. However, higher and lower prices are possible. The highest price a producer received last harvest was \$35 BOB and the lowest was \$20 BOB, a variation of about +/- \$7 BOB from the mean, but such price extremes are rare. Overall, producers were asked if they were satisfied with the price they get for their fish and 27 said that they were while 13 said that they were not.

The sources of high and low prices are important to know as it may inform marketing strategies. Sources were divided into four groups; restaurants, markets, fish buyers (middlemen), and friends/family. Figure 5.16 shows which group tended to be the buyers at high and low prices, as well as what the average of those

prices were. This is based on the stated highest and lowest prices ever received, not the most recent harvest.

Figure 5.16: Sources of historical high and low prices, and their averages (in \$BOB)



The buyers that historically offered the highest prices most frequently that producers had ever received were restaurants. Eighteen producers said this and the average price they received was \$29.66 BOB. On the other end of the spectrum, the most frequent buyer at a low price was friends and family. Fifteen producers experienced their lowest prices ever selling to them, and the average of that price was \$26 BOB. Although restaurants and friends/family were the most frequent purchasers at high and low prices respectively, the average highest and lowest prices overall were paid by markets in both instances (tied with fish buyers for lowest). The likely reason that restaurants are most often cited as the place where producers obtained their highest prices ever is that they have the highest margin of any retailer and occasionally have a high demand for fish. Friends and family are the most frequent low payers because producers tend to give discounts to that group for obvious customary and social reasons. Markets have given both the

highest and lowest overall likely because they are the purest manifestation of consumer demand, which can go high during festivals and holidays, but can go low during times when there is little interest in eating fish.

Data was also collected on the buyers of fish during the most recent production cycle. Table 5.13 below shows the quantity of fish sold, how much went to each type of buyer, and the average price they paid. It also shows how many separate sales were made to each type of buyer.

Table 5.13: Latest production cycle sales data

Buyer group	Mean price (\$BOB)	Mean volume (# of fish)	Total volume (# of fish)	Total # of sales
Restaurants	28.13	1,436	77,560	54
Markets	26.07	701	9,820	14
Fish Buyers	26.37	870	2,6970	31
Friends/family	26.16	112	2,137	19
Total			116,487	118

Restaurants are clearly the best outlets for producers looking to sell their fish. On average they pay the most, buy the most, buy the most often, and place the largest orders. The second best outlets in all categories are fish buyers, and markets and friends and family were the least lucrative. From a food system development perspective, it seems that supporting the development of fish restaurants would generate the best financial returns for farmers.

Fish farmers were also asked if these buyers that they had sold to the last harvest were the same or different than the buyers they had sold to in the past. Every single producer said that they were the same, pointing to challenges with market expansion and questionable resiliency to economic shocks.

As another proxy for marketing flexibility and adaptability amongst producers, they were asked if there were any retailers that they would like to sell their fish to but do not. Only six producers identified such a buyer, which included a university, two markets, two restaurants, and a commercial urban retailer. The

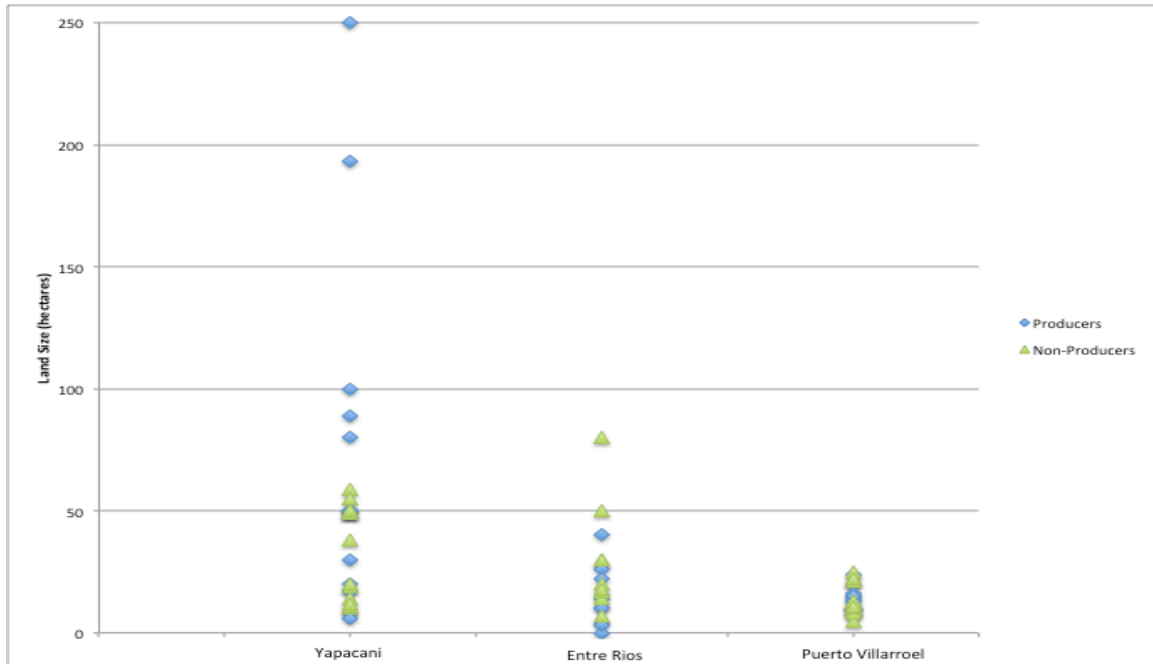
reasons they did not sell to these buyers included prices being too low for one restaurant, food health and safety standards not attainable for the commercial urban retailer, and a general lack of organization and capacity for the others.

5.3.7 Land

Most plots of land held by farmers in the study region do not exceed 80 hectares. Their size depends on how land distribution was carried out in the past in different communities. Sizes were typically based on a number of factors such as topography, vegetation density, and what agricultural activity it would likely be used for. In the less densely forested area of Yapacani, where it is relatively flat and more conducive to monoculture cereal farming, plots of land tend to be relatively larger. This is also the case in a large portion of Entre Rios. However, in the municipality of Puerto Villarroel, which is hillier, more remote, and much more densely forested, plots of land are smaller on average. It is here where farmers tend to focus more on products with higher value to weight ratios such as pineapple, citrus, and coca. The more tropical weather of the area (warmer and more precipitation) is also more conducive to these activities.

For producers, all the land they own has official titles and is held privately. Most (32) own only one parcel of land, with the most parcels that one producer owns being 5. Average parcel size is 26.6 hectares and people who have a lot of land achieve this by purchasing whole parcels and adding them to their total. The size of producer's total land holdings ranges from 3 hectares to 250 hectares. In the case of the person with 250 hectares, he also claims 5 parcels, which likely means that he is counting the land of his extended family rather than his personal household. The mean amount of land owned is 35.5 hectares while the median is 15 hectares. Figure 5.17 shows the distribution of producers across the three target municipalities and the total size of their land holdings.

Figure 5.17: Producer and non-producer land sizes and municipal location



All non-aquaculture producers have privately owned land. Parcels range from 5 to 80 hectares, with a mean of 25.3 and median of 18.5 hectares. Non-producers were not explicitly asked how many parcels of land they had, but rather their total overall. Based on the highest total being only 80 hectares, it is unlikely that any non-producers have more than one parcel (with the possible exception of the 80 hectare owner who may have two parcels). Figure 5.17 above shows the distribution of land size of non-producers across the three municipalities.

Chain workers were also asked if they or their immediate family own land, but not about the number of parcels or hectares. The purpose was to determine if they could potentially produce aquaculture themselves or take on agricultural activities. Only 3 of 26 chain workers said that they or their family owned land. Most live in an urban area such as a regional town (54%) or city (35%). Only 3 (11%) live rurally.

5.3.8 Return on Investment

The return on investment (ROI) is calculated for surveyed producers. The formula is:

$$ROI = \frac{\textit{investment gain} - \textit{cost of investment}}{\textit{cost of investment}} \times 100$$

This is calculated by finding the gross income from the most recent harvest and deducting the cost of feed, fingerlings, and pond construction for all ponds used during last harvest. This is then divided by the sum of those three costs. The ROI is calculated for each survey respondent individually, and then the median ROI is calculated for the group. The median is used because there are numerous outliers (the year 1 ROI mean is 79% but the median is 60%). For the ROIs of year two, three, and so forth, the same calculation as above is used, but investment gain, cost of fingerlings, and cost of feed are all multiplied according to how many years are in question (2 for year 2, 3 for year 3, etc.). Cost of pond construction is kept constant, as it is a one-time cost. Figure 5.18 below plots the median stated ROI of surveyed participants over a five-year span assuming all ponds are stocked every year (ROI1). The second ROI replaces the stated pond construction costs with a standard \$3000 USD pond construction cost and assumes all ponds are stocked every year (ROI2). Pond construction was subsidized in some form for many producers, and is the most volatile variable. It ranges from \$0.43 USD to \$2.32 USD per m², a range of 540%. In-country experts and key-informants suggested that a typical price for pond construction that is not subsidized is \$3000 USD for a 2000 m² pond (\$1.5 USD per m²). The third ROI line in the graph incorporates the cost of 1/3 of pond area sitting idle and uses pond construction costs stated by respondents (ROI3). Most producers with multiple ponds will usually not stock them all each cycle. During the last cycle, only 66% of available ponds were stocked, hence the decision to model the assumption of 1/3 sitting idle. This ROI represents a more realistic scenario in which a producer has three ponds and stocks two per production cycle. The fourth

ROI line incorporates both the standardized pond construction cost and the 1/3 of pond space sitting idle (ROI4). This model is useful for understanding what a new entrant into aquaculture who does not receive start-up assistance and manages his/her ponds in a typical fashion can expect for an ROI.

Figure 5.18: Median ROI of aquaculture under various conditions

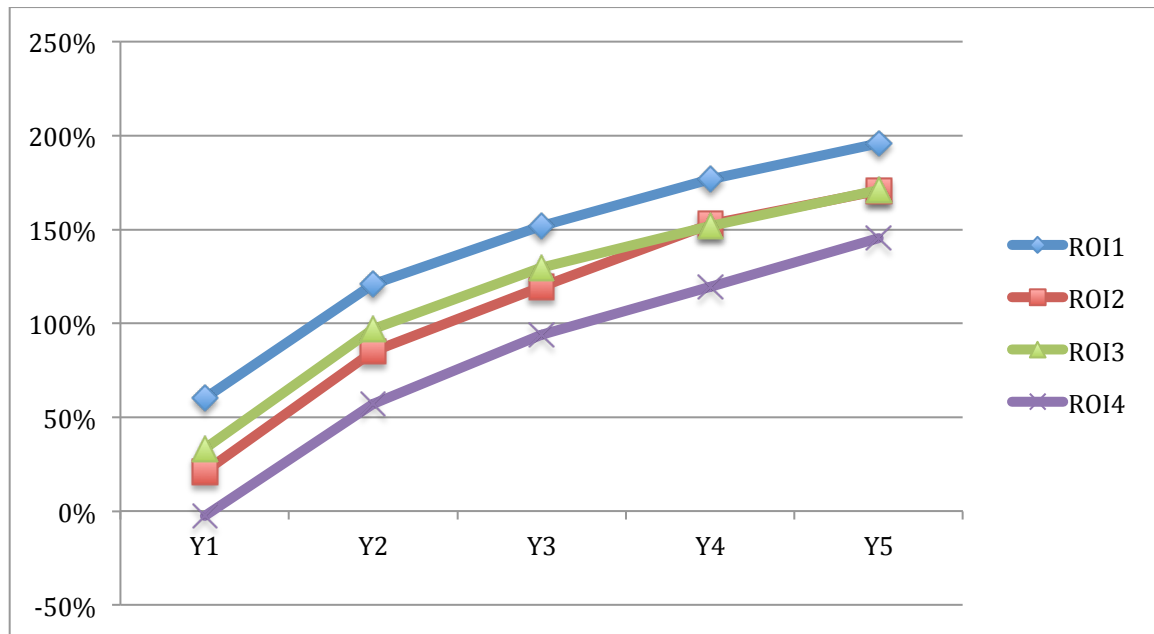


Figure 5.18 indicates that producers will experience slowing growth of returns over time. This is due to the one time cost of pond construction diminishing over time. However, despite this, the ROI forecast will perpetually yield positive returns if all factors remain constant.

This model does not factor in labour costs, but this is usually represented as time put in by household members, which is quite minimal relative to other agricultural activities. Nonetheless it should be considered, as should any formal employees, especially as an operation expands and requires more labour. Both of these factors would reduce the ROI a small amount. The model also does not include infrequent costs such as, for example, fish and pond health and sanitation inputs, but they are small in comparison to feed and fingerling costs. Both of these factors would have a negative effect on the ROI projection, albeit a modest one. The

other factor that is not accounted for in this model and that could have a significant negative impact on the ROI is land cost. If land is purchased specifically for aquaculture then such a large cost would significantly lower aquaculture's ROI. Adding the cost of land to the model is quite difficult since land values would vary significantly by region and obtaining values is a challenge because sales happen infrequently and most often within families. However, not incorporating land value into the model does not have much of a distorting effect since most producers build aquaculture ponds on land that they already own.

One factor that could push the ROI higher is operational improvements and efficiencies. The ROI is calculated using mean net income per m² (\$2.06 USD), but deviation from the mean is somewhat high. Eight producers manage to make more than \$2.90 USD per m², nearly 30% more than the mean. This indicates that there is significant room for production improvements that would drive the ROI higher. Overall, the ROI points to an economic investment that will provide sustainable returns over the long-term.

5.3.9 Aquaculture Income Compared to Other Agricultural Activities

Aquaculture in the study area is an economically appealing livelihood activity. The income per unit it generates exceeds that of other agriculture activities, with the one exception of coca (table 5.14). However, due to legal restrictions coca production is limited to only two small regions of Bolivia, and is illegal in most other countries, making it a non-starter for most Bolivian small-scale farmers outside of the coca region, and almost all small-scale farmers outside of Bolivia. Furthermore, the area that a household can plant with coca is capped, precluding the achievement of any economies of scale. This makes coca profitable only to a certain point; once a volume threshold of fish is surpassed, fish becomes more profitable in real terms.

Table 5.14: Farm sale prices of agricultural commodities in Bolivia.

Agricultural commodity	Price/kg (BOB)
<i>Aquaculture Fish</i>	<i>\$30.00</i>
Coca	\$35.00
Cattle	\$17.00
Milk	\$3.30
Rice	\$1.70
Pineapple	\$3.00

Source: Prices were derived from values stated by research respondents

A further advantage of aquaculture is that its ratio of income to land requirement is much higher compared to most other agricultural products. A standard 100m x 20m pond stocked with 2000 fish can reliably yield \$27.5BOB per m². By contrast, one m² of rice generates \$0.78BOB: 4600kg per ha multiplied by \$1.70BOB (average farm gate price from respondents) (FAOSTAT, 2017). One m² of pineapple generates \$7.5BOB: 25,000kg per ha multiplied by \$3BOB (average farm gate price from respondents) (Agri Knowledge Centre, 2012).

5.4 Food Security

As outlined earlier, Bolivia is the most food insecure country in South America. Although somewhat counterintuitive, rural people tend to be disproportionately affected by this problem. The reasons for this are complex and are affected by numerous factors that include the evolving economics of agriculture, access to land and other agricultural inputs, changing diets, and household income. This section outlines the food security of actor groups in the CBAVC.

5.4.1 Household Food Security

An assessment tool developed by the FAO specifically for Latin America called Escala Latinoamericana y Caribeña de Seguridad Alimentaria (ELCSA, 2012)

was used to determine the degree of food insecurity amongst research participant households. The results are in table 5.15.

Table 5.15: ELCSA results of different interviewed groups.

Category	AQ Producers	Non Producers	Chain Workers
Average degree of food insecurity	1.08	1.43	1.00
Percentage who are food insecure	78%	88%	88%
Percentage who are severely food insecure	10%	18%	12%

The definitions of mild, moderate and severe food insecurity are as follows. Mild food insecurity is from when there is anxiety and concern about food supplies up to when adjustments are made in the household budget that affect the quality of diet. Moderate food insecurity is from when adjustments are made in the household budget that affect the quality of diet up to when adults limit the quality and quantity of food they consume. Severe food insecurity is from when adults limit the quality and quantity of food they consume up to when the quality and quantity of food consumed by children is also affected. A score of 0 indicates a household is food secure. A score of 1-3 for adult only households or 1-5 if there are children in the household indicates mild food insecurity. A score of 4-6 for adult only or 6-10 for households with kids indicates moderate food insecurity. A score of 7-8 (no kids) or 11-15 (with kids) indicates severe food insecurity. The different score ranges reflect the extra questions that are added that ask specifically about children in the household.

A large majority of households from each group is at least mildly food insecure. However, non-producers tend to have higher rates of food insecurity and are more often severely food insecure than aquaculture producers. This points to aquaculture having a modest but positive effect on household food security.

Workers have a similar degree of severity of food insecurity as producers, but are food insecure more frequently. It should be noted that many workers can have different livelihood and living characteristics than people in the other two groups. Some are urban (urban market workers), some are single, and some receive room and board as a perk of employment (many restaurant workers and pond labourers). Most of these factors would favour less food insecurity, so it is interesting that they have a comparably similar severity and frequency of food insecurity as the other two groups. It likely points to the limited income that can be obtained from working in the CBAVC.

5.4.2 Dietary Diversity

The FAO's *Guidelines for Measuring Household and Individual Dietary Diversity* (2011) was used to determine the nutrition of participants as well as their access to a diverse diet. Households across producers, non-producers, and chain workers had almost identical levels of dietary diversity. The dietary diversity of women was also calculated and was similar across all three groups but was higher amongst non-producers. The reason for this is not known. The results are in table 5.16.

Table 5.16: Dietary diversity of research participants

Category	AQ Producers	Non Producers	Chain Workers
Average Household DDS (out of 12)	7.7 (64%)	7.6 (63%)	7.5 (63%)
Women's DDS (out of 9)	5.0 (56%)	5.6 (62%)	5.0 (56%)

5.4.3 Fish Consumption

Fish is considered to be a nutritious source of protein and a positive contributor to well-balanced diets. Although its nutritional value varies according to species and which part of the fish is consumed, most fish are generally considered nutritious and beneficial to diets. The nutritional value of Tambaqui and Pacu has

not explicitly been analyzed, but it is reasonable to infer from analyses of similar species of fish that their nutritional value is consistent with other fresh water fish.

Aquaculturists, non-producers, and workers were all asked if they had consumed fish the day before their interview. Fifteen (38%) producers said they had, but only five (13%) non-producers and five workers (19%) said they had. This is in keeping with research from around the world that has shown that aquaculture producers tend to eat more fish than others in their communities (Bene *et al.*, 2016). What is somewhat interesting is that workers do not have a higher percentage of consumption despite many working in close proximity to fish. The likely explanation is that despite working with fish, they still usually need to acquire it through purchase, and it is relatively more expensive than other meats, particularly chicken.

Aquaculture producers were also asked how much of the fish that they produce is consumed at home. The total number of fish from last harvest that was consumed by all producers was 10,485. The total number of fish that an individual household consumed ranged from 30 to 1500, and averaged 270. The median was 145. All fish producing households consumed some of their produced fish, and for many it constitutes an important component of their diets.

5.5 Social Sustainability

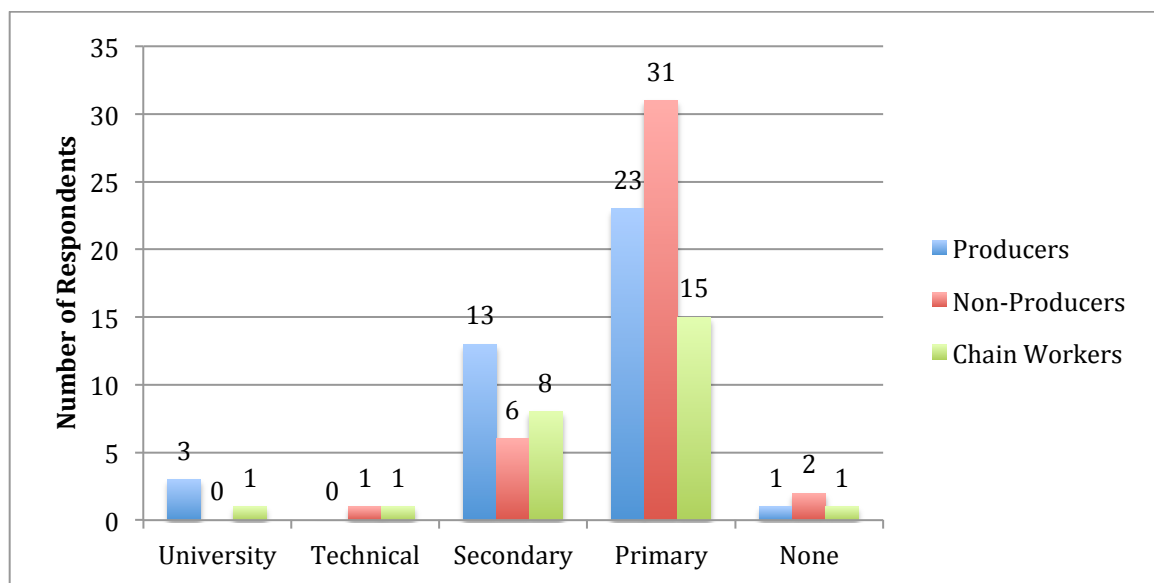
An important component of a sustainable food system is that it is socially sustainable. Education levels were asked of research participants as a proxy for social development and to determine aquaculture's effect. Women's roles in the aquaculture system were also investigated, as they tend to be a relatively marginalized group.

5.5.1 Education

Educational attainment is often associated with more profitable, stable, and capable livelihoods (Lawrence & Tate, 1997). Most respondents, regardless of

surveyed group, did not have an education that went beyond primary school. In a comparison of producers and non-producers, on average producers had a higher level of formal education (figure 5.19). The average level of education amongst workers was lower than that of producers but higher than that of non-producers. It was still only halfway between having a primary education and a secondary education. Further, the numbers are likely affected by the fact that workers were the youngest surveyed group on average, and therefore several of the younger respondents would have benefited from recent improvements in the Bolivian education system, which has raised educational requirements from primary to secondary school.

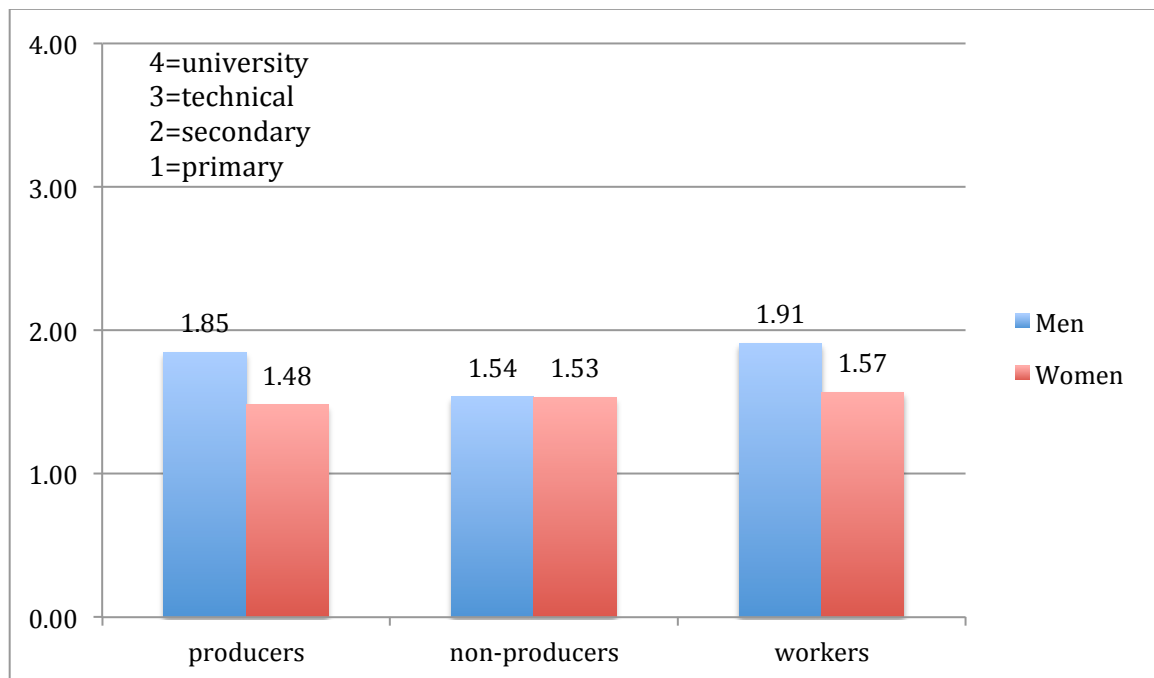
Figure 5.19: Frequency of educational attainment amongst respondents



Education levels of the children of respondents were more positive. All school age children (6-17 years) of non-producers were in the appropriate grade for their age and 50 out of 51 children in producer households were in the appropriate grade. Education rates of children in chain worker households were a little lower, only 26 out of 31 were in the appropriate grade for their age. The likely explanation is that workers are more often poor, particularly workers who have children.

The educational attainment of adult women (18 years and over) tended to be lower than that of adult men in surveyed households with the exception of non-producer households (figure 5.20). The reason for this is unclear. Interestingly worker households tend to be better educated on average for both men and women compared to the other two groups. This is likely a factor of living rural versus living urban. Some workers live in urban areas and therefore have better access to education.

Figure 5.20: Education levels of adult men and women in interviewed households



5.5.2 Women’s Roles and Participation

As an indicator of women’s leadership and decision-making in the aquaculture system, producer respondents were asked who in their household had made the decision to start farming fish. In ten households it was the patriarch, in seven households it was the matriarch, and in twenty-three households it was both equally. Therefore, in three quarters of respondent households the head woman

either led or was equally involved in the decision to adopt aquaculture into the household's livelihood portfolio.

Producer respondents were also asked about who was responsible for the various activities associated with fish farming. The results are presented in table 5.17.

Table 5.17: Gender of people responsible for aquaculture production tasks

Category	Pond construction	Fingerling procurement	Feeding	Pond Maintenance	Monitoring Fish Growth	Harvesting	Processing	Marketing	Record Keeping
Led solely by a woman	13%	13%	23%	8%	15%	3%	3%	20%	47%
Led solely by a man	18%	40%	35%	70%	58%	15%	18%	23%	42%
A woman is a leader in partnership with another person	70%	45%	43%	23%	28%	83%	80%	58%	11%
Percentage with a woman in a leadership position	83%	58%	65%	30%	43%	85%	83%	78%	58%

The above table shows the tasks where a man, a woman, or a woman and a man equally, undertake leadership. The tasks where a woman is solely responsible with the highest frequency are feeding (23%) and record keeping (47%). The reason that feeding is high relative to other activities is likely because for some households aquaculture is a livelihood that is the general responsibility of the matriarch. Feeding is the most common activity required to grow fish, and dovetails well with women's pre-existing household obligations. In the households where women are solely responsible for feeding fish this is likely the case. For those households that keep records (only 17), 47% of the time it is done solely by a woman and 42% of the time solely by a man. Record keeping is a task that, unlike most others, is difficult to share, hence the near even split. Nonetheless, women's leadership in this area demonstrates an interest in improving operations.

The tasks where a woman is frequently in a leadership role equally with a man include harvesting, processing, and pond construction. The first two are due to the nature of these activities. Everyone in the household and even neighbors, friends and hired workers, usually carries them out. This is because they require many hands and need to be carried out entirely in one day. The involvement in pond construction indicates that women are often involved in household livelihood decisions since pond construction represents the decision to start or expand aquaculture. The only activities where women are infrequently involved are pond maintenance and fish monitoring. The explanation for the lack of involvement in the former is likely that pond maintenance tends to be labour intensive and therefore traditionally carried out by men. In the latter, the reason is less clear, but may be that the activity requires entering the pond, something that men traditionally do and woman often prefer not to do.

Of all producer households interviewed, only three said that no woman undertook any tasks related to aquaculture. In all three cases the interviewee was a man and he did have a wife, and in one case an adult daughter, who could theoretically contribute. However, in one case the man's wife operated a store that likely kept her from contributing to aquaculture. Other women amongst producer

households also worked off-farm. Four tended shops along with their husbands, and two (including the one mentioned above) did so independently.

Aquaculture businesses tend to be dominated by men. Five owners of input companies were interviewed for this research, four were men and the fifth was a woman who was an equal partner with her husband in the business. The employees they hire also tend to be men: 36 employees were identified between the five companies and all of them were men. This is somewhat explained by most of the jobs in supply companies being relatively labour intensive such as carrying feed, operating heavy machinery, and various other outdoor labour intensive tasks.

Positions of leadership in the CBAVC also tend to be male dominated, but not entirely. Four restaurant owners, four market managers, three association leaders, and one university professor were interviewed and of them, two market managers, one association leader, and one restaurant owner were women. It should be noted that women were not interviewed at two other restaurants but were clearly equals in the business.

The gender of workers was split, but tended towards women with 16 interviewed and 10 men interviewed. The gender of workers aligned almost perfectly with traditional conceptions of male and female work. All of the market and restaurant workers were women and all of the supply company labourers and production labourers were men. It seems that the CBAVC offers employment opportunities to women, but only in certain nodes.

5.6 Environmental Impact

The environmental impact of the CBAVC was investigated by interviewing chain actors about how their activities do and may effect the environment.

Particular attention was paid to production since that node in the chain is by far the most widespread and active.

5.6.1 Land Use Tradeoffs

Producers were asked what the land where their ponds are located was used for before the ponds were built. Twenty-three producers built their ponds on pastureland that had already been cleared. Eight used a small portion of their rice growing land to build their ponds. Five others used land that had previously been used to grow crops such as corn, coca, or pineapple. Five used land that was unused for anything previously and had been covered with shrubs. Only one producer said that they cut down mature forest to make land for their ponds.

While the land used for ponds could theoretically produce a larger volume of food if it was used for cereal production, the volume of food output to land use of fish is much higher than that of other livestock. Since the majority of land was altered from pastureland, this is actually an improvement in efficiency. A lot of land in the Puerto Villarroel and Entre Rios regions, because of its rockiness and unevenness, is not conducive to rice or other cereal production. In these areas fish production may actually be the most efficient activity for yielding large volumes of food from small areas of land.

5.6.2 Water

The water that is used to fill ponds comes from a river, rain, or a well, or some combination of the three. Twenty-six producers said that they fill their ponds only using rainwater. Three rely exclusively on pumping water from a nearby river or creek, and one draws his water from a well. Ten use a combination of methods, usually using both rainwater and pumping from a river. There is virtually no pressure on water resources exerted by aquaculture production in the central Bolivian aquaculture system.

Wastewater management in Bolivian aquaculture production is an issue that should be monitored but currently has a negligible environmental effect. The frequency with which producers drain their ponds varies considerably. Thirteen producers drain their ponds once a year, three do so every two years, two do so

every three years, two do so every four years, and nineteen have never drained their ponds. Many producers avoid draining their ponds because of the time it takes to re-fill them using rainwater, which can take 1 to 6 months, and averages around 3 months. Several mentioned that they also do not drain them because they see no reason to. The producers who do drain their fields predominantly use gas-powered pumps (19), and four have in-ground pipes that can also be opened to help with draining. When they drain their ponds, producers drain them onto a nearby field (14), into another pond (2), or into a nearby creek (4). More than half (21) of producers have their ponds located 100m or less from the nearest creek or river, and therefore dumping of wastewater into watersheds may become a larger issue as the system expands. Furthermore, they do not do any treatment to the water prior to draining it from the pond. However, there is little reason to do so as chemical inputs are rarely used and therefore the water for the most part only contains organic material. The inputs that are used are lime, which all producers use, and some added a few other things. Four add salt, eleven add dolomite, eight add stucco, two add cow manure, five add urea, and three add plaster as a pond liner.

Management of the mud that comes out of a pond when it is cleaned can also be an environmental issue, but it too is relatively benign in this case. Of the half of producers who drain their ponds, only ten remove the mud. In all cases they simply place it next to the ponds. The other producers either let it dry in the tank, or never drain the tank completely. One mentioned that the mud is a good fertilizer and spreads some on their grass.

5.6.3 Species

Most producers culture Tambaqui and Pacu to generate income, and a few also grow other species, primarily for home consumption. All of the species that producers grow in ponds are indigenous to the region, with the exception of the few who are growing carp. For this reason the escape of most species is a negligible problem. However, carp may prove problematic, especially if their production increases along with aquaculture in Bolivia generally. Tilapia is another commonly

cultured specie that is likely to be adopted in Bolivia as the sector expands and fish demand continues to rise. A few producers are already experimenting with tilapia, and although their production has not reached a point where they are regularly marketed, it is likely to happen soon. Efforts to either eliminate carp and tilapia production, or, more realistically, to educate producers on the risks of species escape, will be needed moving forward.

With respect to Tambaqui and Pacu, there is reason to review whether breeding programs may lead to their genetic divergence from wild stocks. However, this does not seem likely at this point. Fingerling producers acquire their brood stock from wild capture fisheries, and exchange them every few years. The fingerling supply companies will need to significantly increase the sophistication and size of their operations before genetic alteration is likely to occur.

5.6.4 Feed

Although feed producers were reluctant to give specific details of their feed formulas, they were willing to discuss the general ingredients. They indicated that feed for Tambaqui in Bolivia is typically composed of corn, beans, wheat, sorghum, soy, sunflower, and meat flour. The degree to which each component is produced sustainably is unknown, but is very likely typical to most cereal crop production methods in Bolivia. What is important to note is that the majority of the protein needed for the feed comes from soy. The little meat powder that is added is made from the by-products of beef processing. The result is that feed production does not rely heavily on input intensive protein products such as meat, and more importantly, aquaculture in central Bolivia does not rely on fisheries to produce feed inputs.

5.7 Alternative Food Systems

Alternative food systems are receiving increasing academic attention as pathways towards more equitable and sustainable food systems. Actors in the

CBAVC do not explicitly self-identify as architects of alternative food systems, or even give much thought to building a system that directly address broader food system problems. However, their activities nonetheless shed light on how such a system could be employed to improve food systems. It is also worth noting that while CBAVC actors do not concern themselves with broad issues associated with food systems, they do regularly seek to address local problems such as poverty, food insecurity, and governance, which are proxies for the larger food system problems. The following two sections discuss how the CBAVC actors are associated to, or not, alternative food systems.

5.7.1 Locality and the Aquaculture System

The CBAVC is highly localized around the production region. As outlined earlier, the mean distance fish travel from producer to retailer is 55km, but two outliers of 209km and 250km skew this higher. The median is therefore only 30km. This is further remarkable once one considers how remote many producers are. For the majority, fish is taken to one of the closest markets or restaurants available to them. For the few exceptions that travel longer distances, they are usually to take fish to a city. But even in those circumstances, the urban retailers they sell too are in the closest cities.

Other actors in the CBAVC tend to be physically located in proximity to the production region as well. Restaurants, markets, and input suppliers tend to be located in smaller villages and towns that are the hubs in the region. Geographic specialization has allowed multiple businesses to emerge rather than one dominant one. One exception is the feed and fingerling company Vallacito, which is located in Santa Cruz, but they have moved to localize their distribution, particularly of feed, by setting up retail outlets or distributors. Some of the distributors are in the remote villages where feed is made readily available to remote farmers. They have also invested in fingerling transport equipment that allows them to provide high quality fingerlings to dispersed farmers.

Consumers are also generally local. Markets cater predominantly to local consumers, as they are the primary food source for locals but do not attract shoppers from afar. Restaurants too tend to serve local consumers, but two restaurants are located on major highways and therefore also attract a number of travellers. This has been good for developing the local food system, but as production expands so will the consumer base need to expand. The current situation shows the need for such expansion to occur both amongst local consumers, who still have low frequency and quantity of fish consumption, especially relative to other meats, and urban consumers. Nearby cities of Santa Cruz and Cochabamba represent important opportunities for growth without over extending capacity of the local food system.

5.7.2 Food Sovereignty

Each group of actors interviewed during this research were asked about food sovereignty. In the first instance, they were asked if they were at all familiar with the term. Fourteen producers (35%), five non-producers (12.5%), and three workers (11.5%) said that they were. They were then asked about their perception of food sovereignty. On average, producers viewed it as somewhat positive, with none having a negative opinion. Non-producers averaged a view of 3.6, slightly above the midway point between neutral and somewhat positive, and they too had no negative perceptions. Workers averaged a somewhat positive view of food sovereignty, and also had no negative views. All respondents from all three groups, with the exception of two producers, indicated that to them, food sovereignty meant homegrown food. One producer said that it meant environmentally sensitive food production, and the other said it meant a variety of food for her children.

The people who indicated they knew the term food sovereignty were also asked if they thought fish farming in their region contributed to Bolivian food sovereignty. Twelve of the fourteen producers said it did, with two saying it didn't. Four of the five non-producers said it did, with the fifth saying that he didn't know. All three workers said that it did.

Key informants were also asked about food sovereignty. In some cases it was clear that the respondent was not familiar with the term. These tended to be market and association leaders who are usually farmers themselves. Those that did have some familiarity pointed to importance of food security and poverty reduction through helping farmers as the key element of the concept. They also tended to have a favorable view of it, but pointed out that it was often talked about by government representatives, but difficult to relate to specific actions. A point was also made that the message and meaning was often unclear. The example given was that there is confusion over at what scale food sovereignty should occur. For some people households should be food sovereign, that is they should have access to the elements needed to produce food, specifically land and water. Others discuss regional or national food sovereignty. The former is not well defined as it runs up against regional sociopolitical tensions, and the latter is often seen explicitly as the replacement of food imports, but little effort is made at the other elements of the concept such as environmental protection and social justice. The key informants who were familiar with this conundrum said that it generally led the concept to be somewhat hollow.

The key finding here is that in reality, there is very little knowledge about food sovereignty amongst CBAVC actors, and rural people in general. Although producers claimed to know what food sovereignty is at a higher rate than others, observation during interviews indicated that they tended to respond positively because they did not want to seem like they didn't know, rather than due to them actually knowing. Furthermore, they would also have heard of the term, but would show little evidence of knowing much about what it means. This is supported by the common, generally positive but tepid views of food sovereignty, which indicate that most do not hold any strong opinions of it, likely because they haven't given it much thought. The same could be said for respondents who answered in the affirmative from other groups. However, not all respondents who said they knew about food sovereignty had a superficial understanding. There were at least two respondents (both producers) who seemed to have a deeper grasp of food sovereignty, and seemed to have given it some thought. One was in favour, and outlined the concepts

benefit to rural producers and environmentalism. The other producer was a little more critical and cynical. He said that even though the government had started to use the term, and the concept had merit, it had not really led to any change.

5.8 Summary

This chapter presented an analysis of the data from the investigation of the CBAVC. The first section outlined the functioning, as well as the opportunities and barriers associated with the central Bolivian aquaculture value chain. The second section presented information on the aquaculture production and emphasized pathways to improvements. The third, fourth, and fifth sections outlined the effects of the CBAVC on the economy, society, and environment. The last section presented information on how the CBAVC related to concepts of alternative food systems. Overall the study showed that the CBAVC generates social and economic benefits to participants, is environmentally sustainable, and can provide lessons for food system development in other contexts.

In the following chapter the broader implications of the findings are discussed. Specifically, insights into how the CBAVC and other aquaculture systems can be more productive and sustainable. It also outlines how various actors can instigate these improvements.

Chapter 6: Discussion and Recommendations

This chapter discusses the implications and insights derived from the study. The first section presents recommendations for improving the Central Bolivian Aquaculture Value Chain (CBAVC). Section two discusses the relationship between the CBAVC and dimensions of poverty reduction, and makes recommendations for bolstering the relationship. Section three discusses a new framework for undertaking food system based rural development and outlines how a focus on small-scale farmers and their relationship with their local food system is appropriate for development interventions.

6.1 Optimizing the Central Bolivian Aquaculture Value Chain (CBAVC) for Inclusive Growth

This section details the actions and policies that CBAVC stakeholders could implement to drive sustainable and inclusive growth. The focus is on how to do so while also generating social benefit. This primarily means improvements for producers and workers, but also input and retail businesses as well.

6.1.1 Governmental Engagement and Coordination

At the national level, an organization called Institucion Publica Desconcentrada de Pesca y Acuicultura (Decentralized Public Institution of Fisheries and Aquaculture or IPD PACU) was formed under the Ministry of Rural Development and Land (MDRyT) in 2014 by decree of President Evo Morales to support the development of the fisheries and aquaculture sectors, and, to promote the consumption of fish (IPD PACU, 2014; 2015; 2016). It has begun a number of projects and activities related to aquaculture, and has plans for many more. At the time of this writing, however, the agency is undergoing a degree of re-organization, and is not currently active in any substantial way (pers. com., 2017).

The other national level organization that affects aquaculture is SENESAG (Servicio Nacional de Sanidad Agropecuaria e Inocuidad Alimentaria - National Service of Agricultural Health and Food Safety). Like IPD PACU, it also falls under the Ministry of Rural Development and Land but, unlike IPD PACU, it is well established and functional. Despite this it has only very recently taken an interest in aquaculture, establishing the “National Area of Aquaculture” in August of 2015 (SENESAG, 2016). Its mandate is to ensure that fish products, regardless of source, comply with environmental and health regulations. In practice this has had some effect on the CBAVC, and its influence and oversight is likely to increase in the future.

In 2017 the national government of Bolivia passed the law of sustainable fisheries and aquaculture that laid out the framework for the government’s involvement in the promotion and growth of these sectors (Ley No. 938). It empowers IPD PACU to prepare development plans that ensure the sector yields benefits to small-scale producers while also being sustainable. During the last year SENESAG has also been focusing on fisheries and aquaculture. It has consulted stakeholders so as to refine fish health and consumer food safety regulations, thereby opening new domestic markets and expanding access to fish. Their goal is to devise a new set of standards and best practices that maintain fish health and food safety but that are also within small-scale producer’s capacity to meet. These activities demonstrate the national government’s growing interest in fish for food security and rural development.

The results and impacts remain to be seen. If SENESAG rules and regulations for formal food distribution networks are too cumbersome, either in a capital or technical sense, small-scale producers may face significant barriers to accessing larger and more distant markets, and the growth of the aquaculture system may be stunted. IPD PACU has yet to have much impact but, once it becomes functional, it could have a profound effect on the course of development of the CBAVC.

In many ways aquaculture in central Bolivia has operated in a legal vacuum and with minimal formal national governmental involvement. Despite the uncertainty that this occasionally generates, the aquaculture system has contributed

to social and economic development. The national government should therefore look to create an enabling environment. This includes clear and accessible regulatory frameworks where needed, as well as investment and technical expertise that is coordinated with lower levels of government, which are currently more prominent in the aquaculture system. Such an approach would be in keeping with the national government's trend towards decentralization.

At regional and local levels, formal governance is more hands on, but is also varied and inconsistent. As outlined in Chapter 3, departmental, provincial, municipal, and community governmental actors regularly engage in development activities, often with little coordination. Different organizations and associations specific to productive sectors and activities also often impose another layer of governance that can add further complexity. This multifaceted combination of formal and informal governance structures has been increasingly reinforced over recent years with the national government's juggling act of decentralizing power while also being reluctant to lose it. This has resulted in overlapping and unclear mandates, along with significant funds being handed down to various regional governments, and thus occasionally sparking intra and inter association and government tension over priorities and investments (Kennemore & Weeks, 2011; Schilling-Vacaflor, 2011; Tockman, 2016).

For aquaculture this has meant highly variable degrees of interest from decision-makers, which has yielded an inconsistent aquaculture landscape. For example, one community may have dozens of relatively successful aquaculture operations, a neighboring one may have a few small operations, and yet another nearby one will have none. Not only has the varied interest in adopting and developing aquaculture led to uneven distribution of funds, projects, and subsidies, but it has also led to variation in approaches, which can be rooted more in local politics than science and evidence. This has led to everything from community led aquaculture rather than private aquaculture being promoted, subsidized pond construction with improper equipment, and highly variable pond sizes. There have also been attempts by some local governments to construct and operate fingerling

hatcheries and feed mills. The lack of such sustained enterprises points to lost money rather than aquaculture sector growth.

Despite these problems, governments, particularly regional and local ones, occasionally make important tangible contributions to aquaculture growth. These primarily take the form of subsidies for pond construction or fingerling sourcing. Although these subsidies vary in size and type, and are administered inconsistently, they have been important drivers of aquaculture adoption and continuation. Subsidies therefore may be a useful tool for addressing barriers to aquaculture adoption, expansion, and technical improvement, and thus could be used as key drivers of system-wide development. What will be critical will be the effective identification of aquaculture system hurdles, and the subsequent identification of the subsidy and its form that helps to overcome those hurdles. For example, producers with small ponds may want to expand to larger ones so as to take advantage of their already acquired aquaculture knowledge, but are hindered by low income. A subsidy that targets those people and provides a properly sized and constructed pond would be beneficial. Another example would be subsidized training that presents best practices and the most effective techniques for day-to-day fish care to producers who experience low yields (a problem identified in this research). It would also be beneficial to standardize and formalize such subsidies to improve confidence from users and continuity and predictability in growth. Currently municipalities are the primary administrators of aquaculture subsidies and focus primarily on aiding production. It would be reasonable for them to continue to do so since they are small enough to be familiar with the sociocultural context but also large enough that they have a reasonable degree of administrative capacity.

The departmental government can also play an important role in developing aquaculture. In particular, their greater fiscal clout and availability of agricultural experts who are familiar with the local food system can provide an important compliment to municipal priority setting. It also enables them to engage with the aquaculture system more broadly. Their expertise is best focused on supporting the

aquaculture value chain rather than specifically farmers. Table 6.1 illustrates the recommended division of activities across scales of government.

Table 6.1: Recommended roles of governments

Governmental Scale	Priorities and Activities
National	Health, safety, and environmental regulation setting and standardization, Financial support, National (urban) fish promotion
Departmental	Financial disbursement, System-scale technical support, Local fish promotion, Standards enforcement
Municipal	Association coordination, Support and subsidy disbursement, Day-to-day on-farm technical support
Community	Farmer coordination, Information dissemination

While a more clear and partitioned set of responsibilities and goals for each level of government is needed, the importance of coordination and cooperation between them should not be overlooked. The process of decentralization in Bolivia makes it necessary for governments to work together towards common goals. The system above, with an integrated feedback system, would help to organize the piecemeal nature of governmental support for aquaculture and facilitate a more robust growth trajectory.

There is a need for more research on the effects formal governance has on the central Bolivian aquaculture system, and how it may help or hinder future growth and development. One important question is how subsidies are decided upon and administered. There may be an important social and human capital component that drives local governmental interest in aquaculture. Understanding how to leverage that capital would be quite valuable to aquaculturists, particularly those in communities whose governments have placed low priority on aquaculture. At the national level there is a need to address the problems with ministries that are tasked with the development of aquaculture. Having an aquaculture department like IPD PACU could be highly beneficial to small-scale aquaculturists, but it would

need to operate with their needs and best interests in mind and would need to increase its efficiency and efficacy.

Overall, the formal governance structure for aquaculture overall has had a small impact on the system, with a few exceptions. Regulations in certain contexts, such as the localized system, are non-existent, which jeopardizes growth potential and sustainability. In other contexts, such as those looking to engage urban distributors, regulations are too complex, making them almost impossible for small-scale producers to navigate. This undermines growth into more formal value chains such as those that lead to urban markets and higher end restaurants. Subsidies and governmental support is sporadic and is often linked to politics rather than an economic and social development plan. Addressing these problems and inconsistencies through better coordination and a clearer set of responsibilities and goals will make a significant contribution to the growth of the sector and help to ensure that benefits continue to accrue to targeted groups such as small-scale producers and women.

6.1.2 Navigating Chain Governance

Most research on value chains has tended to focus on governance – i.e. the power relationships between up stream and down stream actors – as a means to understand how chains function and can be altered.

The CBAVC is neither a producer driven nor a buyer driven chain, and would best fit within the “market” type of chain governance. Gereffi *et al.* (2005) define market governance as

“when transactions are easily codified, product specifications are relatively simple, and suppliers have the capability to make the products in question with little input from buyers, asset specificity will fail to accumulate and market governance can be expected. In market exchange buyers respond to specifications and prices set by sellers. Because the complexity of information exchanged is relatively low, transactions can be governed with little explicit coordination,” (p.86).

The presence of a lead firm is almost always the case for global value chains due to the need to manage their trans-boundary complexity. However, they also exist in domestic chains. For example, in domestically produced and consumed agricultural goods, supermarkets tend to be the lead firms and hence perpetuate the buyer-driven chain structure. In the case of the CBAVC, there is no supermarket or any other lead firm. However, as it grows and evolves, it is possible that a lead firm will emerge, and that the governance of the chain will change from being market to some other form, but what that will be remains to be seen. For this reason producers should begin to plan for this development and, if possible, become the lead firm themselves. Most agricultural chains become buyer driven because producers tend to be disorganized and lack solidarity, and therefore have little power or leverage in the chain. Once such a chain is established, it is not only hard to alter, but it is hard for producers to upgrade within. Therefore, undertaking steps to mitigate these problems and retain power in the chain should be prioritized.

A potential approach would be to form a producer led marketing cooperative. As the system grows and expands, larger and more influential buyers will emerge. A marketing cooperative would serve as a counter weight to this power, and keep the system balanced. It would also maintain the role of small and medium scale producers, and their associated social and economic benefits, in the system. In the face of increasing demand and a broadening geographical interest in fish consumption, without a marketing cooperative the demand will be met by the most successful producers consolidating production and/or agri-corporations shifting into the aquaculture sector. An appropriately governed marketing cooperative would have the capacity to keep aquaculture production benefits widespread and the producer/buyer dichotomy of power balanced.

The CBAVC's fit in the Gereffi *et al.* (2005) typology is "market" because each node in the chain interacts with each other mostly based on a typical supply and demand basis with no one set of actors endowed with enough power to bend the chain to their will. To have this relative balance is unusual for an agricultural product. The explanation is that the aquaculture fish produced in the region has a relatively high value, especially in comparison to more common commodities such

as fruits, vegetables, cereals, and other more traditional proteins. Also, relatively low consumer demand has kept large operations seeking economies of scale from forming. This has allowed the small-scale fish farmers to remain the core of production. However, the ability of suppliers and retailers to influence producer behavior by constricting the chain at times has offered a counterweight to small-scale producers. Overall, the lack of a singular entity to dominate any one node in the chain has contributed to a relatively even disbursement of value adding.

A key finding of this research is that while the CBAVC is closest to being a market governance system, it is in fact more complex. Specifically, it exhibits characteristics of what Polanyi (1945) refers to as social embeddedness, the idea that economic decisions are embedded in the sociocultural context. For example, it was found that while prices of fish in the CBAVC are subject to supply and demand, they are also somewhat driven by established norms and informal relationships between actors. The evidence for this is the stability in the historical price producers have received for their fish. There has been relatively little price fluctuation since producers started aquaculture, and no price crash or spike. For comparisons sake, rice, which is a staple of Bolivian diets, ranges in price from \$4-13 BOB per kg depending on location, and can see long-term fluctuations in value (FAO, 2011b; Numbeo, 2017). The fact that fish farmers regularly expressed concern over market saturation and increasing competition, despite the data showing that prices were almost even with the historical average, further points to social elements at work in the aquaculture economy. In a pure market system, such concerns would be taken as signals and would quickly be reflected in prices. It is likely that the localized nature of the system (both producers and buyers, such as restaurant owners and marketers, are usually from the same community or municipality and know one another well) causes close relationships to form. These relationships influence the market decisions of both actors on either side of transactions. Past agreed upon prices thus influence new sales and act as a magnetic force that pulls the price towards the historical average.

In order to maintain a small/medium sized producer oriented growth trajectory, it is recommended that producers and retailers should pursue a duel

pathway. On the one hand they should continue to foster the established relationships they have with one another. On the other, they should seek to diversify their market relationships. The first pathway exploits the advantages of the embedded economy by cementing relationships and keeping prices stable. The second allows for growth and expansion, which not only increases incomes but also spreads the nutritional benefits of fish to other regions. The overall result of this approach will be the reduction of producer and buyer vulnerability to shocks, a prominent problem in food systems generally and fish food systems in particular (Gephart *et al.*, 2017).

This dual pathway also supports the recommendation for a producer led marketing cooperative. The cooperative could aid in supporting existing relationships and fostering new ones. Purchasing thresholds could also be established that would allow small restaurants to continue to deal directly with producers, but larger purchases from supermarkets for example would be coordinated with the cooperative.

Finally, the identification of this socially embedded market system contributes to our understanding of local value chain governance. A central argument of this thesis is that localized system approaches to agricultural development can have broad poverty reducing impacts. As such, further research into developing the value chains that support these local systems would benefit from a local value chain governance typology.

6.1.3 Pathways to Chain Entrance and Upgrading

Understanding how to effectively enter into the CBAVC will spread the benefits of participation more broadly across the rural population. It is also necessary if the aquaculture system is to continue to grow and meet demand for fish from a wider consumer base while still benefiting small-scale farmers. The key elements that help or hinder chain entrance are opportunities and barriers at various nodes in the chain.

Upgrading is the pathway current chain participants can take to achieve higher incomes and potentially improve their wellbeing. The trajectories that value chain upgrading can take have been conceptually well developed (see chapter 2).

Humphrey & Schmitz (2002) classified them into four broad categories:

- Process upgrading: firms can up-grade processes - transforming inputs into outputs more efficiently by re-organising the production system or introducing superior technology.
- Product upgrading: firms can up- grade by moving into more sophisticated product lines (which can be defined in terms of increased unit values).
- Functional upgrading: firms acquire new functions (or abandon existing functions) so that they increase the overall skill content of their activities.
- Intersectoral upgrading: firms apply the competence acquired in a particular function of a chain to move into a new sector.

Like the governance frameworks that have been developed for value chains, these upgrading trajectories have been developed for global value chains. Nevertheless, they have certain elements that are useful for the analysis of the CBAVC.

Supply Companies

Entering into the CBAVC as a supply company can be very difficult due to high start up costs and technical knowledge requirements. Infrastructure such as land, buildings, and machinery can cost upwards of hundreds of thousands of dollars for a medium sized operation. While smaller, less capital intensive companies are possible, they still require more investment than an average person in the region would likely have. Skills and experience are also not easily acquired, and production shocks such as supply chain disruptions, weather related problems, labour and transportation disruptions, disease outbreak (in the case of fingerling production), and various other unexpected disruptions all increase the risk of falling short of the production reliability that is critical for customers. This is exemplified by several attempts by aquaculturists to expand into feed and fingerling production

only to fail after a year or two. Consistency in production and quality is critical to build up a customer base, and this is difficult to acquire without adequate knowledge and capital. The extent of the market for aquaculture inputs such as feed and fingerlings is difficult to estimate, and can be volatile. There does not seem to be a dearth of supply, therefore a new supplier would be entering a competitive market and, given their newness, would be doing so at a disadvantage. However, the growth potential of the market may present an opportunity. Geographical specialization that follows the sectors expansion would also be important so as to avoid direct competition with established businesses. Also, there are no explicit barriers to entry *per se*; it is just that the competition that already exists presents a challenge to viability. Any entrant would have to have confidence, supported by a market analysis, that the growth trends in aquaculture in Bolivia will continue.

Upgrading for supply companies is less straightforward. All companies interviewed indicated that they are undertaking process upgrading in some way, and tend to do so regularly. For example, one fingerling company has purchased specialized transportation equipment that minimizes fingerling mortality. Two feed companies are in the process of upgrading their machinery so that they can produce larger volumes of feed more efficiently. They also occasionally experiment with product upgrading by changing feed input combinations so as to improve their bottom line as well as fish production. Fingerling producers are beginning to explore species other than Tambaqui or Pacu. Intersectoral upgrading also occurs, such as when a company undertakes fingerling and fish feed production. However, opportunities beyond that would require expansion into other chains altogether. Functional upgrading is the least open pathway. Companies could get into production or even marketing, but these activities would have minimal complementarity to their existing operations and therefore would be an expansion that does little to improve efficiencies or economies of scale.

Aquaculture Production

The recent entry of many surveyed producers, the large number of ponds they are building, and the stated desire of many to continue to expand, suggests that

barriers to entry for new aquaculture producers, and barriers to growth for existing producers, are not difficult to overcome.

The responses from non-producers help to corroborate this finding. Although a variety of reasons for why they do not engage in aquaculture were given, the breadth of answers points to the need for a more nuanced interpretation. Non-aquaculture producers all have livelihoods that they have been engaged with for years. This creates a degree of comfort for households that is not easily disrupted or abandoned. For households to change or add livelihoods, they must consider the risks and rewards of that new livelihood and compare it to their current livelihoods. Only when that analysis makes it clear that the opportunity cost of adopting the new livelihood is high relative to their existing livelihood(s) will they then switch or add. In the study region, non-producers had a positive view of aquaculture's livelihood potential, but their reasons for not adopting pointed to a risk/reward analyses that were not sufficiently one sided in favour of reward for those farmers. While this can complicate efforts to expand the industry, it can also be interpreted positively. There have been development projects in agricultural systems throughout the world that were very successful in recruiting participants, but eventually created unsustainable growth that collapsed, and left people worse off, when they reached a tipping point in their viability. Healthy skepticism of a new livelihood activity by potential adopters allows time for its risks and benefits to emerge. It also weeds out unenthusiastic producers that could conceivably contribute to a glut in supply and a collapse in price. The variety of responses for why non-producers have not adopted aquaculture can be interpreted as a manifestation of this skepticism. Although they point to a lack of financing, access to finance in the study region is not problematic as many producers access it for other farm-based activities. Therefore, the situation with aquaculture can be best characterized as one where those who are set on adopting it can, but those who would only adopt if it were sufficiently easy and convenient, cannot.

The above argument assumes the adoption of aquaculture by non-aquaculture agricultural producers, all of whom own land. Others interested in aquaculture would also have to own or have access to land, making it the only firm

barrier to aquaculture adoption. However, this is not uncommon as it is the case with the adoption of any food production activity. A further question is whether the poorest of the poor can adopt aquaculture. The answer is generally no in most contexts since the poorest of the poor tend to be landless, but for some in Bolivia the answer may be yes. As outlined in chapter three, land distribution in Bolivia during the mid twentieth century, and significant restrictions on land sales and collateralization, have kept farms small and numerous. This condition has also reduced land's significance as an indicator of wealth since such restrictions undercut its usefulness as leverage to accumulate capital. This has led to an equality of poverty in the region; a general condition of poverty that tends to be above extreme poverty income thresholds, but where other factors such as food security, asset endowments, and multidimensional aspects of poverty are widespread. Amongst these generally poor farmers are those who are poorer than others and who live below the extreme poverty line. For them, aquaculture, although difficult to access in the same way that adopting almost any new livelihood activity would be difficult, is not out of reach. For this reason, some of the poorest of the poor can indeed adopt aquaculture, but for the poorest of the poor without land they cannot adopt.

Aquaculture farmers face a number of barriers to upgrading. Acquiring government health and safety certification is beyond the capacity of many, which limits their access to certain consumer groups. Government run institutions such as schools, prisons, resource companies, utilities, and others often provide meals to their employees and wards, but selling foodstuffs to these groups tends to require certification from the national governmental agency. Fish, given its perishable nature and susceptibility to contamination is challenging to process, store, and transport in accordance with government standards. The infancy of the fish sector also means that infrastructure and management techniques are lacking. During informal conversations, several producers mentioned this problem, and pointed to the large financial and infrastructure requirements needed for health and safety certification, and argued that they were too high to bother to try and meet. This has

led many producers to ignore this pathway to consumers altogether and to focus on existing linkages with markets and restaurants instead.

Process upgrading is more feasible for aquaculture farmers. Most regularly adopt new techniques and technologies. The purchase of gas powered water pumps can help to increase yields and provide stability to harvests. Putting nets over ponds to keep away predatory birds is another. Aquaculture farmers have also begun to monitor their water and the growth of their fish more closely which allows them to recognize, diagnose, and treat problems earlier, thereby reducing mortality and maximizing growth. There is, however, more work to be done on this front. Better feeding practices would reduce feed waste, and improved general record keeping would allow efficiency improvements to be made year over year.

Functional upgrading has also been taking place. Some producers have sought to vertically integrate, but with mixed success. Vertically integrating with feed and/or fingerling production has proven to be wasteful of time and money. Producers generally lack the technical and capital assets needed to undertake these activities in a productive, efficient and profitable manner. Other upstream integrations identified by respondents included acting as a part time transporter, a feed distributor, and renting ponds to other farmers (one response each). The income from each of these was nonetheless relatively small. Chain integration downstream in the chain, however, has been successful for some farmers. Two respondents have opened restaurants where they can sell their own fish and reap more of the value added.

The last form of upgrading, intersectoral, is the least common. Rearing new species of fish could be classified as intersectoral upgrading, and some producers are indeed experimenting with this. However, there is currently no evidence that they are being successful enough that their activities are forging new product chains. The growing of other species is done more as a curiosity rather than as an explicit plan. However, with a more concerted effort to bring other reared species to market, it may contribute to greater fish consumption amongst the population, and reach groups for whom fish can be too expensive for more regular consumption. It may also allow for more sustainable growth of the producer population.

Another intersectoral upgrading that is taking place is the growth of *pesque y pague* (fish and pay) side businesses. This is when producers permit people to bring fishing rods and catch fish out of their ponds for a fee. However, the popularity of *pesque y pague* is not sufficient to make it a lucrative prospect so most producers don't bother with it.

Overall, upgrading is something that is lacking in the CBAVC but is of interest to some producers. As mentioned in chapter 5, fifteen respondents wanted to upgrade into other aquaculture related activities, which points to a reasonable degree of interest and enthusiasm. The key barrier identified was capital but the widespread acquisition of capital for other farm activities indicates that this is not likely a case of access, but rather planning and execution.

Employment in the Chain

Workers tend to move in and out of the chain with relative ease. Many occupations are quite similar to others not related to aquaculture. An example is moving from selling fruit at the market to selling fish, or working in agriculture as a hired hand and then working in aquaculture as a hired hand. Only supervisory positions at feed and fingerling supply companies require some specific skills, which means that for most other positions in the CBAVC there are few if any barriers to entry. This bodes well for people seeking employment, particularly the poor, since most CBAVC work requires few skills. However, pathways to upgrading for workers are limited. The only exception is supervisory positions, which are attained through years of work experience. Such positions are so few and far between, however, that they do not currently benefit many people.

Retail Businesses

The ease of entering into the CBAVC as a retail business depends on the type of business. The most common is a restaurant, and as mentioned above, some producers have opened them next to their ponds. The only significant barrier to entry is capital. However, entering the CBAVC as a restaurant in a town or city that is outside the core aquaculture area will likely face other challenges. The largest

will be obtaining customers. There is a cultural resistance to consuming new foods in Bolivia, which seems to increase in tandem with distance from the aquaculture region, which is further along in accepting fish (see section 6.2.2). Restaurants that serve fish in a city would likely face this high risk, but the rewards are high if they can carve out a niche and attract large numbers of customers. Another lesser but not insignificant barrier to entry for restaurants is the logistics of sourcing fish. This includes finding and maintaining suppliers, ensuring reliable and fast delivery, and maintaining fish quality. This is more complicated for out of core region businesses due to distance. Despite these challenges, the promotion of aquaculture fish restaurants that are further afield than the core production area will be necessary for broader aquaculture system development.

Opening a retail outlet is not generally difficult but, like opening a restaurant, the difficulty of doing so increases with the size of the operation and the distance from the aquaculture region. At the most basic level fish can be sold right from a producers home, and they simply hang up a sign (photo 6.1). This is more effective if they live next to a frequently used road. Others sell out of the backs of trucks on the side of the highway. Overall the barriers to entering into fish retailing are minimal. However, as the size and sophistication of operations increase (i.e.: more trucks, more personnel, more locations, increased volumes, etc.) capital becomes an issue.

Photo 6.1: Producer selling fish from his house



Upgrading opportunities for current retail businesses are numerous but the outcomes they would generate are unclear. Introducing more efficient storage and cooking procedures could be undertaken as a form of process upgrading, but this is not likely to translate to income that eclipses the time and capital that would be required. Restaurant owners were asked about their storage and spoilage. All said that they had sufficient freezer storage space. They also indicated that they have had spoilage issues on occasion in the past, but that they were not regular or problematic today. The culprits were either poor handling, over-purchasing, or power outages. The first two have been addressed and improvements in regional infrastructure have made outages an infrequent event. Product upgrading is a pathway open to retail businesses, but the benefits may not warrant the effort. Offering a more sophisticated product, such as a boneless fish fillet or better side options could be undertaken, but it seems like consumers would not be sufficiently interested. Current plates are simply Tambaqui split in half on a bed of rice, with a few vegetables to make a salad (photo 6.2). Consumers seem to enjoy eating the fish whole, including many of the bones (which is actually better for nutrition). Offering boneless fillets may appeal to a few consumers, but would be unlikely to make a

significant impact on the restaurant's bottom line. However, such upgrading may be critical in expanding fish consumption to other regions outside of the core. A wider variety of products would make the food more appealing to a wider number of consumers and increase the likelihood that they would try it and consume it regularly. If urban or far afield restaurants enter the CBAVC, they should carefully consider such forms of upgrading.

Photo 6.2: Typical Tambaqui dinner from a restaurant



Like the other two upgrading pathways, functional and intersectoral upgrading is possible, but not likely to generate immediate benefits for restaurants in the core aquaculture production region. In general, the upgrading opportunities to retail businesses are numerous, but since they currently serve the interests of consumers, and do so with relatively low costs, changes in consumer preferences or behavior will need to occur for various forms of upgrading to be advantageous. The other possibility is to undertake upgrading that introduces new products, but the demand for this is not apparent, so doing so would come with a certain degree of risk.

6.1.4 Production Improvements and Value Chain Bottlenecks

Although aquaculture tends to be profitable for the farmers of central Bolivia there is a lot of room for improvement and greater efficiency. Such improvements will contribute to higher incomes, lower risk, and more stability to aquaculture livelihoods. Production improvements will also increase the likelihood that producers remain the largest and highest earning actor group.

The first improvement is one that spans all producers. When discussing size of operation, number of ponds is typically used. While this is simple and seems logical, it can be misleading due to the wide variation in pond sizes. An aquaculture farmer with three 1000m² ponds will seem to be a larger producer than a farmer with one 3800m² pond if only the number of ponds, and not their dimensions, is mentioned. This commonly occurs in local conversation and occasionally in local reporting (e.g. PPV2, 2016); therefore it is recommended that people involved in the aquaculture system in Bolivia use m² rather than number of ponds when describing sizes of operations. This would improve analysis, simplify comparisons, and create a standard that would aid in creating policies and regulations.

At the individual level, the first activity that can be improved is the protection of fingerlings. All producers reported some loss of fingerlings, but the amount varied significantly across respondents and the average losses were 20%. While causes for losses varied, the far and away largest culprit was birds. This did not lead to significant lost investment since fingerlings are relatively inexpensive, but for some farmers translated into thousands of dollars in lost revenue. Producer response to this problem thus far has been somewhat complacent, but a few have been more experimental and innovative. The most effective approach has been to string fishing line over ponds while the fish are small to keep birds from landing on the water. More aquaculturists should adopt this innovation and local NGOs should help implement it. More importantly, efforts should be made to encourage experimentation, and when innovations are discovered, to disseminate the related

information. Utilizing the experimenters and innovators as teachers for other producers may be an effective approach (de Silva & Davy, 2010).

Another inefficiency that could be overcome and that would yield considerable income benefits for producers is reducing the number of ponds left fallow. Fallow ponds can represent a large loss of potential income. The average size of a pond in this study is 1590m² and the average net income per m² is \$2.06 USD. This means that on average, each pond that is left empty represents a lost potential income of \$3275.40 USD. This is particularly pernicious given that many of the reasons for leaving a pond empty for a production cycle can be addressed with a bit more effort or basic equipment. However, running at full capacity would mean a 28% increase in fish production which may saturate the market. Nonetheless, since an increase in capacity would occur gradually, it serves as an entry point for extension workers looking to improve aquaculture producer incomes.

Yet another aspect of aquaculture production that could be improved and expanded is polyculture. Supporting aquaculturists in diversifying their products could have two key benefits. The first being greater income potential for farmers, but also more diversified production would likely increase their resiliency in the face of economic, environmental, or consumer behavior change. The second is it would help to foster broader fish consumption amongst the Bolivian population. More variety increases the likelihood that consumers will find a product they like, but also, if planned effectively, can introduce fish at lower price points. Tambaqui is currently the only product that the producers of the CBAVC sell. While it is not prohibitively expensive, it typically costs more than alternative proteins such as beef and chicken. If another species was introduced, carp (*Cyprinus carpio*) for example, at a price point that is comparable to other meats then it may become more ubiquitous and therefore regularly accessed. Such a situation would be particularly beneficial to the poorest strata of the population who are most impacted by the relatively higher price of fish.

Although this approach would be beneficial to producers and consumers, much work would need to be undertaken to make it happen. It is clear that there is

an interest in rearing other fish species amongst producers, either alone or through polyculture. Some producers reported experimenting with growing river fish or carp. Although this was usually as a curiosity and way to diversify their household fish intake, they would likely do so commercially under the right conditions. However, most producers have a lack of related technical and market understanding, and do not have access to appropriate inputs. This leads to a lack of confidence amongst some producers, but there is a spirit of experimentation and risk taking among others. According to the Bolivian national agricultural census (INE, 2013), carp (*Cyprinus carpio*) is the most widely cultured fish. The majority is likely reared in small numbers by rice farmers in their paddies for home consumption rather than as a commercial product. This is supported by the fact that carp is rarely sold at markets. But this may be an opportunity, and carp may serve as a low cost fish to compliment the higher valued Tambaqui. However, further research into the technical and market potential of culturing new species, particularly in a polyculture system, is necessary. Carp is invasive, and may present particular challenges that producers are not capable of addressing. Nonetheless, further investigation of polyculture opportunities would contribute to a better understanding of the future potential of the aquaculture sector in central Bolivia. It would also support the work that farmers are doing on their own to improve their productivity and profitability.

Transportation is another area of inefficiency in the CBAVC. Although it is not a bottleneck in the chain *per se* (producers manage to get their fish to their buyer easily enough), the methods that are used to transport fish undermine its quality. Fish is often transported in nothing more than the back of a truck or car, either loosely or in old fish feed sacks, and often with no ice and almost never refrigerated. This exemplifies the lack of health and safety standards and serves as a significant barrier to sector development. While this has been sufficient for local restaurants and markets, it impedes access to more sophisticated and higher regulated urban retailers. Refrigerated transportation would be ideal, but likely unnecessary, for transporting fish to local retailers. It would also likely cause an increase in the price of fish since current transport costs are negligible but a

dedicated refrigerated system would have to charge a high premium to cover its costs, and those costs would get transferred into the fish sale price. For sales to urban retailers, however, refrigerated transport would be appropriate. With effective coordination, large volumes of fish could be taken in one trip to cities, thus minimizing increased transport costs. Urban consumers would also have a higher capacity to absorb the modest additional cost. A marketing cooperative, as mentioned earlier, would be in a good position to establish such coordination.

The final chain bottleneck that could be improved is access to credit. Producers have had success in obtaining credit for their aquaculture activities, but the full nature of these loans, such as what repayment schedule they had to follow and what collateral they had to offer, is unknown. The loans are typically normal agricultural loans that are obtained by producers who are familiar with such a process. During fieldwork, several producers mentioned having obtained loans for other agricultural activities at various times, but these were not formally included in the research because they were not specifically for aquaculture production. This furthers the argument that obtaining credit is not a widespread problem for current producers, although for a few it may be, and it is unclear if it is attainable for those looking to start aquaculture. What is clear is that interest rates do not seem excessively burdensome, and that credit is not wholly absent from the aquaculture sector.

Despite these findings, the credit system for aquaculture still has some room for improvement. Loans specific for aquaculture activities with interest rates comparable to other agricultural activities would even the financial playing field across farm-based livelihoods and lead to greater aquaculture adoption and expansion. Loans and other financial instruments could also be created as support mechanisms in cases of large losses, thereby reducing aquaculturist vulnerability and introducing a higher degree of stability, and hence economic sustainability, to the activity of aquaculture.

There are other technical problems that producers face, but they were varied, as were their approaches to dealing with them. This research investigated the problems and responses, but did not evaluate their efficacy. It did, however,

determine if the solutions that were applied were successful in the opinion of the farmer who applied them (see chapter 5). A technical expert may find this information useful not only to see what innovations and techniques farmers are utilizing, but also to see if there are disconnects between what people think works, and what should work. More broadly, an understanding of what problems producers face and how they are addressing them provides important insight into pathways to improved production and efficiency, which is necessary for long-term sustainability and poverty reduction.

6.1.5 Producer Knowledge and Coordination

It is common for agriculturists in Bolivia to formally coordinate as members of agriculture activity specific associations. This stems from, initially, the history of rural neglect and peasant resistance in the country, and today from the trend of decentralization and rural empowerment and mobilization. Such associations take on many different activities and forms, and have varying degrees of impact on their members. Aquaculture associations are no exception. They range from being small and highly active to large and relatively idle. Nonetheless, they exert some degree of influence and provide benefits to their members. Supporting these associations will build good will amongst diverse producer groups and communities, and serve as an effective entry point for information and technical skill dissemination. They may also be key to organizing producers more effectively to cope with the growing sector. However, a greater understanding of the role of local associations is needed. In their current iterations, their value as it translates to aquaculture livelihood development fluctuates from one association to the next. More research could uncover in more detail what works, what doesn't, and what drives such outcomes. It would also be valuable to know what, if any, local association structure, size, and activities yield the most benefits and drive sustainable growth.

Less formal coordination amongst aquaculture producers is also common. Although respondents typically indicated that they did not generally coordinate often with others, in-field observation indicated otherwise. During field work

aquaculture farmers were regularly and eagerly talking about their activities with other producers, and anyone else interested enough to listen, leading to a high degree of openness, cordiality, and solidarity amongst the group. Many farmers know one another, not only because they are from small towns where they have lived all their lives, but also because fish farming is a relatively uncommon livelihood. This brings producers closer together over common interest and purpose. The likely reason that producers did not point to these activities as coordination is that they take it for granted. The significance of this is that peer-to-peer information dissemination may be an effective approach to improving skills and knowledge, but it should be explicitly promoted and encouraged rather than assumed to happen organically.

The acquisition, retention, and dissemination of knowledge and skills related to production are essential for technical improvement in fish farming, but is lacking in central Bolivia. Over half (21) of producers interviewed do not know what price other producers are getting for their fish. Although producers seem to talk with one another fairly regularly, more personal/sensitive topics like prices and income are often not talked about because there is a small social taboo against discussing money. This points to a key problem; knowledge and information are difficult to acquire, especially about technical and marketing aspects of aquaculture. This is compounded by a lack of potentially helpful assets such as computers (27 do not have) and home internet (34 do not have), and a lack of knowledge about how to use them. However, there are promising avenues through which information about aquaculture may be delivered. All but one producer has a cell phone, and many of them are smartphones that could access the internet. Even the most basic of their cell phones have some capacity to acquire data from the web, or at least receive texts and emails. Applications, text alerts, websites and the like, accessed through cell phones and internet, may be highly effective vehicles for spreading information.

Another area for improvement is record keeping. Few producers keep records of their activities and, when they do, they are limited in scope. Improved record keeping would allow for better decision-making and analysis in many variables of aquaculture production. Targeting women would be an important

strategy, as they tend to have a higher degree of interest and responsibility for this activity.

As an overview of knowledge and training amongst aquaculture producers, one could say that it is in need of improvement. While some producers do regularly seek out information to improve or problem solve aquaculture issues, as well as attend various training sessions and/or keep data on their activities, there is a smaller but not insignificant group who do not do any of this. The data suggest that the Internet and input suppliers are entry points for disseminating information to aquaculturists, as well as serving as reliable points where information can be accessed. Also, extension workers could stand to have more aquaculture training and engage in more outreach.

6.1.6 Minimizing the Environment Impact of Aquaculture

Generally, aquaculture in central Bolivia has a high degree of environmental sustainability. Therefore, efforts to maintain this situation, and make improvements where possible, should be prioritized.

Very little deforestation is associated with aquaculture production, as most ponds are built on former pasture or scrub land. However, as the sector expands, this may change. Currently producers do not want to invest in deforestation for aquaculture because there is idle land that can be taken from other activities (e.g. cattle or rice). For many aquaculture remains a secondary livelihood activity that is carried out when convenient rather than with explicit intent to maximize profitability. But, as new producers enter the sector and existing producers continue to expand, the pressure on land resources will increase.

Regardless of the land pressures that may manifest from aquaculture, they are extremely small relative to other agricultural activities. Rice and cattle farming require large-scale clearing of forests, which can greatly harm biodiversity. Aquaculture by contrast requires much less land, even for medium to large size operations. Ponds can also be constructed in irregular patches of land. Land use

planning that incentivizes the maintenance of forests and supports identification of ideal pond locations could go a long way in reducing the land costs of aquaculture.

Wastewater management is often a concern in aquaculture systems, but in central Bolivia, since ponds are typically rain fed and almost no chemical treatments are used, it is not a significant environmental risk. But, like land use, if the sector continues to grow more intensive chemical dependent methods may be adopted. In such a case the environmental consequences from wastewater will need to be more closely managed.

The mud that is removed when cleaning the ponds is likewise not an environmental concern in central Bolivia. It is usually disposed of next to ponds, or, for some farmers, is used as a fertilizer. Such nutrient recycling makes a positive contribution to the environmental impact of central Bolivian aquaculture. Scaling up this technique will require explicit effort by NGOs and/or local governments to educate producers.

The escape of fish into lakes and rivers is another concern often associated with aquaculture. In central Bolivia, Pacu and Tambaqui are indigenous, so their escape would likely have minimal consequences. If new species are introduced and grown in larger volumes however, the consequences of species escape could be much larger and would require management. Carp, for example, which is already becoming more and more common in central Bolivia, can be highly invasive (USDA, 2017). In such a case, strategies, techniques, and innovations will need to be disseminated to minimize the potential negative environmental consequences.

One concern with endemic species escape is that although they are indigenous to the region, when fish are made to artificially reproduce, their genetic makeup is altered from that of wild versions. If they were to escape they would still have an impact on natural biodiversity (Aguiar *et al.*, 2013). Although there has not been research to determine if cultured fish in central Bolivia are different than their wild equivalents, there is not much reason to suspect this is the case. Broodstock used by fingerling producers are captured from rivers and they are alternated every few years, limiting the amount of time and spawning cycles needed for genetic divergence. Nonetheless, the advantages of this method should be made explicitly

clear and be encouraged to fingerling suppliers, especially as the sector and their operations grow and increase in sophistication.

The composition and sourcing of feed is another element of aquaculture that can be environmentally unsustainable (Naylor *et al.*, 2009). A considerable environmental advantage of Pacu and Tambaqui is that they are omnivorous, and do not require a high percentage of animal protein in their food. Most of the protein is derived from soy. The small portion derived from animals is from the remnants of beef processing. As such, feed does little to contribute to diverting proteins from human consumption. However, the environmental sustainability of their feed is problematized by the lack of sustainability in the agriculture system overall, which supplies the feed ingredients. All feed suppliers interviewed said they did not know precisely where their ingredients come from or how they are produced, but said that conventional large-scale farming was likely the source. Although such feed is more sustainable than carnivorous fish feed, having a better understanding of its production process would allow for even greater sustainability.

Other potential points of environmental unsustainability in the CBAVC are negligible. Aquaculture in central Bolivia is not energy intensive and does not produce much green house gas (GHG) emissions. Although these were not researched explicitly, they are reasonable conclusions based on observation. No stage in the CBAVC requires electricity in large quantities. Input and retail businesses are the largest users, but it is predominantly to keep lights on and run some equipment such as pumps and freezers respectively. GHG emissions, besides those generated when making electricity, predominantly come from transportation. Since the distance from seller to buyer is almost always short, and fish is transported by car and motorbike, the contribution of emissions is relatively low. The aquaculture system is especially environmentally friendly in these regards when you compare it to other agriculture activities of the area. Cattle are recognized as considerable GHG contributors (Herrero *et al.*, 2013), and rice production in the region is highly mechanized.

Environmental management will require a combination of incentives and disincentives, both as policy and as sector/social norms, to encourage producers to

maintain the environmental sustainability of the system. The need for immediate regulations is limited since there are few problems prominent enough to justify the implementation and enforcement efforts and costs that would be necessary to overcome them. As the sector grows and expands into other species, feeds, and production methods, however, policies and regulations may be needed. Regulations may need to be created for input and retail businesses as well, but this too would depend on the growth trajectory of the system. Building up a culture around aquaculture, Pacu and Tambaqui specifically, that emphasizes not only its nutritional benefits, but also its minimal environmental impact may also be an effective approach. Creating connections to Bolivian's reverence of the Pachamama (mother earth) that is often imagined holding and caring for fish, may be a creative approach. This could create a social norm that causes producers to be concerned for the environmental impact of their aquaculture, and to increase consumer demand for environmentally sustainable fish.

6.1.7 Market Development

Market development for aquaculture fish is a critical issue and there are both opportunities to exploit and challenges to overcome at the consumption node of the CBAVC. On the opportunity side, despite low historical fish consumption and continued low rates of consumption in many regions, per-capita fish consumption overall is on the rise in Bolivia (FAOSTAT, 2016; IMG, 2016). Fish is associated with religion in Bolivia, Catholicism specifically, and therefore is widely consumed on holidays and at festivals. Easter in particular sees a huge demand for fish, Tambaqui included. General consumption is also on the rise. This has likely been helped by Bolivia's economic growth and increases in individual wealth. Globalization, both directly through importation of Sabalo, and indirectly through greater foreign influence over perceptions and preferences towards food, has also helped. Government and NGOs have fostered this trend by promoting fish consumption in the country and highlighting its nutritional benefits. The growth of farmed fish systems has grown in tandem with overall demand for fish. Farmed fish from the

Lake Titicaca region have always enjoyed a degree of popularity from consumers, particularly in and around La Paz. The farmed Tambaqui and Pacu of the Central Bolivian region have also seen increases in demand from consumers. The system's growth has likely been more rapid than the Lake Titicaca system as it seems to have contributed to filling a vacuum of demand for fish in the region. It has also been aided by the formation of a consumption niche for farmed fish that is popular with tourists, travelers and locals alike.

Despite growing national fish consumption, aquaculture producers face several marketing challenges. A key one is competition with fishers for market share. Although producers are doing well, they could be doing better. Fish acquired from fisheries continues to dominate Bolivian fish consumption, and this is true even in the heart of the Tambaqui growing region. It is not only problematic for aquaculturist income and the aquaculture sector, but for environmental protection and food system sustainability. Bolivian fisheries can be highly exploitative, which has contributed to some having collapsed or being on the brink of collapse (Castello *et al.*, 2011; Oberdorff *et al.*, 2015; Puelles *et al.*, 2016). Despite this, fishing remains a prominent livelihood activity in the fish-farming region. Informal discussions with producers and market leaders during field research indicated that fishing laws are not heavily enforced and that many fishers continue their activity despite them. Aquaculture, by comparison, has a relatively low environmental impact. A marketing approach may therefore be to emphasize aquaculture's environmental sustainability credentials vis-à-vis fisheries. This could be easily tied into the Bolivian interest in environmentalism as demonstrated in their Law of Mother Earth and cultural reverence to the Pachamama.

The large volumes of imported Sabalo from Argentina also pose a challenge for aquaculture producers. These fish constitute the majority of imported fish into Bolivia and are particularly popular in urban areas such as the city of Santa Cruz. This is problematic for aquaculture growth since expansion into urban areas will be an important component. Tambaqui will have to face established consumer preferences and the relatively lower price of Sabalo. However, as economies of scale are established amongst larger producers that are capable of meeting the

health, safety, and transportation demands of serving urban markets, the prices consumers pay for Tambaqui may decline and become competitive with Sabalo. Furthermore, Tambaqui has a similar bone composition and flavor profile as Sabalo (some would argue it is more flavorful), and therefore may easily substitute Sabalo without offending consumer taste preferences. Also, like fisheries, imported Sabalo's production tends to be more environmentally harmful than Tambaqui's, and this too may be commercially exploited.

A further challenge is the static nature of aquaculturist marketing and sales activities. Fish farmers were asked if the buyers that they had sold to the last harvest were the same or different than the buyers they had sold to in the past. Every single producer said that they were the same. This is both good and bad. On the one hand it represents strong marketing relationships, which build reliability and stability into the marketing system. It is likely a driving force for the relatively high and stable price that aquaculturists receive and, as such, is critical to maintaining the unique characteristic of having power balance in the value chain. It also reduces friction in the marketing and deal making processes since producers form long-term relationships with buyers where expectations and trust are well established. However, on the other hand, these entrenched seller-buyer relationships likely increase vulnerability to economic shocks. If established buyers disappear or shift their buying behavior or choices, producers may not have the resiliency to cope or capacity to adapt. In the short term this could have a significant impact on household income. If new buyers are not found then long term chronic problems may emerge. A strategy to diversify buyers could build resiliency into the system and limit exposure to shocks, but this would not be without its challenges. When producers were asked if there were buyers they wanted to sell to but were not doing so currently, the majority of producers said that there wasn't. This indicates a certain degree of complacency in their marketing efforts. A marketing cooperative representing a large portion of producers, as discussed earlier, may be an effective tool to manage this situation. It would allow for smaller order producer-buyer relationships to remain intact, but would create a node at which both sellers and buyers could meet to arrange new transactions, thereby

leading to a more diversified set of buyers, in both outlets and regions. This would essentially provide the best of both worlds.

The last key challenge for aquaculture market development is production growth that is outpacing market growth. A recurring concern of aquaculture producers was the increasing competition they face in the marketplace. This is understandable due to the recent rise in number of new producers as well as the increasing number of ponds being built by current producers. The fact that producers generally rely on the same buyers year after year, and tend not to change or expand, further compounds the problem. Prices that producers were getting for their fish, and the prices that restaurants say they are paying, were relatively stable compared to the historical average. Formal and informal agreements and relationships, coupled with established expectations and norms on pricing between producers and sellers has maintained this stability, but the voiced concerns of farmers hints that basic supply and demand is starting to override this situation. This is concerning, and indicates that efforts to expand the market while maintaining small/medium producer control (such as through a marketing cooperative) will need to move quickly. However, it also indicates that there is still time to effectively undertake such a strategy.

This is an opportune time to try and generate a leap forward in the nature of fish marketing in Bolivia. A few producers have begun to engage with more distant and urban markets, particularly Santa Cruz and Cochabamba, which have much more growth potential than local markets. While local markets remain an important outlet, they are not growing as quickly as production, and are unlikely to grow more quickly without a significant change in eating preferences and habits among local consumers, as well as a drop in price of fish that brings it in line with alternatives such as chicken. Urban markets on the other hand seem to hold more promise, particularly those that are further afield and are seeing increasing demand for fish, but are not yet very familiar with Tambaqui/Pacu. An effective approach to broadening the market for fish may be capacity building focused on marketing with both individual producers and associations.

A complimentary market development approach may be to situate Tambaqui as a luxury food. In general fish is a luxury food as compared to chicken, beef, and pork, and therefore consumers expect it to be more expensive, albeit only marginally. In fact, this may work to promote its consumption as it becomes increasingly synonymous with special occasions and holidays. This makes it accessible to the general population, who are often only marginally better off than being poor, but does make it elusive for poorer members of society.

The overall recommendation to address these challenges is threefold. First, producers should coordinate in order to maintain fish prices at an optimal range of being attainable for consumers, but maintain its relatively high profitability for producers. This may be done through a marketing cooperative that sets prices of fish collectively. A key challenge will be transcending regional boundaries and disparate associations. NGO leadership and producer solidarity and buy-in will be critical. The second step will be to establish a marketing plan that targets both rural and urban consumers. To meet the growing demand, high potential and capacity producers should be supported with education and tools to help them reach urban consumers. Smaller-scale producers should be helped in firmly establishing local outlets for their products while also increasing their capacity to weather economic and environmental shocks and increase the consistency of their output. The third step will be to promote a diversification of aquaculture products, both in species and preparation. This would allow aquaculture producers to expand their target market to both lower and higher income households, to increase the normalization of fish consumption, and to reach new geographical regions. Overall, market development for aquaculture products is currently the largest obstacle to aquaculture system growth, and the most important to overcome.

6.2 Aquaculture, Poverty Reduction, and Rural Development

The findings of this research generally point to aquaculture having a positive impact on poverty reduction, and therefore driving rural development. In this

section, elements of the relationship between central Bolivian aquaculture and poverty reduction and rural development are discussed.

6.2.1 Income Generation

The CBAVC has had a positive effect on income generation, and thus poverty reduction through three primary pathways. The first is the direct income effects it has on producers. The second is the multiplier effect of creating rural employment. The third is the other multiplier effect of creating space for entrepreneurship.

In comparison to non-aquaculture farmers, aquaculturists tend to make more money and have higher asset endowments. This seems to be driven by certain characteristics of aquaculture in the region. First, it has a high return on investment. Starting to farm fish is relatively inexpensive as compared to cattle or rice, which require the purchase of expensive stock or machinery respectively. Second, it is a high value product with low capital costs. Producers enjoy a balance of power with buyers that is highly uncommon in agricultural value chains. This allows for relatively high cost to income ratios and a market price that has become both relatively high and stable. Third, it is an activity that can be absorbed into an existing on/off farm household livelihood portfolio with minimal disruption to existing activities. This is both in the sense of labour; it doesn't take much time away from other activities, and land; it doesn't occupy much land that could be used for some other productive activity. This allows for the addition of income rather than trading a somewhat lower income activity for a somewhat higher income activity. Fourth, nearly any family member, including women and children, can help with most of the labour requirements. While total household involvement in agricultural occupations is common in Bolivia, key activities are often dependent on certain members of the household exclusively, whether due to gender norms or household hierarchy (men driving machinery, women tending chickens, etc.). Such age/gender/power divisions are less common or necessary in aquaculture.

As for the question of whether wealthier farmers enter into aquaculture, or if farmers enter into aquaculture and then become wealthier, the evidence points to

the latter. Aquaculture farmer respondents, like non-aquaculture farmer respondents, varied considerably in size of farming operation, and hence income. But lower income aquaculture farmers tended to be better off than lower income non-aquaculture farmers, and the same was observed at the high end. This suggests that farmers with higher capacity (more capital, skills, etc.) would do relatively better than farmers with low capacity regardless of the agricultural activity they engage in. Poorer farmers likewise would do relatively poorly regardless of activity. Furthermore, both aquaculture farmers and non-aquaculture farmers had similar ranges of diversity in their livelihood portfolios, including off-farm sources of income. Overall aquaculturists and non-aquaculturists, both at the high and low ends of the income spectrum, are quite socioeconomically similar. Therefore, the fact that aquaculturists tend to generate more income than non-aquaculturists across the spectrum indicates that in general aquaculture has a positive impact on household income.

The CBAVC also generates employment and increases the aggregate number of jobs in the region. This generates income for people beyond the production node and also contributes to poverty reduction for the landless and poorest. Jobs in the chain are relatively easy to access for the poorest members of society, as they require little training and few skills. Also, many CBAVC jobs are located in rural regions making them much more accessible for the poorest. However, there is one caveat to this finding; work in the CBAVC seems to be poverty reducing only to a point. The low skilled activities associated with many CBAVC jobs make it difficult for workers to acquire more advanced skills and experience that would qualify them for more lucrative employment. The large time commitment of CBAVC jobs can also serve as a barrier to skill acquisition outside of work, such as taking training or classes. Therefore, work in the CBAVC can be beneficial for poorer households, but does not generate higher value employment and therefore only marginally contributes to generating upward economic mobility. This perpetuates the common condition in the production region of living standards that are moderately above poverty conditions.

Aquaculture is also increasing incomes and reducing poverty by driving entrepreneurship. Many small-scale entrepreneurs open stores or sell goods by the road because they do not have the livelihood capital required for more lucrative employment. The CBAVC, however, has made a real contribution to opening space for lucrative entrepreneurship. The increasing popularity of restaurants selling aquaculture fish in particular has benefited numerous entrepreneurs. Input businesses are also seeing strong growth, although some entrepreneurs with high ambition but low capacity have experienced uneven success. As the system expands these spaces for entrepreneurship are likely to grow, and thereby drive further income growth, both directly to the entrepreneurs, and indirectly through the employment they generate.

6.2.2 Moving Away from Small-Scale/Small-Medium Enterprise Dichotomy

A key insight of this research concerns the debate over whether small-scale or small-medium enterprise (SME) aquaculture production systems generate the most robust economic development outcomes. Development actors have promoted small-scale aquaculture for years as a poverty-reducing livelihood. They argued that it had direct effects on poverty by generating household income and food security. But recently a group of analysts have argued that the indirect impacts from SMEs have a greater effect on poverty reduction by generating employment and lowering the price of fish. They have advocated for aquaculture development capital and technical expertise to be re-oriented towards supporting aquaculture SMEs (Allison, 2011; Beveridge *et al.*, 2010; Little *et al.*, 2012). This argument was initially controversial and seen as not being pro-poor, but is now more commonly viewed as an example of objective poverty analysis that sheds common and prominent biases towards small-scale producers in development contexts (Belton & Little, 2011). However, more recent research, as well as the findings of this work, has demonstrated that the dichotomy between small-scale and SMEs is overly simplistic (Kassam & Dorward, 2017). It rests on the narrow presumption that

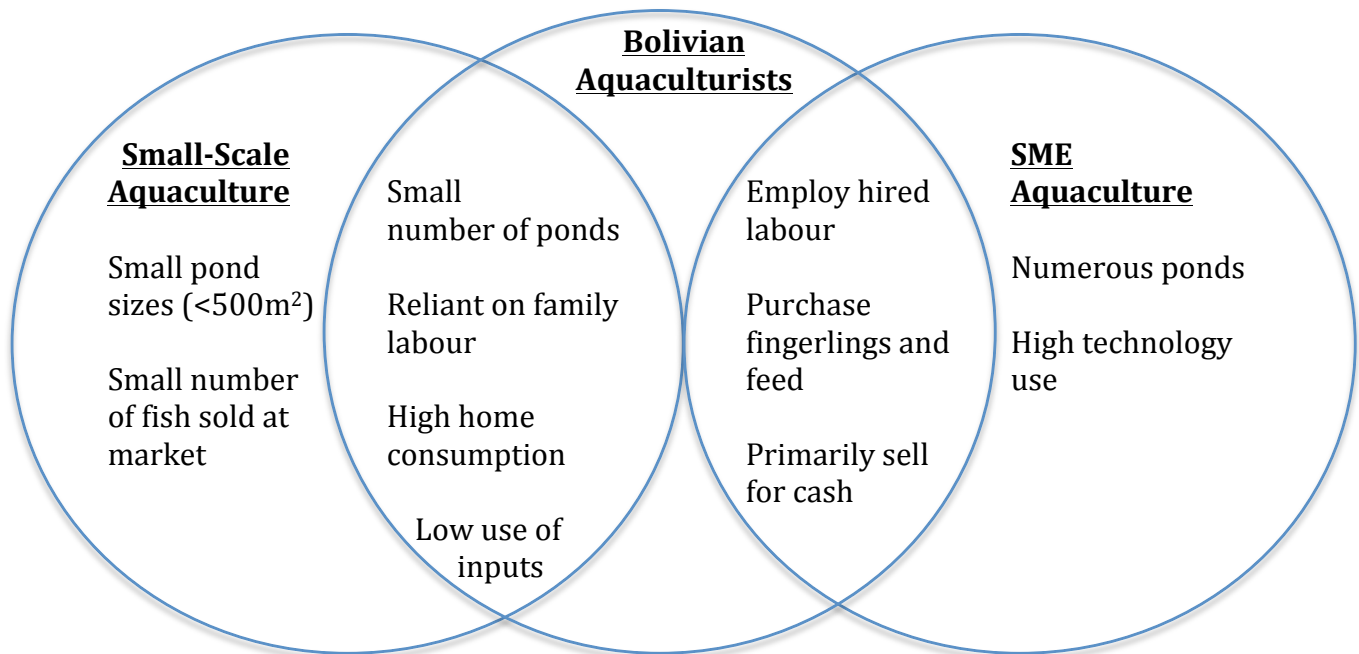
aquaculturists are easily categorized into one of two groups, rather than recognizing that the multifaceted nature of aquaculture operations is better represented with a wider spectrum of specific categorizations. It also tends to overlook the fluidity of producers to move from one production classification to another as the aquaculture system they participate in evolves.

A problem with the small-scale versus SMEs debate is that the majority of research that drove this perception was derived from Asian (China and Bangladesh in particular) and sub-Saharan African contexts. This narrow body of evidence generates an understanding of what constitutes poverty and who is poor that does not fully appreciate the diversity of the poor. In absolute terms, the impoverished strata of the population in Bolivia is likely wealthier than their counterparts in Bangladesh or SS Africa. Brummett *et al.* (2008) found that in SS Africa, although some food security benefits accrued to poor farmers engaged in small-scale aquaculture, they generated little if any income. This stifled their ability to save or re-invest, making the activity a poor option for poverty reduction. Kassam & Dorward (2017) found that in Ghana the cost of constructing one small pond was more than the country's GDP per capita, making aquaculture unobtainable for most. Arthur *et al.* (2013) argue that aquaculture in Asia has primarily benefited higher resource households. Findings such as these have been the drivers behind the calls for a shift in focus away from small-scale aquaculturists and towards SMEs. However, small-scale farmers in Bolivia, many of whom are poor, do not experience these challenges to the same extent. There, aquaculturists tend to generate household revenue. Small-scale farmers looking to adopt aquaculture are not barred by significant obstacles such as high startup costs. In Central Bolivia, being a small-scale aquaculture farmer, although not a panacea for poverty alleviation, can generate a sustainable income.

Part of the problem is the often universally applied definition of small-scale and SME, and by extension poor and non-poor farmers, when in practice it should be constructed based on regional realities. Brummett *et al.* (2008) characterize African small-scale aquaculturists as having a small number of small ponds (usually less than 500m²), reliant mostly on family labour, high home consumption, low use of

inputs, and only small quantities of fish sold for cash. They characterize small and medium enterprises as having more ponds, a higher use of technology, employ hired labour, purchase fingerlings and feed, and primarily sell their fish for cash. They go further by indicating that “the main difference between SME and artisanal farmers is motivation; artisanal farmers primarily seek food security and farm diversification, while SME farmers seek cash, often at the expense of diversity and, sometimes, sustainability,” (p380). How Bolivian aquaculturists fit in this characterization is presented in figure 6.1.

Figure 6.1: Venn diagram of Bolivian aquaculture characteristics compared to SMEs and small-scale aquaculture.



*Catagorizations drawn from Brummett *et al.* (2008).

Bolivian aquaculturists overlap the small-scale and SME designation. The research also found that there was not a close alignment between being poor and small-scale, and being wealthier and an SME. Some small-scale farmers would not be considered poor, and some SME farmers could be. In general, while some farmers fit neatly into one side or the other of the small-scale/SME dichotomy, most

farmers were simultaneously small-scale and SMEs. For example, Central Bolivian producers may hire people sometimes and not others, or always or never, and hire in various numbers for various tasks. This is driven by several factors outside of scale of operation and poverty condition. They include size of family and degree of their contribution, social capital, community relationships, and other livelihood obligations.

Overall, Bolivian aquaculturists blur the lines between small-scale and SMEs (and by extension poor and non-poor) as defined in the literature. This points to the limitations of the small-scale/SME typology and the risk of relying on it too heavily as a basis for policy and action. Brummett *et al.* (2008) claim that “evidence to date indicates that a pragmatic business approach focusing on small and medium-scale private enterprises would produce more benefits for more people than centrally planned and government led development projects,” (p371). Here too a dichotomy of intervention is proposed. This research, however, shows that a rethinking of the best approaches and priorities to aquaculture development that is appreciative of rural producer dynamics is needed, particularly for Latin America. A broad conclusion is that roles for governments and NGOs remain, and they should focus on for-profit aquaculture enterprises, but not ignore the potential of some poor and artisanal producers to participate.

6.2.3 Improving Food Security and Nutrition

More than three quarters of all respondents (78% of aquaculture producer households, 88% of non-producer households, and 88% of chain worker households) were at least mildly food insecure. Although rates of severe food insecurity were lower (10% for producers, 18% for non-producers, and 12% for chain workers), they too are quite concerning. There is a clear need for interventions to improve food security in central Bolivia.

The high rates of mild food insecurity are rooted in issues of food system stability. The most frequently cited food security problem was anxiety about food being available in the future. General poverty is likely the most significant driver of

this anxiety, and is exacerbated by the seasonality of food and income that are typical for small-scale farmers. Short-term food disruptions that can occur due to political actions also shake confidence in the reliability of food to be available on a day-to-day basis.

Severe food insecurity is also problematic across respondent groups. The primary driver is a more extreme household poverty. This can include or be a combination of having low household income, a large family, and being a single parent/income (usually female) household. Such a situation does not seem to be geographically fixed, such as urban or rural, or be due to other factors such as infrastructure, food supply, or governance.

Availability and consumption of food was analyzed by investigating the dietary diversity score (DDS) of participants. Results across the three groups (producers, non-producers, and chain workers) were quite similar. The majority consumed foods from similar key food categories. Consumption of nutritionally problematic foods that are high in sugar or highly processed was low, and respondents tended not to skip meals. People in the region do not necessarily lack a diverse diet in the sense of having a food from each of the categories identified in the DDS, but they lack diversity within each category. For example, a category for women is “vitamin A rich fruits or vegetables” and a large majority had eaten such a food the day before. However, the food that fell into that category was almost always a carrot. The likely reason for this is that a diverse diet of basic foods is available to the people in the region, but not a wider variety of less common foods, and this is rooted in general poverty. Furthermore, all respondents tended not only to eat the same foods, but they tended to eat the same simple and bland dishes. A typical lunch is a thin soup with a small amount of a few vegetables, some noodles, and a small piece of meat. A typical dinner is a piece of meat with a large serving of rice and a few vegetables that form a modest salad. Poverty does not explain this lack of diversity in food preparation. Many cultures throughout the world that struggle with poverty such as India, Southeast Asia, and other regions of Latin America, for example, enjoy a rich cuisine. There seems to be a cultural resistance

against diversity of foods. This can be seen in restaurant offerings as well as they all have the exact same small menu of dishes.

Fish consumption in the region is the dietary item that differs the most across the groups. As expected, fish producers consume more fish more frequently than non-producers and workers. Workers are the second most frequent consumers. Both of these are related to proximity and convenience. Workers have a lower consumption rate than producers because although they work with fish regularly, they typically still have to pay for it. Non-producers claim to eat fish, but its source is varied. While restaurants and markets were regularly mentioned, the most mentioned source was recreational/subsistence fishing from a river. This is an often overlooked and underappreciated pathway to fish supported nutrition and food security (Cooke *et al.*, 2017).

All of these findings point to a number of insights. The first is that being an aquaculture producer has a modest but nonetheless important effect on reducing food insecurity, both in mild and severe forms. The pathway between these is likely primarily based on the increased income that aquaculture is providing to producers. Household consumption, and the ease of preparing fish, are also likely contributing factors. Fish will form the central portion of a meal (unlike crops), is a good source of protein and multiple nutrients (unlike most crops), is easily acquired for quick consumption (unlike livestock), and does not require processing of food beyond what is needed at a particular moment (unlike livestock). The only agricultural product in Bolivia with similar characteristics is chicken, but even it is inferior since it is not as easy to produce in large numbers. Overall, aquaculture fish help to reduce food insecurity.

The second insight is that food system stability is a key concern, but less so for aquaculture producers. They had less anxiety about obtaining food in the future on average compared to non-producers and chain workers. Aquaculture, as part of a diversified livelihood portfolio, contributes to reduced anxiety about food system instability, can act as a bulwark against food instability thanks to its low input requirements, low susceptibility to environmental shocks (as compared to many crops), and relatively stable market price.

A third insight is that the homogeneity of diets in the study area may be a barrier to food system development. While poverty is partly to blame for similar diets, it can only be a partial justification as diets were highly homogenous across households regardless of their socioeconomic condition. An entrenched cultural preference may act as a barrier to adoption when introducing and scaling up the consumption of a food that is regionally and culturally atypical. Such a narrow interest in food may pose a challenge for development workers looking to improve diets through the introduction of new foods, such as fish.

The homogeneity of diets also suggests problems with food access. The dietary diversity findings point to widespread access to basic food staples but not to many alternatives. Should availability of one or more of these staples decline, many people may experience increased vulnerability to food insecurity. Increasing the ubiquity of fish and other atypical foods may contribute to increased resilience against food insecurity, but strategies for overcoming cultural resistance to new foods will have to be established.

Although aquaculture production households have higher rates of fish consumption, it does not translate into improved overall household nutrition. Aquaculture households continue to have very similar diets to other non-production households, indicating that neither the increased income nor the direct fish consumption they enjoy has improved or altered their diets vis-a-vis other community members. This insight contributes to filling a key gap in the literature identified by Bene *et al.* (2016).

It is recommended that fish consumption, and aquaculture fish consumption in particular, be promoted in Bolivia. This would ideally take place through partnerships or at least mutually informed approaches between government and NGOs, and focus on the health benefits of fish as well as the support of local producers and the food's cultural connections. This would help to increase the ubiquity of fish, and potentially increase the population's interest in a more diverse diet, all of which would make contributions to food security. The lessons and insights from central Bolivia can inform activities and interventions in other countries and regions where aquaculture is being promoted as a pathway to food

security. Finally, the improved clarity of the pathway between aquaculture and food security laid out by this research can help address poverty and food system sustainability.

6.2.4 Equality

Several studies have found that although women often have a large presence in post-harvest value chain nodes, such as processing and retailing, in general they tend to be relegated to lower value opportunities (FAO, 2017; Coles & Mitchell, 2011). In the central Bolivian aquaculture system, this does not hold as firmly true. Women are not only participating at all nodes, but also occupy some leadership roles. While there is room for improvement and further empowerment of women, Bolivian aquaculture sheds light on some pathways for women that may be forged in other contexts.

Drivers of women's relatively broader participation in aquaculture in Bolivia are both structural and social. On the structural side, aquaculture is conducive to women's participation as ponds tend to be constructed close to homes, and the day-to-day labour and time requirements for aquaculture are quite small. Even the intensive production activities, such as stocking and harvest, are very short compared to other agricultural activities. Women can care for fish with minimal displacement of culturally established household responsibilities (homemaking, childcare, etc.). This is in contrast to most other agricultural activities that are much more time and labour intensive.

On the social side, increasing women's participation and leadership seems to be generating a positive feedback loop. Becoming key breadwinners raises women's social profile, directly and indirectly contributes to benefits for their children, and overall supports empowerment. Women in the vast majority of circumstances are equal decision-makers in aquaculture adoption and expansion. Some women have expanded into other businesses such as restaurants, which are a manifestation of economic mobility and normalizes women in positions of economic power. Women's leadership at retail nodes is further evidence of growing respect and

authority. Aquaculture in central Bolivia is highly inclusive of women and seems to be driving further participation and empowerment.

Women's participation in aquaculture also does not cleanly fall along economic lines, unlike in other contexts where a family's socio-economic status means a higher likelihood of women participation (FAO, 2017). Women participate in production across the spectrum of income levels, and do so in a multitude of capacities. The economic situation of a farming household, therefore, does not act as a significant barrier to women's participation or championing of aquaculture for the household.

Women as workers in the CBAVC are also common, and this has positive social impacts. The primary one is that the employment opportunities for women, who are a disadvantaged group. Such positions are generally accessible to the landless and the poorest of the poor, thereby contributing to poverty reduction. Although the work has long hours, it is not physically labour intensive, and some positions, such as those at markets, are even accommodating of children at work.

Although there are a number of benefits that accrue to women who participate in the CBAVC, there is some room for improvement and opportunities that could be exploited. Women, although in some leadership positions and in charge of some household production, are not as prominent in these categories as men. In some cases this is explained by them having equally important roles elsewhere (eg: owning a store, having a different job), but in aggregate indicates that they remain unequal to men. Further promotion of women in aquaculture, with emphasis on its fit with traditional roles and responsibilities, would help to improve equality in aquaculture. Specific forms of training should also be targeted at women. A prominent example is record keeping. Poor or non-existent record keeping is a significant barrier to household aquaculture production upgrading, and to broader system growth in general. For those households who did keep records, women were often the ones solely responsible. Training that targets women would not only help to increase the frequency and quality of record keeping, but also broadly generate a more resilient and profitable aquaculture system. Other training targeted at the tasks they tend to do most often (feeding, marketing, etc.) would

further contribute to women's empowerment and sustainable growth of the central Bolivian aquaculture system.

Aquaculture may also provide pathways to indigenous empowerment. Although less clear than the connections for women, there are two spaces where fish can be more closely linked with indigenous identity and therefore empowerment. The first is based on the lessons learned from coca. The aquaculture production region of central Bolivia closely overlaps with the nation's coca production region. Coca has been a significant driver of indigenous identity building, empowerment, and by extension, attainment of governmental power. Since fish is also produced in the region, and is a relatively unique but revered food, it too could occupy a similar (albeit less significant) position as coca in the national imagination. With certain forms of promotion that connect fish to the Pachamama, to health and to environmental responsibility, it could be entwined in a narrative of national pride associated with the indigeneity of the country.

The second space where aquaculture fish could lead to indigenous empowerment flows from the first space. Fish is a prominent food for catholic religious ceremonies and celebrations. Connections may be made to the honorable activity that indigenous producers (most of whom are themselves catholic) are doing in providing such a revered food for spiritual purposes to Bolivians.

Building social impacts into food system development can address food system sustainability problems. It recognizes that economic and environmental sustainability are often achieved by following pathways that traverse through social issues. Improving food systems, and in this case the central Bolivian aquaculture system's impact on equality of gender and race, can be key components in addressing the triple challenge.

6.3 Pathways to Rural Food System Development

This research has yielded a number of insights related to bolstering rural development generally. Those that are more specific to aquaculture systems and

the Bolivian context were laid out in the preceding sections. In this section, the broader insights relating to food systems and development are presented.

6.3.1 Transitioning from Horizontal-Vertical Value Chain Analysis to Holistic Value Chain Analysis

In recent years there has been a rapid expansion of interest in value chain research and its usefulness for development. As that interest has grown, so too has a recognition that a traditional value chain approach, that was often similar to a supply chain analysis, insufficiently captures the specifics and dynamism of development contexts. This led to calls for the inclusion of horizontal elements – usually social and environmental – into traditional value chain analysis (Bolwig *et al.*, 2010; Riisgaard *et al.*, 2008; 2010; Rubin & Manfre, 2014). While this has been a welcome and needed approach, it maintained the rigidity of value chain analysis by emphasizing the exploration of specific horizontal attributes of the value chain in inflexible ways. This rigidity was further reinforced by the disproportionate weight given to quantitative over qualitative data and the lack of complementarity of such data. This research sought to contribute to filling this gap by creating a value chain analysis that is more holistic in its approach. This involved the following six components:

- A semi-structured interview process. This allowed for a more detailed discussion with respondents about a topic or claim. It provided follow up questions to confirm or better understand the reasons behind responses.
- Collection of quantitative and qualitative data. This built understanding of an issue by uncovering different ways that an issue can be understood and confirming that the results from one form fit with results from the other.
- The use of a comparison group. By interviewing farmers who were neighbours to current aquaculture producers, and therefore theoretically could take on aquaculture but do not, it was possible to understand how aquaculture stacked up against alternatives, and what household differences

emenated from aquaculture production. It also allowed for more precise identification of barriers to entry into production.

- A learning approach to data collection. As interviews were carried out, issues and situations which were unknown or originally misunderstood were noted. As interviews continued, focus on confirming these and estimating their significance could be done with subsequent interviewees. The most important element of this approach was the interviewing of key informants near the end of data collection, once the bulk of producer, non-producer, and worker surveys were conducted. In this way insights garnered from those interviews could be discussed with individuals who have a broader understanding of the nature and functioning of the CBAVC.
- A social, cultural, political, and historical analysis. A shortcoming of conventional value chain analysis is that it does not account for the mediating influence of these factors. In a context such as Bolivia, these factors play a particularly outsized role in helping or hindering development.
- An exploratory approach. An issue with many value chain analysis that incorporate horizontal linkages has been they seek to uncover issues of interest to the researcher, but that may not be the most significant issues in chain functioning. This may reduce the value of the research for participants and stakeholders, and may generate an incomplete picture of the context that can lead to misdirected policy and action. An exploratory approach that probes for the key issues and remains open to their identification can shore up these potentially less than ideal outcomes from the traditional vertical-horizontal value chain analysis.

One example of the consequent effects of this holistic approach can be illustrated using an example from this research. In recent years focus on, and enthusiasm for, credit as an emancipatory tool for the poor has grown. Lack of credit is often blamed for slow growth in agricultural sectors, particularly those involving small-scale producers. In the central Bolivian aquaculture system, credit

was believed to be lacking and hence a barrier to development. This was confirmed by questions asked of producers and non-producer respondents. However, the holistic analysis based on the components outlined above, allowed for a more precise understanding of the nature of credit in the aquaculture system. As outlined in chapter five, credit was frequently accessed by aquaculture farmers, indicating that although it was likely more challenging for the poorer farmers to access, it was nonetheless available. Conventional issues of credit-worthiness were the primary obstacles. With respect to access to credit for adopting aquaculture, again the initial rigid responses alluded to a situation that, when explored further, turned out to oversimplify the situation. When non-producers were asked why they had not adopted aquaculture, the most common answer was lack of money or credit. But when followed up with a discussion of whether they had pursued credit for aquaculture, or if they knew about credit options, or if they would adopt aquaculture immediately if credit was readily and easily available, non-producers tended to waffle. The more holistic approach uncovered the fact that when non-producers were pressed for an answer for why they had not adopted, it was easy to blame a lack of money. But in reality, a number of more subtle factors were at play. Many were comfortable in their current activity, many did not experience sufficient incentives to adopt aquaculture, and others simply wanted to provide an easy answer to a straightforward question. The holistic value chain analysis adopted for this research allowed for this more precise understanding, and thus provided insights that can lead to more relevant recommendations.

The significance of this approach to value chain analysis is that it can improve its worth to development analysts and policy makers. It also generates more bottom-up than top-down insight; opportunities and challenges are identified by participants rather than presumed by researchers. As action towards building more sustainable food systems increases, having an approach that provides understanding of the complex interaction of social, environmental, cultural, and economic factors that influence food systems will become increasingly critical.

6.3.2 Navigating Food Sovereignty

The Central Bolivian aquaculture system exhibits characteristics of being a food sovereign system. Following Akram-Lodhi's (2015) five key components²⁷, the system tends to focus on food for people, value food providers, is local, builds knowledge and skills, and is environmentally friendly. However, like the food sovereignty concept more broadly, the food sovereignty nature of the aquaculture system faces a number of challenges and inconsistencies. The main problem is that the people in the system are not aware of it as being food sovereign. The majority of respondents had never heard of the term food sovereignty yet alone knew what it means. While many terms would be obscure to small-scale farmers who generally have low levels of formal education, food sovereignty is meant to be a concept of the peasant class. It is not only supposed to be embraced by them, but to emanate from them. Bolivia is one of the few countries in the world where the concept is embedded in political discourse and policy-making. If any peasants were to be expected to be familiar with the concept, it would be there. Although the aquaculture system of central Bolivia is generally food sovereign, this condition is much more coincidental than explicitly created.

In brief, ownership of the food sovereignty concept in Bolivia is in the hands of the elite. The manifestation of this situation is due largely to the top-down nature of food sovereignty in the country. Because it has become a policy of the federal government, the very people who are meant to be owners of it have seen it appropriated. This appropriation to the federal level, and by extension the elite, is further perpetuated by the ongoing food sovereignty policy and law making that is being done more in the name of the people rather than with the input and participation of the people. This contradicts the spirit of food sovereignty and raises the question of who is the sovereign in food sovereignty? While food sovereignty can include the state, indeed its role in policy-making makes it necessary, it is not sufficient, nor is it primary. One could argue that in Bolivia, because of the indigenous and populist leadership of Evo Morales, the state is an effective

²⁷ See chapter 2 for a detailed outline of the five components of a food sovereign system.

representative of the peasant class, and therefore it is not an elite institution. However, this ignores the oxymoronic nature of the idea of a non-elitist state government. It also ignores the recent history of Bolivia that has seen the MAS party attempt to solidify its rule. Food sovereignty policy and discourse in Bolivia has been manufactured at the state level, and then disseminated to the people. Ideally in a food sovereign system, the construct of food sovereignty would be defined by the people, and then directed upward to the regional and state governments for implementation.

The few respondents who were familiar with food sovereignty and who could comment on it authoritatively confirm these findings. While their sentiments tended towards the positive, it was in an abstract form. They agreed with what food sovereignty sought, in a general sense greater social justice for the peasant class, but lamented the lack of concrete action and 'buy-in'. Research in other food sectors of Bolivia supports the views of these respondents and of this research (eg: Cockburn, 2014; McKay *et al.* 2014; McKay & Colque, 2016; McKay, 2017).

6.3.3 Clustered Production, Short Value Chains, and Local-Regional Food Systems

A key insight of this research is that emphasizing a combination of food production clusters, short value chains, and regional food systems may be an effective pathway to building more economically, socially, and environmentally sustainable food systems in countries of the global South. It holds potential as an approach to scaling up small-scale food systems in rural regions.

Production Clusters

A cluster is a grouping of interconnected businesses that are geographically concentrated. The value of cluster formation has long been recognized in the business world. Porter (1998) has said "...paradoxically, the enduring competitive advantages in a global economy lie increasingly in local things – knowledge, relationships, and motivation that distant rivals cannot match" (p.77). He argues

that clusters can increase the productivity of the companies in the cluster, drive innovation, and stimulate the creation of new businesses (1998). While he was writing about industry, the same idea has merit when applied to agricultural based rural development.

The central Bolivian aquaculture production system is a cluster. It is a grouping of interrelated producers, businesses, and workers in a specific geographic location. This clustered nature has yielded a number of outcomes beneficial for development. The first is the social embeddedness of the system, which fosters information transmission, collaboration, and a degree of predictability of trends in the system. This has contributed to increasing the resiliency of participants, and the system as a whole, to shocks. The second is that it promotes rural employment. Having input businesses and production systems close together allows for the formation of a somewhat specialized workforce and the provision of sufficient work to keep it occupied. The creation and maintenance of rural off-farm work is considered a critical component of effective rural development. The third benefit is the potential for positive social outcomes. While rural food production clusters do not in and of themselves create social improvements, they can act as vehicles for spreading positive changes throughout a region. The participation of women in aquaculture, for example, once established as valuable, is more likely to be recognized and spread. If production is scattered, sociocultural barriers are harder to breakdown. Potential aquaculture adopting households would be less likely to see and be convinced of the merits of women centered aquaculture, whereas direct and constant exposure to the successes of such systems would be formidable evidence to ignore. Clusters also serve to spread information quickly. Another social outcome is that clusters can help to imbue the product in question, in this case fish, with social or cultural value. The place of production has long been a tool of product promotion (think Champagne, Greek olives, Japanese fish, Argentinian beef, etc.) and has provided such regions and their people with a source of pride, and therefore empowerment. The combination of these characteristics of production clusters can have important positive effects for sustainable scaling up of food systems.

Production clusters for rural agriculture do have some potential drawbacks. The most significant is the effect on price. Clusters without an absolute or comparative advantage over production in other regions or countries may cause price inflation of their product. However, if and/or how this would occur is dependent on factors beyond simple supply and demand. If there are high inefficiencies or input costs then a product's price may increase and make it uncompetitive with alternatives. But, if short value chains are maintained, which is argued for in the following section, than this may offset price increases by reducing the number of parties that contribute to the formation of the final price. Furthermore, if a regional food system were emphasized, then the increased price could be offset by lower transportation costs. A second potential drawback is the disadvantage producers outside of the cluster would face by not being in the cluster. If sufficiently disadvantaged they may be forced to exit the system in question altogether, and the multiplier effects would potentially be unemployment and income losses.

These potential drawbacks establish the need for further research. A better understanding of the price effects is needed, as is the effects on producers and stakeholders outside the production cluster. However, despite the potential challenges posed by production clusters, they hold opportunities that when combined with the following two rural food system development approaches, hold significant socioeconomic potential.

Short Value Chains

A short value chain is one where the steps taken from the conception of a product to its consumption are minimal and the pathway is not burdened by complexity. In a geographical sense, this usually means connections between rural producers and consumers in local towns or in some cases nearby cities. The CBAVC is a short value chain as the product does not travel far, does not transfer between many hands, and is not significantly affected by regulatory or institutional actors.

Short value chains are ubiquitous amongst food products in rural regions of the global South. Semi-subsistence and small-scale cash oriented farmers more

often than not produce their products with minimal outside influence and sell them at nearby outlets. They tend to be personally involved in many if not all the product's value chain stages. For such producers, a short value chain is part necessity and part choice, depending on individual situations. For low capacity farmers, long and complex chains are not an option, as they require standards, regulations, and scale of operation that they simply cannot meet. For moderately higher capacity farmers, participation in longer and more complex chains, such as global value chains (GVC), is sometimes possible but comes with new and greater risks, and an overall increase in livelihood volatility. For many GVC participants, participation can lead to immiserating work, adverse incorporation, or being barred or ejected from the chain entirely (du Toit, 2004; Phillips, 2011a; 2011b; Phillips & Sakamoto, 2011; Stoian *et al.*, 2012). This makes long chain participation often inconsistent with poverty reduction and socioeconomic sustainability for small-scale rural producers.

Entering into long and complex value chains has been heavily promoted in recent years by multinational development institutions and some analysts. The view is that participation in GVCs opens up large markets for producers. In reality, however, because of the complexity and asymmetrical power relationships inherent in most food GVCs, only the most capable and resilient producers (those who are far from poverty) are able to participate and benefit. Small-scale farmers are often either barred from participation or adversely incorporated, and therefore bypassed or harmed by global value chain oriented development strategies. GVCs are also promoted because of the belief that they generate employment. While off-farm rural employment generation is critical for rural development, the nature of employment in GVCs is often associated with similar problems as would be faced by a small-scale producer. Social and geographical dislocation engenders weak ties between employers and employees that tends to place employees in a constant state of uncertainty and vulnerability. The volatility that is common in international markets, the concentration of activities under one enterprise, and the heavy profit motive all contribute to the disposability of workers and efforts to reduce their wages. Although long and complex chains often create employment, they tend not to

foster sustainable livelihoods. Another misunderstood angle of employment creation from GVCs is that the economies of scale that such chains engender likely yields a net deficit of jobs as compared to numerous small and medium enterprises, although more research is needed to confirm this.

Due to the risks and potential negative outcomes of participating in long and complex value chains, it is argued here that development efforts for small-scale producer poverty reduction and sustainability should focus on enhancing short value chains. Short value chains have a number of advantages for small-scale producers. Short value chains contain less transactional friction. The more complex a value chain is, the more difficult it is to navigate successfully and the more likely it will be that barriers arise. Long chains are more likely to involve actors who are somewhat superfluous to the production or consumption of the product travelling the chain and who siphon off value that would otherwise accrue to more critical participants such as producers or consumers.

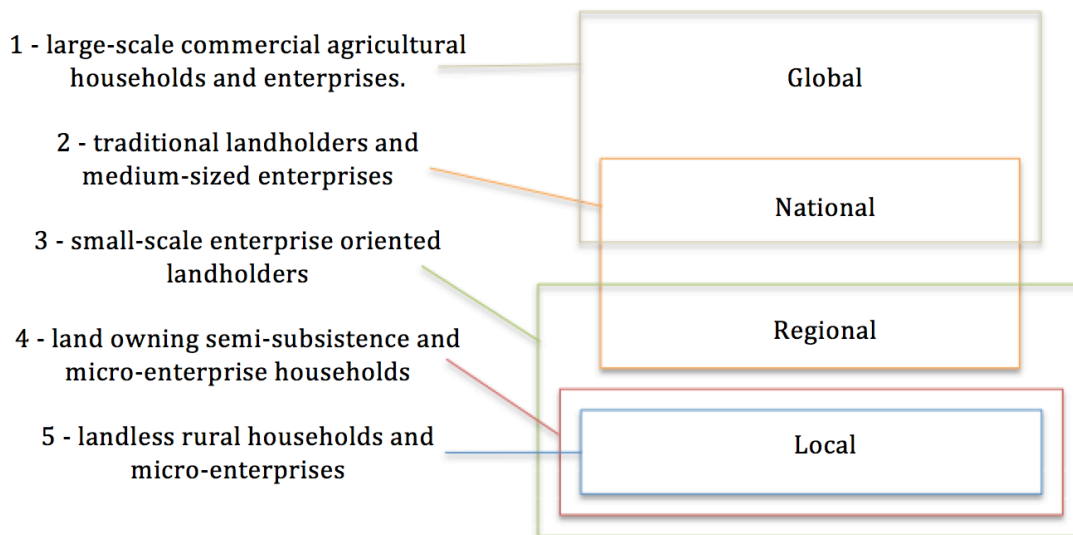
The governance of short value chains also tends to be more favorable to small-scale producers. They tend to be market oriented, allowing for more balanced power relationships between chain actors. Complex value chains by contrast tend to generate asymmetrical power relationships amongst chain actors, with large retailers or traders exerting downward pressure on prices. Producers often find themselves losing their share of value creation. Finally, short value chains are what the vast majority of small-scale food producers are a part of. Improving participation in short value chains is a more direct and impactful pathway towards improving socioeconomic conditions and the sustainability of the food system.

The arguments for the development of short value chains are not meant to be an attack on long complex value chains. Participation in complex value chains is often appropriate and more lucrative for larger scale producers. Such chains do generate employment, contribute to meeting globalizing demand for food, can have important macroeconomic development impacts, and can in some cases apply downward pressure on food prices. But, when it comes to generating rural development for small-scale food producers, their potential seems less than that offered by short value chains. For these reasons, a development and scaling up

approach that can be characterized as “chain enhancement and transitioning” is needed. The approach starts with the recognition of which scale of chains certain groups are participating in, and what chains, given their capacity, they should be participating in. If producers are participating in chains that are beyond their capacity, they should be encouraged and supported to transition to the chain best suited to their capacity. Development interventions should focus on enhancing chains, which requires a systems approach that identifies chain bottlenecks and challenges, and looks to address them for the benefit of the most marginalized actors. Finally, as a means to scaling up the system in question, interventions should seek to transition producers to a broader chain scale. Transitioning is fluid, producers can participate in more than one value chain scale, and indeed would do so to ease into the transition and mitigate the risk of transitioning into a new scale of chain. For poverty reduction efforts, improving the shortest value chains has the most direct impact on the poor and near poor since it is the short local and regional chains that they participate in. This approach also promotes a more sustainable food system and contributes to addressing the food production and poverty alleviation components of the triple challenge. Development interventions focused on environmental sustainability would support the third triple challenge component.

An important component of this approach is the recognition that rural producers are not best described using a dichotomous typology of the small/large variety. As outlined earlier in this chapter, the socioeconomic condition of rural producers is better characterized as lying on a spectrum. Using a more specific typology for rural producers, figure 6.2 outlines the best value chains for different socioeconomic producer groups to target. By extension, it demonstrates that development activities that seek to directly improve short value chains (local and regional) will have the most direct impact on the poor and close to poor.

Figure 6.2: Socioeconomic groupings* of rural producers and ideal value chain scale participation



*Wealth groups adapted from those outlined in OECD (2010)

Value chain scale should also be outlined. Local value chains typically exist in close geographical proximity to producers and consumers are often found at businesses and markets that are either neighbors or in nearby towns. The local value chain in the CBAVC would end in the towns of Yapacani or Ivirgarzama, which are the small nearby urban hubs of the aquaculture region. A regional value chain will expand into Santa Cruz or Cochabamba. CBAVC producers who sell to La Paz, Tarija, Oruro, Sucre, and other cities that are far afield would be considered to operate in a national value chain. Global chains would transport the product to any place in the world. Currently no CBAVC producer participates in such a chain, and none are likely to in the short to medium term.

Aquaculturists in the study benefited from many of the advantages of short value chains outlined above. Enhancing the chain, by incorporating some of the recommendations in previous sections, will prepare some CBAVC producers to engage with larger scale chains, which will in turn open space for lower capacity producers to expand their participation. This dual approach of enhancing and

transitioning will aid in scaling up the system while simultaneously driving poverty reduction.

Local-Regional Food Systems

Supporting production clusters with a focus on short value chains means that bolstering local and regional food systems is critical for rural development. Such food systems not only facilitate the participation of small-scale farmers, but also generate multiplier effects that accrue primarily to rural and semi-rural people. Building up local and regional food systems for rural development in the global South has been largely overlooked in economic and development literature, but has recently appeared front and center in the FAO's 2017 *The State of Food and Agriculture: Leveraging Food Systems for Inclusive Rural Transformation*. It argues for the "harnessing of food systems" by connecting rural areas using food value chains to nearby towns and cities. It considers that "this inclusive rural transformation would contribute to the eradication of rural poverty, while at the same time helping end poverty and malnutrition in urban areas," (p.vi).

A key benefit of a local-regional food system is the economic impact it can have. When food is produced and consumed in a particular area, the vast majority of support activities required to support the product as consumers demand pulls it through the chain are likewise located in the area. This generates jobs and leads to income being re-circulated in the local economy, thereby having both employment and consumption effects. It also creates space for entrepreneurship by offering simple pathways to serve product value chain. Moreover, it also makes entering the chain relatively easy since no power dominates the decision making or functioning of the chain. The bolstered producers, and opportunities for workers that local-regional food systems offer overall boost rural economic development.

Another benefit of local-regional food systems is the impact they can have on food security. The economic activity they generate provides an important indirect pathway to food security, but these systems can also generate direct impacts. Better nutrition in local-regional food systems is driven by increased availability of nutritious foods. It promotes local produced food that is more likely to be whole

foods and culturally relevant. This also pushes back against the trend of processed food consumption that is a driver of health problems in rural areas (Popkin, 2014). Local-regional food systems also decrease food access volatility and vulnerability to shocks to the food system. This is because local-regional systems reduce the reliance on foods that travel a longer and more complex value chain that is more at risk of encountering a breakdown.

Finally, local-regional food systems may generate increased social sustainability. The close proximity and interaction of people involved in food value chains reduces social dislocation and can be a positive force for closer connections between food, culture, and wellbeing. Local-regional food systems engender a sense of community, and this can increase organizational capacity, local pride, and overall local-regional empowerment.

Local-regional food system development requires a systems approach. One that considers the actors and institutions in the system, how they interact with one another, and how that manifests in opportunities and challenges for marginal actors. Taking such a pathway to rural development is likely to yield more poverty reduction and sustainability outcomes, and will contribute to addressing the triple challenge.

6.4 Summary

This chapter began by outlining how the findings of this research revealed areas for improvement to the CBAVC, particularly enhancements to the chain that would benefit producers and workers. The second section discussed the connections between aquaculture and dimensions of poverty such as income, equality, and food security. It provided insight into how such connections can be improved and how aquaculture can be a greater force for sustainable rural development. The third section made a unique contribution to knowledge at a more macro scale than the previous two sections. Drawing on the insight from the research, it outlines ideas for how aquaculture development, and potentially other agricultural livelihoods, can be structured to improve rural development outcomes.

Through these pathways, food systems may become more socially, economically, and environmentally sustainable as well as productive, and therefore serve to address the emergent triple challenge of reducing rural poverty, mitigating the environmental impact of food systems, and increasing production to meet the needs of 9 billion people by the year 2050.

Chapter 7: Conclusion

This dissertation set out to understand how to forge pathways to more sustainable food systems. Such pathways must overcome the triple challenge facing food systems: the need to be more productive, to reduce their environmental impact, and to reduce rural poverty. As the global population approaches 9 billion, and environmental and economic challenges remain acute, especially for the rural poor, this research makes an important contribution to understanding how to build a more sustainable food future.

Aquaculture systems are particularly in need of insights for greater sustainability. As the fastest growing food system on the planet, and one that is critical for the food security of people in the global South, it is necessary to understand how aquaculture can overcome social and environmental problems while at the same time evolving into a food system that helps to sustainably feed the planet (FAO, 2016). This research has provided insights into aquaculture systems that contribute to answering key questions about aquaculture and its socioeconomic impacts, as well as how it can become an important and sustainable contributor to poverty reduction for marginalized rural peoples.

In central Bolivia, the recent growth of the aquaculture system presents opportunities for income generation, food security, and women's empowerment. Such opportunities tend to be available across actor groups in the CBAVC, and can contribute to a sustainable, equitable, and poverty reducing food system. However, the central Bolivian aquaculture system also faces numerous challenges related to productivity, food health and safety standards, and increasing competition. The linkages that this research has uncovered between the system and these outcomes build our understanding of how to utilize the opportunities while avoiding emerging challenges. This research also has value for other Latin American countries looking to bolster their aquaculture systems. Overall, the insights derived from this study contribute to understanding development pathways for Bolivian aquaculture

participants and aquaculture actors around the world specifically, as well as small-scale rural farmers and food system actors of the global South generally.

The first objective to achieving the study's overall goal was to conduct a value chain analysis of the smallholder aquaculture system of central Bolivia. The purpose was to generate a blueprint of the functioning of the system and to understand how power and benefits were distributed (or not) throughout the chain. To meet this objective, as well as the other objectives of this study, a holistic value chain analysis method was developed. It incorporated methods to investigate horizontal linkages: the social, cultural, and political context that contributed to shaping value chain functioning and outcomes. This included the use of mixed methods, semi-structured interviews, and the adoption of established methods for the analysis of food security, gender and poverty. It also included an in-depth review of Bolivia's history, politics, and sociocultural context since these play an important role in mediating development possibilities, approaches, and outcomes. This approach makes an important methodological contribution by building on the work conducted by scholars who have pointed out the need for value chain analysis to yield development insights beyond economics and governance (Bolwig *et al.*, 2010; Riisgard *et al.*, 2010).

The holistic value chain analysis found that the CBAVC had few nodes of participation and little institutional oversight, making it a short value chain. It also found that power relationships tended to be balanced between producers and retailers. This was a particularly interesting finding given that agricultural value chains tend to be buyer driven where lead-firms, usually large brands or retailers, dictate terms of chain function and processes (Gereffi & Korzeniewicz, 1994a; Gereffi & Korzeniewicz, 1994b). This has contributed to historically stable prices for Tambaqui that have provided good profit margins and return on investment for producers. The CBAVC also generates employment across regions and for marginalized actors, although the extent of such employment is limited. For input businesses, large numbers of customers is superior to a few large-scale operations that would have much more bargaining power, making the short nature of the chain favorable to them as well. The research has contributed to our understanding of

short value chains and how they can provide rural economic development if effectively fostered and perpetuated.

The second objective was to investigate aquaculture's effect on the environment, and the income, food security, and gender equality of chain actors. The environmental analysis revealed that the CBAVC had a relatively minimal impact on the environment. The culturing of an indigenous fish species that could be given feed with a low content of animal protein, and no fish protein, in small earthen ponds means that many of the environmental issues that challenge marine aquaculture are not present in the Bolivian system. The short value chain and locality of the system also indicates that it likely does not generate significant GHGs or other forms of pollution related to production, processing, and transport. Environmental concerns have historically been high for aquaculture (ex: Goldberg & Naylor, 2004; Naylor *et al.*, 2009) which has led many analysts to point out the importance of identifying and analyzing more environmentally sustainable aquaculture systems (Dinesh *et al.*, 2017; Waite *et al.*, 2014). Understanding the central Bolivian system, with its low environmental impact, has led to the identification of some best practices for environmentally sustainable pond aquaculture, and provides an outline for the adoption of a similar model in other contexts.

The income effect of the CBAVC was positive and dispersed. Producers varied in their household income and in the size of their aquaculture operations, but nonetheless they tended to have higher household income than non-aquaculture producers of similar means. Income for workers associated with aquaculture was comparable to similar non-aquaculture jobs. Most such jobs are un-skilled and therefore tend to be low paying, but do provide income above the poverty line. Income for input supply businesses was very robust for those who were established, but some upstart businesses would go out of business after a few years of having started. Anecdotal evidence indicates that this tended to be due to a lack of skills either in business or in producing the product in question (feed or fingerlings) rather than a structural problem with the CBAVC. A key insight generated by this research is that aquaculture tends to be accessible to small-scale farmers and can

generate returns that contribute to poverty reduction. This is somewhat inconsistent with aquaculture literature that argues for small-medium enterprise aquaculture as the necessary pathway to poverty reduction through the employment it generates (ex: Allison, 2011; Beveridge *et al.*, 2010; Little *et al.*, 2012). The Bolivian context shows that small household based production can also be an effective poverty-reducing model.

Food insecurity was found to be widespread, but generally (although not always) mild. Rates of food insecurity were slightly lower amongst aquaculture producer households as compared to neighboring non-producer households and worker households. This was true of both prevalence and severity of food insecurity. The primary reason for this is likely the added income households receive from being aquaculturists. Findings also corroborated the common finding in other contexts that another important pathway between aquaculture and food security is through increased consumption in producer households. Diets amongst respondents tended to be somewhat diverse, indicating that there were no systematic barriers to balanced and nutritious diets. However, although a variety of food groups that made for a well-rounded diet were available, there was not much diversity within the groups. Most diets consisted of a small number of staple foods while higher-value and processed foods were uncommon. This led to the interesting finding that all people in the study region, regardless of social or economic standing, tended to eat a small number of similar dishes, and did so routinely. There seems to be a cultural resistance to new foods, which is an important consideration for development interventions looking to introduce a new food value chain to a region with a similar context for the sake of economic development and/or food security. Unlike the prevalence and severity of food insecurity, food diversity was also found not to vary between aquaculture producers and other people in the study region. This contributes to answering an important question posed in the aquaculture and food security literature about whether aquaculture producers tended to have different diets than non-producers, beyond simply consuming more fish (Bene *et al.*, 2016).

To investigate the nature of women's participation in the CBAVC, sex disaggregated data was collected. This met the call by many analysts and development institutions for value chain research that explicitly explores gendered division of labour and the consequent effects (Kruijssen *et al.*, 2017). The degree to which women held leadership roles in aquaculture activities varied, but they were usually involved in the key household decisions regarding starting and expanding aquaculture. This indicates that aquaculture as a household livelihood has an empowering effect for women. Another important finding was that there was no clear correlation between household income and women's participation, which indicates that women participated in the activity regardless of the socio-economic standing of the household. A further finding of this research related to women's participation was that the aquaculture system model in central Bolivia shows indications of being conducive to their participation. The proximity of the work to the home, the low physical and capital demands of the activity, and the connections to household food security combine to make this form of aquaculture suitable for women. By extension, it may serve as a household livelihood diversification strategy for some households that is minimally disruptive to the capital and labour needs of existing livelihood activities.

The third objective was to identify opportunities and barriers to aquaculture value chain entrance for potential chain actors and improved participation for current chain actors. The primary barrier to entrance into aquaculture was land ownership. Other barriers such as start up capital and technical know-how were present, but credit and training in the area tended to be accessible. Generally, barriers to entry into aquaculture were less steep compared to other agricultural activities common in the study area. For chain workers, barriers to employment in the CBAVC were minimal due to its low demand for skills, the availability of work in both urban and rural areas, and the similarity of the work to other agricultural jobs throughout the value chain. Becoming an input provider or fish retailer were the hardest nodes of the chain to enter. The primary reasons tended to be the large capital commitment required, as well as developing the necessary advanced technical and business skills.

A large number of details related to upgrading for actor groups are presented in this study since there are numerous small improvements that could be made. Particularly important ones for producers included recommendations for higher yields, adoption of technology, and improved marketing strategies. Opportunities for workers to upgrade were scarce since there are few human-capital intensive positions in the CBAVC. For input providers, more specialized services oriented to different geographical areas was suggested as a potentially beneficial upgrade. For retail locations, there were a number of small improvements that were identified that cumulatively could have significant effects. These were related to transport, storage, handling, processing, and product differentiation. The research and findings of this objective overall contributed to understanding applied elements of aquaculture development across the value chain.

The fourth objective was to investigate how food sovereignty and the localized nature of the aquaculture system mediate development outcomes. Food sovereignty is not a widely known term in the study region, regardless of respondent group. This implies that the concept and actions taken in its name are constructed by the governing elite, rather than originating from a grassroots movement. Ironically, the study found that despite this, the aquaculture system of central Bolivia generally fits with the framework of food sovereignty that has been outlined by theorists and promoters of the concept (ex: Akram-Lodhi, 2015). For agricultural producers in Bolivia, this means that food sovereignty currently exists more as a coincidence rather than with institutional or producer intention. If they want to continue to reap the benefits of a food sovereign system, they will have to take greater ownership of the implementation of the concept. For food sovereignty theory more broadly, the central Bolivian aquaculture situation provides empirical evidence of it functioning in reality and thus provides insight into understanding some critical food sovereignty questions and conundrums.

Insights related to the localized nature of the central Bolivian aquaculture system came from findings related to all five research objectives. The system is highly local, and to a certain extent regional. This led to an embedded economy where the social context affected economic outcomes. The consequences include a

relatively stable price for fish and aquaculture inputs. It also drove a certain degree of marketing reliability for producers as well as supply for retailers. For workers it meant stable local job opportunities. The research indicates that this local food system tends to spread positive economic outcomes broadly. Positive social outcomes also tend to emanate from the system since power relationships are much more balanced, which can help the empowerment of disadvantaged groups.

The fifth objective of this study was to identify interventions and policies that would support sustainable and inclusive scaling-up of small-scale aquaculture in Bolivia. The findings of the other objectives collectively contribute to meeting this objective by providing details specific to Bolivian scaling-up. This included recommendations on efficiency and productivity improvements, and means to grow the system while maintaining its dispersion of benefits. A key recommendation was for producers to co-operate at the marketing node by forming a marketing board. The collective findings also led to insights regarding the need to identify differences in the capacity of producers, and to support them in participating in the scale of value chains most conducive to their capabilities. This led to the call for development support for local and regional food systems because it is at these scales that most small-scale and impoverished producers can most effectively participate. As producers gain skills and experience with a livelihood activity that is fostered by the local/regional food system, they can transition towards greater specialization and begin to engage more sophisticated value chains. Support should be system wide, including a focus on related workers and businesses since they too can follow a similar trajectory as producers. Building capacity and supporting the local food system seems to be a potentially important catalyst to reduce local poverty and support producers on a pathway to greater income. Research findings also indicated that this would improve the social, economic, and environmental sustainability of food systems. These insights not only hold value for Bolivian aquaculture value chain participants, but for food system actors in other development contexts as well. Thus, this research makes a theoretical contribution to understanding food systems in the global South, and how they may be supported to generate sustainable development.

The five objectives discussed above contributed to achieving the overarching goal of this study, which was to improve our understanding of how rural small-scale aquaculture systems can contribute to food production while also being environmentally, socially, and economically sustainable. The insights drawn from the central Bolivian aquaculture value chain indicate the system is making positive contributions, and with some changes and future planning, could continue to do so. It also provides broader understanding of what pathways can lead to the development of food systems that address the triple challenge. Furthermore, it shows evidence that aquaculture is a food system that can be an important contributor to a sustainable food future, but as Robert Jones (2017), the global aquaculture strategy lead for The Nature Conservatory says; “Aquaculture can feed the world and protect the planet – *if we get it right*”.

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Appendix 1: Commercial Fish of the Bolivian Amazon

PECES CON VALOR COMERCIAL EN LA AMAZONÍA BOLIVIANA

Vol. 1

Pseudoplatystoma fasciatum
(surubi, pintado)

Zungaro zungaro
(muturo, chanana, bagre, toro)

Leiarus marmoratus
(tujuno, bagre pintado, pira)

Pseudoplatystoma tigrinum
(chuncuina, semicuyo, surubi, caparari)

Brachyplatystoma rousseauxii
(dorado, dorado de piel, plateado, sailador)

Sorubimichthys planiceps
(paleta, pantalón, pez leña)

Calophysus macropterus
(bianquillo)

Phractocephalus hemiopterus
(general, coronel)

Pirirampus pirirampu
(bianquillo, barba chata)

Agenesiosus inermis
(poca de sapo, seferino, bocón, manduvé)

Brachyplatystoma tigrinum
(zebra)

Brachyplatystoma filamentosum
(piratiba, bacalao, azujejo, bianquillo)

Colossoma macropomum
(pacu, pacu negro, tambaquí)

Mylossoma duriventre
(pacupeba, plato, palometa, jatara)

Piaractus brachipomus
(tambaquí, pacu blanco, pacusillo, piraptinga)

Prochilodus nigricans
(sábalo)

Pygocentrus nattereri
(piraña roja, piraña colorada, palometa, fiata)

Serrasalmus rhombeus
(piraña blanca, palometa)

Brycon cephalus
(yatorana, yatorana)

Cichla pleiozona
(tuonaré, yaounda)

Plagioscion squamosissimus
(corvina, curvina, curuvina)

Hoplias cf. malabaricus
(benton, comunario)

Arapaima gigas
(paiche, pirarucú, paichi)

AMAZONÍA BOLIVIANA

Nota: Los peces fueron fotografiados después de su captura en distintos ríos de la Amazonía boliviana entre los años 2002-2010

Appendix 2: Aquaculture Producer Questionnaire

Survey No. _____

Cuestionario para productores(as) piscícolas

Aquaculture Producer Questionnaire

Consent: Interviewer signs to confirm the receipt of consent from participant

Consentimiento: Entrevistador firma para confirmar la recepción de formulario de consentimiento

X _____

Ubicación de Encuesta

Survey Location:

Comunidad
Village

Provincia
Province

Distrito
District

Coordinados _____ S _____ W

Coordinates: _____ S _____ W

Entrevistador: _____

Interviewer: _____

Fecha: _____

Date: _____

Hora: _____

Time: _____

Household Demographics
Demografía del hogar

1. How many people live in your household, how old are they, how many years of schooling have they had, and what is their highest degree?

1. ¿Cuántas personas viven en su hogar? ¿Qué edad tienen? ¿Cuántos años escolares han tenido? ¿Cuál es su mayor grado obtenido?

Member of the house (1-female/2-male) Miembros del hogar (1-mujer / 2-hombre)	Age (#) Edad (#)	Currently in school? 0-No 1-Yes Actualmente en la escuela? 0-No 1-Sí	If yes, what grade? En caso afirmativo, ¿qué grado?	Highest degree achieved? 0-none 1-primary 2-secondary 3-technical 4-university ¿Mayor grado obtenido? 0-Ninguno 1-primaria 2-secundaria 3-técnico 4-universidad
Interviewee/entrevistado:				

Household Economics **Economía del Hogar**

2. What is the primary source of income for your household?

1-Fish Farming 2-Cattle 3-Poultry 4-Rice 5-Corn 6-Coca 7-Other_____

2. ¿Cuál es la principal fuente de ingresos para su hogar?

1-Piscicultura 2-Ganado 3-Pollo/Pato 4-Arroz 5-Maiz 6-Coca-7 Otros _____

2.a) If it is fish farming, what was the primary source of income for your household prior to fish farming?

1-Fish Farming 2-Cattle 3-Poultry 4-Rice 5-Corn 6-Coca 7-Other_____

2.a) Si es piscicultura ¿que era la fuente principal de ingresos para su familia antes de la piscicultura?

1- Piscicultura 2-Ganado 3- Pollo/Pato Arroz 5-Maiz 6-Coca-7 Otros _____

2.b) If it is fish farming, is it more profitable than your previous primary money making activity?
 1-a lot less profitable 2-a little less profitable 3-the same 4-a little more profitable 5-a lot more profitable

**2.b) Si es piscicultura, ¿Es más rentable que su anterior actividad productiva primaria?
 1-mucho menos rentable 2-un poco menos rentable 3-lo mismo 4-un poco más rentable 5-
 mucho más rentable**

2.c) If it is fish farming, do you find it 1-a lot easier, 2-a little easier, 3-the same, 4-a little more difficult, or 5-a lot more difficult than your previous money making activity?

**Si es piscicultura, ¿lo encuentras
 1-mucho más fácil, 2-un poco más fácil, 3-lo mismo, 4-un poco más difícil, o 5-mucho más
 difícil que su actividad productiva anterior?**

3. Does your household have non-farm sources of income (jobs, sell non-farm goods, own a business, rental income, remittances)?

0-No (continue to next question) 1-Yes (fill in table below)

3. ¿Tiene su hogar fuentes de ingresos no agrícolas (trabajo, venta de productos no agrícolas, dueño de un negocio, ingresos proveniente de alquiler, remesas)?

0-No (seguir la siguiente pregunta) 1-Si (rellenar el cuadro más abajo)

Source of income Fuente de ingreso	Person responsible 1-matriarch 2-patriarch 3-male child 4- female child 5-other (indicate) La persona responsable 1-matriarca 2-patriarca 3- niño 4- niña 5- otros/as (indicar)	Approximate weekly income from this activity. (\$BOB) Ingreso semanal aproximado por esta actividad (\$ BOB)

4. Does your household have any aquaculture related sources of income other than farming fish? (own restaurant, work at fish restaurant, work as aquaculture laborer, fish transporter, produce fingerlings or feed)?

0-No (continue to next question) 1-Yes (fill in table below)

4. ¿Su hogar tiene fuentes de ingresos relacionado a la piscicultura pero a parte de la producción de pescado? (propio restaurante, trabajo en un restaurante que vende pescado, trabajo como obrero de la piscicultura (ex. faeneo), transportista de pescado, producción de alevines o alimentación balanceado)?

0-No (seguir a la siguiente pregunta) 1-Si (rellenar el cuadro abajo)

Source of income Fuente de ingreso	Person responsible 1-matriarch 2-patriarch 3-male child 4- female child 5-other (indicate) La persona responsable 1-matriarca 2-patriarca 3- niño 4- niña 5- otros/as (indicar)	Approximate weekly income from this activity. (\$BOB) Ingreso semanal aproximado por esta actividad. (\$ BOB)

5. Do you have fee fishing at your ponds? 0-No 1-Yes
 If no: are you aware of fee fishing? 0-No 1-Yes
 If yes: how much money does this bring in per month? \$ _____ BOB
- 5. ¿Tiene pesque y pague en sus estanques? 0-No 1-Sí**
En caso negativo: ¿Sabe que es pesque y pague ? 0-No 1-Sí
En caso afirmativo, ¿Cuánto dinero recibe usted de pesque y pague cada mes? \$ _____ BOB

Aquaculture Production **Producción Piscícola**

6. Please tell me about how you organize and carry out your aquaculture production.
 Include pond stocking, timing, rotating ponds, etc.

Por favor, dígame cómo organiza y lleva a cabo su producción piscícola.
Incluye la densidad de siembra, el calendario, la rotación de estanques, etc.

7. Please tell me about your harvesting strategy.
 Include how, how often, what tools are used, etc.

7. Por favor, hableme de su estrategia de cosecha.
Incluye cómo, con qué frecuencia, qué herramientas se utilizan, etc.

8. What year did you start fish farming? _____
8. ¿En qué año inició el cultivo de peces? _____

9. What type of fish did you start with.
 1- Pacu 2-Surubi 3-Tambaqui 4-Sabalo 5-Tilapia 6-Paiche 7-Tambacu 6-Other (indicate)

9. ¿Comenzó con qué especie de peces?
1- Pacu 2-Surubí 3-tambaqui 4-Sábalo 5-Tilapia 6-Paiche 7-Tambacu 6-Otros (indicar)

10. Are you still farming that fish? 1-Yes (continue to next question)
 0-No; What fish did you change to? 1- Pacu 2-Surubi 3-Tambaqui 4-Sabalo 5-Tilapia 6-Paiche 7-Tambacu
 6-Other (indicate)
 Why did you change?

10. ¿Siguiendo esta especie? 1-Sí (seguir la siguiente pregunta)
0-no; ¿A qué pez cambiaste a? 1- Pacu 2-Surubí 3-tambaqui 4-Sábalo 5-Tilapia 6-Paiche 7-Tambacu 6-
Otros (indicar)
¿Por qué cambió?

11. Have you thought about farming any other species? 0-No 1-Yes
 Why or why not?

11. ¿Ha pensado en criar otra especie? 0-No 1-Sí
¿Por qué o por qué no?

12. How much does it cost you to build a pond? \$ _____ BOB
12. ¿Cuánto le cuesta construir un estanque? \$ _____ BOB

13. How many ponds did you construct in your first year of fish farming? # _____
13. ¿Cuántos estanques hizo construir en su primer año de cultivo de peces? # _____

14. How many ponds do you have now? # _____
14. ¿Cuántos estanques tienes actualmente? # _____

15. Who in your household arranges pond construction? 1-matriarch 2- patriarch 3-other (indicate)
15. ¿Quién en su hogar organiza la construcción de estanques? 1-matriarca 2- patriarca 3-otro (indicar)

16. Has your fish farming been profitable every year since you started? 1-Yes
0-No: Why not?

**16. El cultivo de peces ha sido rentable cada año desde que empezó? 1-Sí
0-No: ¿Por qué no?**

17. Do you practice polyculture? 0-No 1-Yes
1-Yes: What species do you combine in your ponds?
0-No: Why not?

**17. ¿Practica policultivo (crianza de más de una especie en el mismo estanque)? 0-No 1-Sí
1-Sí: ¿Qué especies combina en sus estanques?
0-No: ¿Por qué no?**

18. Please tell me about your most recent full production cycle of fish farming.

18. Por favor explica como fue su último ciclo de producción piscícola.

How many ponds did you stock? ¿Cuántos estanques sembró?	What are the sizes of your ponds? (<u> </u> m X <u> </u> m) ¿Cuáles son los tamaños de sus estanques? (<u> </u> X <u> </u> m)	What species fish did you stock? 1- Pacu 2-Surubi 3-Tambaqui 4-Sabalo 5-Tilapia 6-Paiche 7-Tambacu 6-Other (indicate) ¿Qué especies de peces sembró? 1- Pacu 2-Surubí 3-tambaqui 4- Sabalo 5-Tilapia 6-Paiche 7-Tambacu 6-Otros (indicar)	Total number of fingerlings stocked Número total de alevines sembrados	Total number of bags of feed used Número total de bolsas de alimento	How many fish came out? ¿Cuántos peces cosechó?	How many fish were consumed at home? ¿Cuántos peces se consumieron en su hogar?

19. What were the costs of your inputs during your last production cycle for all of your ponds combined, who did you purchase from, and please indicate if this price has increased, decreased, or stayed the same since you started to farm fish.

19. ¿Cuáles fueron los costos de los insumos durante su último ciclo de producción para todos sus estanques combinados. ¿De quien compró sus insumos, y por favor indicar si este precio ha aumentado, disminuido o se mantuvo igual desde que empezó a criar peces.

Input Insumo	Who did you purchase this from? ¿De quién se lo compró?	What was the price (\$BOB/per unit)? ¿Cuál fue el precio (\$ BOB / por unidad)?	How was this price set? 1-negotiated on your own 2-negotiated by a group of farmers 3-set by input provider 4-other ¿Cómo se estableció este precio? 1- negociado por su cuenta 2- negociado por un grupo de piscicultores/as/as 3- establecido por el	Was this price an 1-increase 2-same 3-decrease since starting? ¿Este precio ha 1-aumentado 2- quedado igual 3 disminuido- desde el inicio?	Do these costs vary during different seasons? 0-No 1-Yes 2-d/k ¿Estos costos varían durante las diferentes épocas del año? 0-No 1-Sí 2-no sé

			proveedor del insumo 4- otros		
Fingerlings Alevines		\$ per #			
Feed Alimento balanceado		\$ per bag			
Other: Otros:					

20. Who in your household is responsible for different fish farming activities? (do not prompt with list of activities)

20. ¿Quién en su hogar es responsable para las diferentes actividades del cultivo de peces?(no solicita respuesta con la lista de actividades)

Activity Actividad	Household member responsibility 1-matriarch 2-patriarch 3-male child 4-female child 5-other (indicate) Responsabilidad del miembro del hogar 1-matriarca 2-patriarca 3- niño 4- niña 5-otro/a (indicar)
Fingerling procurement Compra de alevines	
Feeding Alimentación	
Pond maintenance Mantenimiento del estanque	
Monitoring fish growth (weighing, sampling, etc.) Monitoreo del crecimiento de los peces (pesar, muestreo, biometría, etc.)	
Harvesting Cosecha	
Processing Procesamiento	
Marketing Comercialización	
Record keeping Mantenimiento de registros	
Other (indicate) Otros (indicar)	

21. Do you hire anyone to work on any of your fish farming activities?

0-No (continue to next question) 1-Yes (fill table below)

21. ¿Usted contrata a alguien para trabajar en sus actividades de cultivo de peces?

0-No (seguir la siguiente pregunta) 1-Si (llene la tabla siguiente)

Activity Actividad	Who is hired? 1-family member 2-friend 3-general laborer 4-laborer specific to the activity ¿Quién contrata? 1 miembro de la familia 2-amigo 3 obrero general 4- obrero específico a la actividad	How many are hired? ¿Cuántos contrata?	1-Female or 2-Male? 1-mujer o 2-hombre?	How are they paid? 1-hourly 2-daily 3-weekly 4-lump sum 5-in fish 6-in food 7-other (indicate) ¿Cómo los paga? 1-hora 2- día 3- semanal 4- monto fijo 5- en pescado 6-en alimentos 7-otro (indicar)	Rate? ¿El monto (\$)?

22. Do you cooperate with other fish farmers on sharing any costs, activities, or infrastructure?

0-No (continue to next question) 1-Yes (please fill table below)

22. ¿Coopera con otros piscicultores/as en compartir costos, actividades o infraestructura?

0-No (seguir la siguiente pregunta) 1-Si (por favor, rellene la siguiente tabla)

Please list cost, activity, or infrastructure Por favor escribe el costo, la actividad, o la infraestructura	Please explain how this is carried out cooperatively Por favor, explique cómo se lleva a cabo en cooperación
Pond building construcción de estanques	
Feed procurement adquisición de alimento balanceado	
Fingerling procurement adquisición de alevines	
Labor procurement la contratación del Trabajadores	
Marketing Comercialización	
Other (indicate) Otros (indicar)	

23. Do you process your fish before selling them?

0-No (continue to next question)

1-Yes: How? 1-gutted and headed 2-filleted 3-de-scale 4-packaged 5-other_____

23. ¿Usted procesa a los peces antes de venderlos?

0-No (seguir la siguiente pregunta)

1-Sí: ¿Cómo?

1- Eviscerado sin cabeza 2- fileteado 3- sacar escama 4- envasados 5-otra _____

24. Do you keep records of your fish farming activities?

0-No (continue to next section) 1-Yes:

24. ¿Mantiene un registro de sus actividades de piscicultura?

0-No (continuar a la siguiente sección) 1-Sí:

24.a) What do you keep records of? 1-feed 2-fingerlings 3-labor 4-transport 5-other (indicate)

24.a) ¿Sobre que mantiene registros? 1-alimentación 2-alevines 3-labor 4- Transporte 5-otro (indicar)

24.b) For how many years have you been keeping records of fish farming? #_____years

24.b) ¿Por cuántos años has estado guardando los registros de la acuicultura?

24.c) For how many years do you keep fish farming records after they are produced?

#_____years

24.c)¿Por cuántos años te mantienes registros de piscicultura después de que se producen?

24.d) Who is responsible for record keeping? 1-matriarch 2-patriarch 3-other (indicate)

24.d) ¿Quién es el responsable para el mantenimiento de registros? 1-matriarca 2-patriarca 3-otros/as (indicar)

Aquaculture Marketing Comercialización de Piscicultura

25. How do you arrange the sale of your fish with your buyers?

1-They visit your house in person 2-You visit them in person 3-Cell phone 4-Internet 5-Email 6-Other_____

25. ¿Cómo organizar la venta de su pescado con sus compradores?

1-Ellos/as visitan su casa en persona 2-Usted los visita en persona 3-Teléfono celular 4- Internet 5-Correo electrónico 6-Otros _____

26. Do you negotiate the price of fish with your buyers?

1-Yes 0-No:Who sets price?

26. ¿Usted negocia el precio del pescado con el/la comprador/a?

1-Sí 0-No: ¿Quién fija el precio?

27. Do you know the price other people are getting for their fish?

0-No 1-Yes: how do you find out?

27. ¿Conoce el precio que otras personas están recibiendo por su pescado?

0-No 1-Sí: ¿cómo se entera?

28. Are you satisfied with the price you get for your fish? 0-No 1-Yes

28. ¿Está satisfecho con el precio que le dan para sus peces? 0-No 1-Sí

29. What was the highest price you ever received for your fish? \$_____BOB

29.a) From who? _____

29. ¿Cuál fue el precio más alto que ha recibido para los peces? \$ _____ BOB

29.a) De quién? _____

30. What was the lowest price you ever received for your fish? \$_____BOB

30.a) From who? _____

30. ¿Cuál fue el precio más bajo que ha recibido para los peces? \$ _____ BOB

30.a) De quién? _____

31. Please list all organizations or people that you sold to after the last harvest in order of largest purchasers to smallest purchasers.

31. Por favor nombra todas las organizaciones o personas a quien ha vendido su pescado en su ultima cosecha por orden del mayor al menor comprador.

Purchaser Comprador/a 1-restaurants 2-markets 3-fish buyer 4-family 5-friends 6-other (indicate) 1-restaurantes 2-mercados 3-comprador de pescado 4-familiares 5-amigos/as 6-otro (indicar)	Number of fish sold Número de peces vendidos	Price received per fish (\$BOB) Precio recibido por pez (\$ BOB)	Was the price higher, lower, or the same as the previous time you sold fish to them? ¿El precio fue mayor, menor o igual que la vez anterior que los/as vendió pescado?

32. Are these the same purchasers or different than the past?

1-Yes 0-No: How has it changed?

32. ¿Son los/as mismos/as compradores/as o diferentes que en el pasado?

1-Sí 0-No: ¿Cómo ha cambiado?

33. How do you get your fish to your buyer? 1-They go to you (skip below) 2-I deliver (fill below)

33. ¿Cómo llegan sus peces a su comprador? 1-Van con usted (saltar adelante) 2-Entrega usted (complete abajo)

Buyer 1-restaurant 2-market 3-fish buyer 4-family 5-friends 6-other (indicate) Comprador/a 1-restaurante 2-mercado 3-Comprador/a de peces 4-familiares 5-amigos/as 6-otro (indicar)	Who is doing the transporting? 1-Yourself 2-Family, 3-Friend, 4-worker you have hired 5-Other (indicate) ¿Quién está transportando? 1-Usted 2- Familia 3- Amigo/a, 4- trabajador contratado 5-Otros (indicar)	Mode of transport used? 1-Your vehicle 2-Borrowed vehicle 3-Rented vehicle 4-Fish transport vehicle 5-Motorbike 6-Bicycle 7-Other (indicate) Modo de transporte utilizado? 1-Su vehículo 2- Vehículo prestado 3- Vehículo alquilado 4- Vehículo de transporte de peces 5-Moto 6-Bicicleta 7-Otros (indicar)	Transported 1-raw 2-on ice 3-frozen? 4-other (indicate) Transportad o sobre 1- crudo 2-sobre hielo 3-congelado 4-otro (indicar)	Typical distance to travel? (KMs) Distanci a típica de viaje? (Km)	Total cost of transport? (\$BOB) 1-Don't know Costo total del transporte ? (\$ BOB) 1 No sabe

34. Is there a person, group, or company that buys fish which you would like to sell to but currently do not?
0-No (proceed to next question) 1-Yes (fill in table below)

34. ¿Hay una persona, grupo o empresa que compra el pescado a quien usted desearia vender pero actualmente no lo hacen?

0-No (pasar a la siguiente pregunta) 1-Si (rellenar el cuadro más abajo)

Who? ¿Quien?	Why do you want to sell to them? ¿Por qué quiere vender a ellos/as?	Why do you not currently sell to them? ¿Por qué no vende actualmente a ellos/as?

Aquaculture Knowledge **Conocimiento sobre la piscicultura**

35. Please discuss where you get information about your fish farming activities.

35. Por favor discutir donde obtiene información sobre sus actividades piscícolas.

Source Fuente	For what reasons do you seek information from these sources? ¿Por qué razones busca información de estas fuentes?	How often do you seek advice from this provider? 1- once a week 2-once a month 3-once every six months 4- once a year 5-less than once a year ¿Con qué frecuencia busca asesoramiento de parte de este proveedor/a? 1 vez a la semana-2-una vez al mes 3-Una vez cada seis meses 4-una vez al año 5-menos de una vez al año	How is the quality of the advice? 1-poor 2-adequate 3-good ¿Cómo es la calidad del asesoramiento? 1-pobre-2 adecuada 3-buena
Friends/family Amigos/as / familia			
Other fish farmers Otros piscicultores			
NGO ONG			
Feed supplier Proveedor/a de alimento			
Fingerling supplier Proveedor/a de alevines			
TV Televisión			
Internet			
Radio			
Books/pamphlets Libros / folletos			
University Universidad			
Extension workers Los/as extensionistas			
Other (indicate) Otros (indicar)			

36. Have you ever received any fish farming training?

0-No (continue to next question) 1-Yes (fill in table below)

36. ¿Alguna vez ha recibido alguna formación en piscicultura?

0-No (seguir la siguiente pregunta) 1-Si (rellenar el cuadro abajo)

Training Provider Proveedor de formación/capacitación	For what? ¿Para qué?	What Year? ¿qué año?	How many days did it last? ¿Cuántos días duró?	How useful did you find it? 1-very poor 2-poor 3-adequate 4-good 5-very good ¿Qué tan útil fue? 1-muy pobre 2-pobre-3 adecuada 4-buena 5-muy buena
NGO ONG				
University Universidad				

Fish farming association Asociación de piscicultores/as				
Municipal Government Gobierno municipal				
State Government Gobierno Departamental				
Federal Government Gobierno del Estado				
Other (indicate) Otros (indicar)				

Aquaculture Finance Finanzas de la piscicultura

37. Have you ever received financial assistance for any fish farming activities?

0-No (continue to next question) 1-Yes (fill in table below)

37. ¿Alguna vez ha recibido apoyo financiero para sus actividades piscícolas?

0-No (seguir la siguiente pregunta) 1-Si (rellenar el cuadro más abajo)

From Whom? ¿De quien?	For what? ¿Para qué?	How much? (\$BOB) ¿Para cuánto? (\$ BOB)	1-Gift, 2-Grant or 3-Loan? 1-regalo, 2-Beca o 3-préstamo?	Interest rate if applicable. Tasa de interés si hubo.
Commercial bank Banco Comercial				
Development bank Banco de desarrollo				
Money lender Prestamista				
Association Asociación				
Friend/relative Amigo/a / familiar				
NGO ONG				
Government Gobierno				
Feed supplier Proveedor de alimentos				
Fingerling supplier Proveedor de alevines				
Fish buyer Comprador de pescado				
Other (indicate) Otros (indicar)				

38. Are there subsidies from the government for fish farming?

0-No (continue to next question) 1-Yes (fill in table below)

38. ¿Existen subsidios del gobierno para la crianza de peces?

0-No (seguir la siguiente pregunta) 1-Si (rellenar el cuadro más abajo)

For what? ¿Para qué?	From which level of government? 1-Municipal 2-State 3-National A partir de qué nivel de gobierno? 1-Municipal 2-Departamental 3-Nacional	How much did you receive? (\$BOB) La cantidad que ha recibido? (\$ BOB)

39. Which of the following do you have in your home?

Internet (0-No 1-Yes) Cell phone(0-No 1-Yes) Computer (0-No 1-Yes)

39. ¿Cuál de los siguientes tiene en su casa?

Internet (0-No 1-Sí) Teléfono celular (0-No 1-Sí) Computadora/laptop (0-No 1-Sí)

Aquaculture Governance Gobernanza en la Piscicultura

40. What rules or regulations exist for fish farming?

0-None (continue to next question) 1-Yes (fill in table below)

40. ¿Qué reglas o regulaciones existen para la piscicultura?

0-Ninguno (seguir la siguiente pregunta) 1-Sí (rellene la siguiente tabla)

Please list the rules and regulations: Por favor indique las normas y reglamentos:	Who issues this rule/regulation? ¿Quién emite esta regla / regulación?	Is it enforced? 0-No 1-Yes ¿Se aplica? 0-No 1-Sí

41. Are you a member of any fish farming organizations?

0-No (continue to next question) 1-Yes (fill table below)

41. ¿Es usted miembro de alguna organización de piscicultores?

0-No (seguir la siguiente pregunta) 1-Si (llene la siguiente tabla)

Organization Name Nombre de la Organización	Its Primary Activities Sus Actividades Primarias

42. Are you aware of any other fish farming organizations?

0-No (continue to next question) 1-Yes (fill in table below)

42. ¿Conoce alguna otra organización de piscicultura?

0-No (seguir la siguiente pregunta) 1-Si (rellenar el cuadro abajo)

Organization Name Nombre de la Organización	It's Primary Activities Sus Actividades Primarias	Why are you not a member? ¿Por qué no es socio?

Aquaculture Opportunities and Challenges Oportunidades y desafíos de la piscicultura

43. What have been the most important problems or challenges that you have had with farming fish?

0-None (continue to next question) 1-Yes (fill in table below)

43. ¿Cuáles han sido los problemas o desafíos más importantes que ha tenido con la piscicultura?

0-Ninguno (seguir la siguiente pregunta) 1-Sí (rellenar la siguiente tabla)

What have the problems and challenges been? ¿Cuáles han sido los problemas y desafíos?	What would you attribute these to? ¿A qué los atribuye?	Were you able to overcome these challenges? 0-No 1-Yes ¿Ha podido superar estos desafíos? 0-No 1-Sí	If yes, how were you able to overcome them? En caso afirmativo, cómo fue capaz de superarlos?

44. Have your fish ever become sick?

0-No (continue to next question) 1-Yes (fill in table below)

44. Alguna vez sus peces se han enfermado?

0-No (seguir la siguiente pregunta) 1-Si (rellenar el cuadro más abajo)

Cause of sickness? 1-don't know 2-other (identify) Causa de la enfermedad? 1 No sabe 2-otro (identidad)	What did you do? ¿Qué hizo?	What happened? ¿Que pasó?	About how many fish did you lose? Cuántos peces perdió?

45. What have been the most important problems or challenges that you have had with selling your fish?

0-None (continue to next question) 1-Yes (fill in table below)

45. ¿Cuáles han sido los problemas o desafíos más importantes que ha tenido con la venta de su pescado?

0-Ninguno (seguir la siguiente pregunta) 1-Sí (rellene la siguiente tabla)

What have the problems and challenges been? ¿Cuáles han sido los problemas y	What would you attribute these to? ¿A qué los atribuye?	Were you able to overcome these challenges? 0-No 1-Yes ¿Ha podido superar	If yes, how were you able to overcome them? En caso afirmativo, cómo fue capaz de superarlos?

desafíos?		estos desafíos? 0-No 1-Sí	

46. Do you plan to increase your production?

0-No: why not? 1-Yes: How?

Please explain why or why not.

46. ¿Tiene planes para aumentar su producción?

0-No: ¿por qué no? 1-Sí: ¿Cómo?

Por favor, explique por qué o por qué no.

--

47. Do you plan to start other aquaculture related activities?

0-No 1-Yes:List (restaurant, transport, fee fishing, other services)

47. ¿Tiene planes para iniciar otras actividades relacionadas con la piscicultura?

0-No 1-Sí: Lista (restaurante, transporte, pesca cuota, otros servicios)

Activity you would like to undertake Actividad que le gustaría hacer	What do you need to start? ¿Qué necesita para empezar?

Environment **Ambiente**

48. What was the land where you have ponds built used for before you built your ponds?

1- shrubs 2-pasture 3-rice 4-corn 5-coca 6-mature forest 7-other_____

48. ¿Antes de la construcción de sus estanques, de que era la tierra?

1- arbustos 2-pastos 3-arroz 4-maíz 5- coca- 6- bosque maduro 7 otros _____

49. Where do you get the water to fill your ponds?

1-Rain 2-River 3-Reservoir/lake 4-well 5-Other_____

49. ¿De dónde saca el agua para llenar sus estanques?
1-Lluvia 2-Río 3-Embalse / lago 4-Poso profundo 5-Otros _____

50. How long does it take to fill a pond?

50. ¿Cuánto tiempo se tarda en llenar un estanque?

51. How far away from your ponds is the closest creek or river? _____ meters

51. ¿El arroyo o río más cercano esta a qué distancia de sus estanques? _____ metros

52. How do you drain your ponds?

1-inground pipe 2-manual pump 3-gas pump 4-electric pump 5-other (indicate)

52. ¿Cómo drena sus estanques?

1-tubería en el suelo 2-bomba manual 3-bomba de gas/diesel 4-bomba eléctrica 5-otro (indicar)

53. How often do you drain your pond? 1-once a year 2-once every two years 3-once every three years 4-once every four years 5-other (indicate)

53. ¿Con qué frecuencia drena su estanque? 1-una vez al año 2-una vez cada dos años 3-una vez cada tres años 4- una vez cada cuatro años 5-otro (indicar)

54. When you drain your pond, what do you do with the water?

1-drain it onto fields 2-drain it into another pond 3-drain it into a creek 4-other _____

54. Al drenar el estanque, ¿qué hace con el agua?

1-drenarlo en los terrenos 2-Drenar a otro estanque 3- Drenar en un arroyo 4- otro _____

55. When you clean the pond, what do you do with the mud that is removed?

55. Cuando limpie el estanque, ¿qué hace con el barro que retira?

56. Do you disinfect your pond after draining? 0-No 1-Yes

56. ¿Desinfecta el estanque después del drenaje? 0-No 1-Sí

Aquaculture Adoption Adopción de la piscicultura

57. Where did you first learn about fish farming? 1-a neighbor 2-a friend 3-a family member 4-an NGO 5-aquaculture producer association 6-other _____

57. ¿Dónde aprendió por primera vez acerca de la crianza de peces? 1-vecino-2 un amigo/a 3-un miembro de la familia 4- una ONG 5-asociacion de piscicultores 6- otros _____

58. Who in your household made the decision to start farming fish?

1-matriarch 2-patriarch 3-matriarch and patriarch together 4-other (indicate)

58. ¿Quién en su familia tomó la decisión de iniciar el cultivo de peces?

1-matriarca 2-patriarca 3- matriarca y patriarca juntos 4-otro (indicar)

59. Why did you start farming fish?

59. ¿Por qué empezó la cría de peces?

60. Was there a program or incentive that helped you decide to start fish farming? 0-No 1-Yes, describe:

60. ¿Hubo un programa o incentivos que le ayudó a tomar la decisión de iniciar el cultivo de peces? 0-No 1-Sí, describa:

61. What would help you improve your income from fish?

61. ¿Qué le ayudaría a mejorar sus ingresos provenientes de los peces?

Livelihood **Medios de vida**

62. Thinking about how much money you had before starting to farm fish, would you say that you were 1-a lot worse off, 2-a little worse off, 3-the same, 4-better off, or 5-a lot better off than the other people in your community?

62. Pensando en la cantidad de dinero que tenía antes de empezar la piscicultura, ¿diría que fue 1- mucho peor, 2-un poco peor, 3- lo mismo, 4-mejor, o 5-mucho mejor que las otras personas en su comunidad?

63. Thinking about the money you have today, would you say that you are 1-a lot worse off, 2-a little worse off, 3-the same, 4-better off, or 5-a lot better off than other people in your community?

63. Pensando en el dinero que tiene hoy en día, ¿diría usted que es 1-mucho peor, 2-un poco peor, 3- mismo, 4-mejor, o 5-mucho mejor que otras personas en su ¿comunidad?

64. Before you started to farm fish, would you have considered yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?

64. Antes de empezar a criar peces, ¿se hubiera considerado 1-muy pobre, 2- pobre, 3- no tan pobre, 4-bien, 5-rico?

65. Today, do you consider yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?

65. Hoy en día, usted se considera 1-muy pobre, 2- pobre, 3- no tan pobre, 4-bien, o 5-rico?

65.a) (ask only if a change occurred) Is this change due to fish farming? 1-Not at all, 2-a little, 3-a lot

65.a) (pregunte solo si se produjo un cambio) ¿Este cambio es debido a la crianza de peces? 1- No en absoluto, 2-un poco, 3 mucho

65.b)What else contributed?

65.b)¿Qué otra cosa contribuyó?

Food security **Seguridad Alimentaria**

1. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted se preocupó porque los alimentos se acabaran en su hogar? 0-No 1-Si

2. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez en su hogar se quedaron sin alimentos? 0-No 1-Si

3. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez en su hogar dejaron de tener una alimentación saludable? 0-No 1-Si

4. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar

tuvo una alimentación basada en poca variedad de alimentos? 0-No 1-Si

5. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar dejó de desayunar, almorzar o cenar? 0-No 1-Si

6. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar comió menos de lo que debía comer? 0-No 1-Si

7. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar sintió hambre pero no comió? 0-No 1-Si

8. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar solo comió una vez al día o dejó de comer durante todo un día? 0-No 1-Si

9. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar dejó de tener una alimentación saludable? 0-No 1-Si

10. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar tuvo una alimentación basada en poca variedad de alimentos? 0-No 1-Si

11. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar dejó de desayunar, almorzar o cenar? 0-No 1-Si

12. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar comió menos de lo que debía? 0-No 1-Si

13. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez tuvieron que disminuir la cantidad servida en las comidas a algún menor de 18 años en su hogar? 0-No 1-Si

14. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar sintió hambre pero no comió? 0-No 1-Si

15. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar solo comió una vez al día o dejó de comer durante todo un día? 0-No 1-Si

Dietary Diversity Questionnaire **Cuestionario de la Diversidad Nutricional**

Please describe the foods (meals and snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink eaten in the morning.

Por favor describe los alimentos (comidas y bocadillos) que usted comió o bebió ayer durante el día y la noche, ya sea en casa o fuera de casa. Comience con la primera comida o bebida que comió en la mañana.

Write down all food and drinks mentioned. When composite dishes are mentioned, ask for the list of ingredients. When the respondent has finished, probe for meals and snacks not mentioned.

Anote todos los alimentos y bebidas mencionados. Cuando se mencionan los platos compuestos, pedir la lista de ingredientes. Cuando ha terminado, indiga para comidas y meriendas que no se mencionaron.

Breakfast Desayuno	Snack Bocadillo	Lunch Almuerzo	Snack Bocadillo	Supper Cena	Snack Bocadillo

--	--	--	--	--	--

When the respondent recall is complete, fill in the food groups based on the information recorded above. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.

Cuando se completa la lista, llena los grupos de alimentos en base a la información registrada anteriormente. Para cualquier grupo de alimentos no mencionado, pregunte al encuestado si algun alimento de este grupo se consumió.

Food Group Grupo de comida	Examples Ejemplos	0-No 1-Yes 0-No 1-Sí
Cereals Cereales	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + insert local foods e.g. ugali, nshima, porridge or pastes or other locally available grains maíz/choclo, el arroz, el trigo, el sorgo, el mijo o cualquier otro grano o alimentos elaborados a partir de éstos (por ejemplo, pan, fideos, avena u otros productos de granos) + insertar alimentos locales por ejemplo, ugali, nshima, gachas o pastas u otros granos disponibles a nivel local	
Vitamin A rich vegetables and tubers Verduras y tubérculos ricas en vitamina A	potatoes that are orange inside + other locally available vitamin A rich vegetables (e.g. red sweet pepper) Papa/Camote que tiene color naranja + otras verduras locales con riqueza en vitamina A (pimiento rojo, por ejemplo)	
White roots and tubers raíces y tubérculos blancos	white potatoes, white yams, white cassava, or other foods made from roots papa blanca, camote blanco, yuca blanca u otros alimentos elaborados a partir de las raíces	
Dark green leafy vegetables Las verduras de hoja verde	dark green/leafy vegetables, including wild ones + locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach etc. verduras con hoja verde oscura, incluyendo los silvestres + disponibles localmente. Hojas ricas en vitamina A como el amaranto, hojas de yuca, la col rizada, espinacas, etc.	
Vitamin A rich fruits Frutas ricas en vitamina A	ripe mangoes, cantaloupe, apricots (fresh or dried), ripe papaya, dried peaches + other locally available vitamin A rich fruits mangos maduros, melón, albaricoques (frescas o secas), papaya madura, duraznos secos + otras frutas locales ricas en vitamina A	
Other fruits otras frutas	other fruits, including wild fruits otras frutas, incluidas las frutas silvestres	
Organ meat la carne de órganos	liver, kidney, heart or other organ meats or blood-based foods hígado, riñón, corazón y otros órganos o alimentos basados en sangre	
Flesh meats carnes	beef, pork, lamb, goat, rabbit, wild game, chicken, duck, or other birds carne de res, cerdo, cordero, cabra, conejo, caza, pollo, pato, u otros aves	
Eggs Huevos	chicken, duck, guinea fowl or any other egg pollo, pato, gallina de Guinea o cualquier otro huevo	
Fish	fresh or dried fish or shellfish	

Pescado	pescado o mariscos frescos o secos	
Legumes, nuts and seeds Legumbres, frutos secos y semillas	beans, peas, lentils, nuts, seeds or foods made from these frijoles, guisantes, lentejas, nueces, semillas o alimentos elaborados a partir de éstos	
Milk and milk products Leche y productos lácteos	milk, cheese, yogurt or other milk products leche, queso, yogur u otros productos lácteos	
Oils and fats Aceites y grasas	oil, fats or butter added to food or used for cooking aceite, grasas o mantequilla añadidos a los alimentos o utilizados para cocinar	
Sweets Dulces	sugar, honey, sweetened soda, sweetened juice or sugary foods such as chocolates, candies, cookies and cakes el azúcar, la miel, la soda azucarada, jugo azucarado o azucarados alimentos como chocolates, caramelos, galletas y pasteles	
Spices, condiments, beverages Espicias, condimentos, bebidas	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages or local examples especias (pimienta negro, sal), condimentos (aji, salsa de soja, salsa picante), café, té, bebidas alcohólicas o ejemplos locales	
Did you or anyone in your household eat anything (meal or snack) OUTSIDE the home yesterday? ¿Usted o alguien de su familia come algo (comida o merienda) fuera de casa ayer?		

66. Are you familiar with the term "food sovereignty"?

0-No (finished survey) 1-Yes (continue)

66. ¿Conoce el término "soberanía alimentaria"?

0-No (terminado encuesta) 1-Sí (sigue)

67. What does food sovereignty mean to you? (do not prompt, circle all that are mentioned)

1-home grown food 2-smallholder farmer empowerment 3-environmentally sensitive food production

4-Womens equality 5-No GMOs 6-farmer control over food system 7-Other (indicate)

67. ¿Qué significa la soberanía alimentaria para usted? (no se solicitará, círculo todos los que se mencionan)

1- producción de alimentos local 2- empoderamiento de pequeños agricultores 3-produccion de alimentos de forma ambientalmente sensibles 4-Igualdad para mujeres 5-No OGM (Organismo genéticamente modificado) 6-Control del/la agricultor/a sobre el sistema alimenticio 7-Otros (indicado)

68. Do you have a 1-very negative, 2-somewhat negative, 3-neutral, 4-somewhat positive, or 5-very positive view of food sovereignty?

68. ¿Tienes una visión 1-muy negativa, 2-algo negativa, 3-neutral, 4-algo positiva, o 5-muy positiva sobre la soberanía alimentaria?

69. Do you feel that your household is food sovereign? 0-No 1-Yes 2-Don't know

69. ¿Siente que su hogar tiene soberanía alimentaria? 0-No 1-Sí 2-No sabe

70. Do you feel that your community is food sovereign? 0-No 1-Yes 2-Don't know

70. ¿Cree usted que su comunidad tiene soberanía alimentaria? 0-No 1-Sí 2-No sabe

71. Do you feel that fish farming in your region contributes to Bolivian food sovereignty?

0-No 1-Yes 2-Don't know

71. ¿Cree usted que la piscicultura en la región contribuye a la soberanía alimentaria de Bolivia?

0-No 1-Sí 2-No sabe

Appendix 3: Non-Producer Questionnaire

Non-Aquaculture Producing Farmer Questionnaire Cuestionario para No-productores

Consent: Interviewer signs to confirm the receipt of consent from participant

Consentimiento: Entrevistador firma para confirmar la recepción del formulario de consentimiento

X _____

Survey Location:

Village

Province

District

Coordinates: _____ S _____ W

Interviewer: _____

Date: _____

Time: _____

Household Demographics

1. How many people live in your household, how old are they, how many years of schooling have they had, and what is their highest degree?

1. ¿Cuántas personas viven en su hogar, qué edad tienen, cuántos años de escuela han tenido, y cuál es el grado más alto que han completado?

Member of the house (1-female/2-male) Miembro de la casa (1-mujer / 2-hombre)	Age (#) Edad (#)	Currently in school? 0-No 1- Yes Actualmente en la escuela? 0-No 1-Sí	If yes, what grade? En caso afirmativo, ¿qué grado?	Highest degree achieved? 0-none 1-primary 2-secondary 3-technical 4-university Mayor grado obtenido? 0-Ninguno 1- primaria 2-secundaria 3-técnico 4-universidad
entrevistado:				

Household Economics Economía del Hogares

2. Please tell me about your crops and livestock.

2. Por favor dígame acerca de sus cultivos y ganado.

2. a) What Crops/ Animals do you Raise? 1-Pigs 2-Cattle 3- Poultry 4-Rice 5-Corn 6-Coca 7-Other (indicat e) 2.a) Qué Cultivos / Animale s cultiva o Cria?	2.b) Area of cultivation (acres)/# of animals? 2.b)Área de cultivo (acres) / # de animales?	2.c) Number of years you have been producing this? 2.c) Número de años que lleva producien do esto?	2.d) Who is primarily responsible for this activity? 1-matriarch 2-patriarch 3-male child 4-female child 5-other (indicate) 2.d) ¿Quién es el principal responsable de esta actividad? 1-matriarca 2-patriarca 3-niño varón 4-niña	2.e) How many/ much did you produce in the last 12 months? 2.e) ¿Cuántas / Cuánto produjo en los últimos 12 meses?	2.f) How many/ much did you consume at home? 2.f) ¿Cuántas / Cuánto consumió en el hogar?	2.g) How many/ much did you sell? 2.g) ¿Cuántas / cuantó vendió?	2.h) What price did you receive at last sale? (\$BOB per unit) 2.h) ¿Qué precio recibió por su última venta? (\$ Bs por unidad)

1- Cerdos 2- Ganado 3-Aves 4-Arroz 5-Maíz 6-Coca 7-Otros (indicar)			5-otro (indicar)				

3. What is the primary source of income for your household?

1-Cattle 2-Poultry 3-Rice 4-Corn 5-Coca 6-Other (indicate)

3. ¿Cuál es la principal fuente de ingresos para su hogar?

1-Ganado 2-Aves de Corral 3-Arroz 4-Maiz 5-Coca 6-Otros (indicar)

4. Does your household have non-farm sources of income (jobs, sell non-farm goods, rental income, remittances)?

0-No (continue to next question) 1-Yes (fill in table below)

4. ¿En su hogar, tienen otras fuentes de ingresos que no son agrícolas (puestos de trabajo, venta de productos no agrícolas, ingresos de alquiler, remesas)?

0-No (seguir la siguiente pregunta) 1-Si (llenar la siguiente tabla)

Source of income Fuente de ingreso	Person responsible 1-matriarch 2-patriarch 3-male child 4-female child 5-other (indicate) Persona responsable 1-matriarca 2-patriarca 3- niño varón 4-niña 5- otros (explicar)	Approximate weekly income from this activity. (\$BOB) Ingreso semanal aproximado por esta actividad. (\$ BOB)

5. What type of land do you work?

5. ¿Qué tipo de tierra trabaja usted?

	Area? (in acres) ¿Área? (en acres)
Owned Terreno Propio	
Rented Alquilado	
Leased Alquilada por tiempo definido.	
Communally owned Propiedad comunal	

Aquaculture Awareness and Potential Conciencia sobre la Piscicultura y Potencial

6. Did you know that fish farming happens in your region?

0-No (continue to next question) 1-Yes (fill in table below)

6. ¿Sabía usted que en su región hay granjas piscícolas?

0-No (seguir la siguiente pregunta) 1-Si (rellenar el cuadro más abajo)

6.a) How did you hear about fish farming? 6.a) ¿Cómo se enteró de que existen	6.b) Do you feel that the growth of fish farming in your region has been good for your community?
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granjas picicolas?	0-No 1-Yes:How? 6.b) ¿Cree usted que el crecimiento en la piscicultura en su región ha sido bueno para su comunidad? 0-No 1-Sí: ¿Cómo?

7. Have you or your family ever discussed starting to farm fish? 0-No 1-Yes

7. ¿Alguna vez ha hablado con su familia acerca de comenzar a participar de la piscicultura? 0-No 1-Sí

8. Is fish farming something that you think you or someone in your household would like to do?

8. Es la piscicultura algo que usted o alguien en su casa piensa que le gustaría hacer?

1-Yes Si			0-No
8.a) Why have you not started fish farming yet? 8.a) ¿Por qué aun no se ha metido en el cultivo de peces?	8.b) What information would you need to start? 8.b) ¿Qué información necesitaría para empezar?	8.c) What support would you need to start? 8.c) ¿Qué apoyo necesitaría para empezar?	8.d) Why do you not want to farm fish? 8.d) ¿Por qué no quiere criar peces?

9. Would you be willing to start fish farming if you could access a loan to pay for the start-up costs?

0-No (continue to next question)

1-Yes: what is the highest interest rate you would be willing to accept? ____% annually

9. ¿Estaría usted dispuesto a comenzar a criar peces si pudiera acceder a un préstamo para pagar los costos de arranque?

0-No (seguir a la siguiente pregunta)

1-Sí: ¿cuál es la tasa de interés más alto que estaría dispuesto a aceptar? ____% anualmente

10. Does your family ever eat fish? 0-No (continue to next question) 1-Yes (fill in table below)

10. ¿Alguna vez come pescado su familia? 0-No (seguir la siguiente pregunta) 1-Si (rellenar el cuadro más abajo)

<p>10.a) What species of fish does your family consume? (Indicate in order of quantity 1=most consumed and so on) Pacu ___ Sabado___ Tilapia___ Trout___ Surubi___ Other (indicate) _____</p> <p>10.a) ¿Cuales especies se consumen por su familia? (Indicar el orden de la cantidad 1 = mayor consumo y así sucesivamente) Pacu ___ Sábado ___ Tilapia Trucha ___ Surubí Otros (indicar) _____</p>
<p>10.b) How many times in the last week did your family eat fish? #____ 10.b) ¿Cuántas veces en la última semana comió pescado su familia? #____</p>
<p>10.c) Where does your family consume fish? (indicate all that apply) 1-Home (answer next box) 2-Restaurant 3-Friend's home 4-Family member's home 5-Other (indicate) _____</p> <p>10.c) ¿Dónde consume pescado su familia? (indique todas las que aplican) 1-Hogar (responder el siguiente cuadro) 2-restaurante 3- casa de amigos 4-Hogar de un miembro de familia</p>

5-Otro (indicar) _____
10.d) If you eat fish at home, where does your family acquire it? 1-Local Market 2-City market 3-Take home from restaurant 4- Gift from fish producing friend 5-Buy from fish producing friend 6-Gift from fish producing family member 7-Buy from fish producing family member 8-Other (indicate) _____
10.d) Si usted come pescado en casa, ¿Dónde lo consigue? 1- Mercado local 2-Mercado en la Ciudad 3-Para llevar desde el restaurante 4- Regalo de un amigo/a productor/a de peces 5- Regalo de un amigo/a productor/a de peces 6-regalo de un familiar productor/a de peces 7 - compra de un familiar productor/a de peces 8 Otros (indicar) _____
10.e) What do you like about eating fish? 1-taste 2-price 3-easy to cook 4-other (indicate) _____
10.e) ¿Qué le gusta acerca de comer pescado? 1-el sabor 2-el precio 3 lo fácil de cocinar 4-otro (indicar) _____
10.f) What do you not like about eating fish? 1-bones 2-taste 3-price 4-difficult to cook 5-not easy to find/buy 6-Other (indicate) _____
10.f) ¿Qué no le gusta acerca de comer pescado? 1-las espinas 2-el sabor 3-el precio 4 lo difícil para cocinar 5-no es fácil encontrar / comprar 6-Otros (indicar) _____

11. Would your family like to eat more fish?
11. ¿A su familia le gustaría comer más pescado?

1-Yes Si	0-No
11.a) What is stopping you? 11.a) ¿Que que le impide?	11.b) Why do you not want to eat more fish? 11.b) ¿Por qué no quiere comer más pescado?

Livelihood Sustento

12. Thinking about the money you have today, would you say that you are 1-a lot worse off, 2-a little worse off, 3-the same, 4-better off, or 5-a lot better off than other people in your community?

12. ¿Pensando en el dinero que tiene hoy en día, diría usted que está 1-mucho peor, 2-un poco peor, 3-igual, 4-mejor, o 5-mucho mejor que otras personas en su comunidad?

13. Today, do you consider yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?

13. Hoy en día, se considera usted que es 1-muy pobre, 2 pobre, de 3 no tan pobre, 4-financieramente comodo, o 5-rico?

14. What are the floors of your house made of?

1-Earth 2-Brick 3-Wood 4-Cement 5-Carpet 6-Tile 7-Other (indicate): _____

14. ¿De que están hechos los pisos de su casa ?

1-Tierra 2-Ladrillo 3-madera-4-cemento 4-Alfombra 6-Baldosa 7-Otro (indicar): _____

15. What is your main fuel for cooking?

1-Firewood 2-Kerosene 3-Propane 4-Piped-in Gas 5-Electricity 6-Other (indicate): _____

15. ¿Cuál es su principal combustible para cocinar?

1-Leña 2-Kerosene 3-Propano 4- Gas canalizado 5-Electricidad 6-Otros (indicar): _____

Which of the following things do you have in your house?

¿Cuál de las siguientes cosas tiene en su casa?

16. Refrigerator? 16. ¿Refrigerador? 0-No 1-	17. Freezer? 17. ¿Congelador? 0-No 1-Yes
--	--

Yes	
18. Dining Set? (table and chairs) 0-No 1-Yes 18. ¿Juego de comedor? (mesa y sillas)	19. Television? 19. ¿Televisión? 0-No 1-Yes
20. VCR or DVD player? 0-No 1-Yes 20. VCR o reproductor de DVD?	21. Stereo or music player? 0-No 1-Yes 21. Radio o un reproductor de música?
22. Computer 0-No 1-Yes 22. Computadora	23. Cell phone 0-No 1-Yes 23. Teléfono móvil
24. Internet 0-No 1-Yes	

Food security Seguridad Alimentaria

1. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted se preocupó porque los alimentos se acabaran en su hogar? 0-No 1-Si
2. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez en su hogar se quedaron sin alimentos? 0-No 1-Si
3. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez en su hogar dejaron de tener una alimentación saludable? 0-No 1-Si
4. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar tuvo una alimentación basada en poca variedad de alimentos? 0-No 1-Si
5. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar dejó de desayunar, almorzar o cenar? 0-No 1-Si
6. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar comió menos de lo que debía comer? 0-No 1-Si
7. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar sintió hambre pero no comió? 0-No 1-Si
8. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar solo comió una vez al día o dejó de comer durante todo un día? 0-No 1-Si
9. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar dejó de tener una alimentación saludable? 0-No 1-Si
10. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar tuvo una alimentación basada en poca variedad de alimentos? 0-No 1-Si
11. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar dejó de desayunar, almorzar o cenar? 0-No 1-Si
12. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar comió menos de lo que debía? 0-No 1-Si
13. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez tuvieron que disminuir la cantidad servida en las comidas a algún menor de 18 años en su hogar? 0-No 1-Si
14. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar sintió hambre pero no comió? 0-No 1-Si
15. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su

hogar solo comió una vez al día o dejó de comer durante todo un día? 0-No 1-Si

Did your household have difficulties getting enough food to eat during the past 12 months? 0-No (continue to next question) 1-Yes; which months?(Tick all that apply) ¿En su hogar han tenido dificultades para obtener suficiente alimento para comer durante los últimos 12 meses? 0-No (siga a la siguiente pregunta) 1-Sí; en que mes? (Marque todo el que corresponda)											
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec

Dietary Diversity Questionnaire Cuestionario de la Diversidad Nutricional

Please describe the foods (meals and snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink eaten in the morning.

Por favor describe los alimentos (comidas y bocadillos) que usted comió o bebió ayer durante el día y la noche, ya sea en casa o fuera de casa. Comience con la primera comida o bebida que comió en la mañana.

Write down all food and drinks mentioned. When composite dishes are mentioned, ask for the list of ingredients. When the respondent has finished, probe for meals and snacks not mentioned.

Anote todos los alimentos y bebidas mencionados. Cuando se mencionan los platos compuestos, pedir la lista de ingredientes. Cuando ha terminado, indiga para comidas y meriendas que no se mencionaron.

Breakfast Desayuno	Snack Bocadillo	Lunch Almuerzo	Snack Bocadillo	Supper Cena	Snack Bocadillo

When the respondent recall is complete, fill in the food groups based on the information recorded above. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.

Cuando se completa la lista, llena los grupos de alimentos en base a la información registrada anteriormente. Para cualquier grupo de alimentos no mencionado, pregunte al encuestado si algun alimento de este grupo se consumió.

Food Group Grupo de comida	Examples Ejemplos	0-No 1-Yes 0-No 1-Sí
Cereals Cereales	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + insert local foods e.g. ugali, nshima, porridge or pastes or other locally available grains maíz/choclo, el arroz, el trigo, el sorgo, el mijo o cualquier otro grano o alimentos elaborados a partir de éstos (por ejemplo, pan, fideos, avena u otros productos de granos) + insertar alimentos locales por ejemplo, ugali, nshima, gachas o pastas u otros granos disponibles a nivel local	
Vitamin A rich vegetables and tubers	potatoes that are orange inside + other locally available vitamin A rich vegetables (e.g. red sweet pepper)	

Verduras y tubérculos ricos en vitamina A	Papa/Camote que tiene color naranja + otras verduras locales con riqueza en vitamina A (pimiento rojo, por ejemplo)	
White roots and tubers raíces y tubérculos blancos	white potatoes, white yams, white cassava, or other foods made from roots papa blanca, camote blanco, yuca blanca u otros alimentos elaborados a partir de las raíces	
Dark green leafy vegetables Las verduras de hoja verde	dark green/leafy vegetables, including wild ones + locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach etc. verduras con hoja verde oscura, incluyendo los silvestres + disponibles localmente. Hojas ricas en vitamina A como el amaranto, hojas de yuca, la col rizada, espinacas, etc.	
Vitamin A rich fruits Frutas ricas en vitamina A	ripe mangoes, cantaloupe, apricots (fresh or dried), ripe papaya, dried peaches + other locally available vitamin A rich fruits mangos maduros, melón, albaricoques (frescas o secas), papaya madura, duraznos secos + otras frutas locales ricas en vitamina A	
Other fruits otras frutas	other fruits, including wild fruits otras frutas, incluidas las frutas silvestres	
Organ meat la carne de órganos	liver, kidney, heart or other organ meats or blood-based foods hígado, riñón, corazón y otros órganos o alimentos basados en sangre	
Flesh meats carnes	beef, pork, lamb, goat, rabbit, wild game, chicken, duck, or other birds carne de res, cerdo, cordero, cabra, conejo, caza, pollo, pato, u otros aves	
Eggs Huevos	chicken, duck, guinea fowl or any other egg pollo, pato, gallina de Guinea o cualquier otro huevo	
Fish Pescado	fresh or dried fish or shellfish pescado o mariscos frescos o secos	
Legumes, nuts and seeds Legumbres, frutos secos y semillas	beans, peas, lentils, nuts, seeds or foods made from these frijoles, guisantes, lentejas, nueces, semillas o alimentos elaborados a partir de éstos	
Milk and milk products Leche y productos lácteos	milk, cheese, yogurt or other milk products leche, queso, yogur u otros productos lácteos	
Oils and fats Aceites y grasas	oil, fats or butter added to food or used for cooking aceite, grasas o mantequilla añadidos a los alimentos o utilizados para cocinar	
Sweets Dulces	sugar, honey, sweetened soda, sweetened juice or sugary foods such as chocolates, candies, cookies and cakes el azúcar, la miel, la soda azucarada, jugo azucarado o azucarados alimentos como chocolates, caramelos, galletas y pasteles	
Spices, condiments, beverages Espicias, condimentos, bebidas	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages or local examples especias (pimienta negro, sal), condimentos (aji, salsa de soja, salsa picante), café, té, bebidas alcohólicas o ejemplos locales	
Did you or anyone in your household eat anything (meal or snack) OUTSIDE the home yesterday? ¿Usted o alguien de su familia come algo (comida o merienda) fuera de casa ayer?		

25. Are you familiar with the term "food sovereignty"?

0-No (finished) 1-Yes (continue)

25. ¿Conoce el término "soberanía alimentaria"?

0-No (terminar) 1-Sí (sigue)

26. What does food sovereignty mean to you? (do not prompt, circle all that are mentioned)

1-home grown food 2-smallholder farmer empowerment 3-environmentally sensitive food production
4-Womens equality 5-No GMOs 6-farmer control over food system 7-Other (indicate)

26. ¿Qué significa la soberanía alimentaria para usted? (no influya la respuesta, circule todos los que se mencionan)

1-La producción de alimentos en casa 2 - el empoderamiento de los pequeños agricultores

3- la producción de alimentos sensibles al medio ambiente 4- igualdad para la mujer la 5-No OGMs 6- control del agricultor sobre el sistema alimentario 7-Otros (indicado)

27. Do you have a 1-very negative, 2-somewhat negative, 3-neutral, 4-somewhat positive, or 5-very positive view of food sovereignty?

27. ¿Tiene usted una opinión sobre la soberanía alimentaria que es 1-muy negativa, 2-algo negativa, 3-neutral, 4-algo positiva, o 5-muy positiva?

28. Do you feel that your household is food sovereign? 0-No 1-Yes 2-Don't know

28. ¿Siente usted que su hogar vive la soberanía alimentaria? 0-No 1-Sí 2-No sabe

29. Do you feel that your community is food sovereign? 0-No 1-Yes 2-Don't know

29. ¿Cree usted que su comunidad vive la soberanía alimentaria? 0-No 1-Sí 2-No sabe

30. Do you feel that fish farming in your region contributes to Bolivian food sovereignty?

0-No 1-Yes 2-Don't know

30. ¿Cree usted que la piscicultura en la región contribuye a la soberanía alimentaria de Bolivia?

0-No 1-Sí 2-No sabe

31. How much money do you estimate your household makes per year? \$ _____ BOB

31. ¿Cuánto dinero estimar usted que su hogar hace por año? \$ _____ BOB

Appendix 4: Chain Worker Questionnaire

Survey No. _____

Chain Worker Questionnaire

Consentimiento: Entrevistador firma para confirmar la recepción de formulario de consentimiento

X _____

Ubicación de Encuesta

Comunidad

Provincia

Distrito

Description

Entrevistador

Fecha

Tiempo

1. How many people live in your household, how old are they, how many years of schooling have they had, and what is their highest degree?

1. ¿Cuántas personas viven en su hogar? ¿Qué edad tienen? ¿Cuántos años escolares han tenido? ¿Cuál es su mayor grado obtenido?

Member of the house (1-female/2-male) Miembros del hogar (1-mujer / 2-hombre)	Age (#) Edad (#)	Currently in school? 0-No 1-Yes Actualmente en la escuela? 0-No 1-Sí	If yes, what grade? En caso afirmativo, ¿qué grado?	Highest degree achieved? 0-none 1-primary 2-secondary 3-technical 4-university ¿Mayor grado obtenido? 0-Ninguno 1-primaria 2-secundaria 3-técnico 4-universidad	Primary job? 0-nothing 1-farmer 2-other (indicate) Trabajo principal? 0-nada 1-agricultor 2-otro(indicar)
Interviewee/entrevistado:					

2. Who is your employer? _____

2. ¿Quién es su empleador?

3. What is your job title? _____

3. ¿Cuál es su profesión?

4. Please list the main tasks of your job. _____

4. Enumere las principales tareas de su trabajo.

5. How many years have you had this job? # _____

5. ¿Cuántos años has tenido este empleo?

6. What was your primary source of employment prior to this job? _____

6. ¿Cuál fue su principal fuente de empleo antes de este empleo?

7. How much money do you make per hour? \$ _____ BOB/hour

7. ¿Cuánto dinero gana por hora?

7.a) Do you receive any other benefits at your job? 1-free meals, 2-lodging, 3-other(indicate)
7.a) ¿Usted recibe otros beneficios en su trabajo? 1-comidas gratuitas, 2-alojamiento, 3-otro (indicar)

8. How many hours per week do you work at this job? _____
8. ¿Cuántas horas a la semana trabaja usted en este empleo?

9. Do you consider the money you make at this job to be 1-a lot less, 2-a little less, 3-the same, 4-a little more, or 5-a lot more than the money you made at your previous job?
9. ¿Considera que el dinero que gana en este empleo es 1-mucho menos, 2-un poco menos, de 3 igual, 4- un poco más, o 5-mucho más que el dinero que usted ganaba en su trabajo anterior?

10. Do you consider the overall quality of this job to be 1-a lot worse, 2-a little worse, 3-the same, 4-a little better, or 5-a lot better than that of your previous job?
10. ¿Considera la calidad general de este empleo es 1-mucho peor, 2-un poco peor, 3-igual, 4-un poco mejor, o 5-mucho mejor que el su empleo anterior?

11. Do you have other jobs or sources of income?
0-No (continue to next question)
1-Yes; please list them: _____
11. ¿Tiene otros empleos o fuentes de ingresos?
0-No (seguir la siguiente pregunta)
1-Sí; por favor anotelos: _____

12. Where do you live? 1-On a farm 2-Small town 3-City
12. ¿Dónde vive? 1-En una granja 2- pueblo 3-Ciudad

13. Do you or your family own farmland? 0-No 1-Yes
13. ¿Usted o su familia son dueños de terreno agrícola? 0-No 1-Sí

14. Have you ever considered starting to farm fish yourself?
14. ¿Ha considerado en empezar a criar peces usted mismo/a?

1-Yes, why have you not started? 1-Sí, ¿por qué no ha empezado?	0-No, why not? 0-No, ¿por qué no?
--	--------------------------------------

15. Do you believe most fish farmers are 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?
15. ¿Cree usted que la mayoría de los/las piscicultores/as son 1 muy pobres, 2 pobres, de 3 no tan pobres, 4- financieramente cómodos/as o 5-ricos/as?

16. What do you think are the challenges fish farmers face in growing their fish operations?
16. ¿Cuáles cree que son los desafíos a los que se enfrentan los piscicultores en el crecimiento de sus operaciones de pescado?

17. What do you think are the challenges that poor farmers face when trying to start fish farming?
17. ¿Cuales cree que son los desafíos que los piscicultores pobres se enfrentan al intentar iniciar el cultivo de peces?

18. Thinking about the money you have today, would you say that you are 1-a lot worse off, 2-a little worse off, 3-the same, 4-better off, or 5-a lot better off than other people in your community?
18. ¿Pensando en el dinero que tiene hoy en día, diría usted que se encuentra 1-mucho peor, 2-un poco peor, 3-igual, 4-mejor, o 5-mucho mejor que otras personas de su comunidad?

19. Before you began this job, did you consider yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?

19. Antes de comenzar este trabajo, se consideraba 1-muy pobre, 2 pobre, 3- no tan pobre, 4-financieramente comodo/, o 5-rico/a?

20. Today, do you consider yourself to be 1-very poor, 2-poor, 3-not so poor, 4-well off, or 5-rich?

20. Hoy en día, se considera usted que es 1-muy pobre, 2 pobre, 3- no tan pobre, 4-financieramente comodo/a, o 5-rico/a?

21. What are the floors of your house made of?

1-Earth 2-Brick 3-Wood 4-Cement 5-Carpet 6-Tile 7-Other (indicate): _____

21. ¿De que están hechos los pisos de su casa ?

1-Tierra 2-Ladrillo 3-madera-4-cemento 4-Alfombra 6-Baldosa 7-Otro (indicar): _____

22. What is your main fuel for cooking?

1-Firewood 2-Kerosene 3-Propane 4-Piped-in Gas 5-Electricity 6-Other (indicate): _____

22. ¿Cuál es su principal combustible para cocinar?

1-Leña 2-Kerosene 3-Propano 4- Gas canalizado 5-Electricidad 6-Otros (indicar): _____

Which of the following things do you have in your house?

¿Cuál de las siguientes cosas tiene en su casa?

23. Refrigerator? 23. ¿Refrigerador? 0-No 1-Yes	24. Freezer? 24. ¿Congelador? 0-No 1-Yes
25. Dining Set? (table and chairs) 0-No 1-Yes 25. ¿Juego de comedor? (mesa y sillas)	26. Television? 26. ¿Televisión? 0-No 1-Yes
27. VCR or DVD player? 0-No 1-Yes 27. VCR o reproductor de DVD?	28. Stereo or music player? 0-No 1-Yes 28. Radio o un reproductor de música?
29. Computer 0-No 1-Yes 29. Computadora	30. Cell phone 0-No 1-Yes 30. Teléfono móvil
31. Internet 0-No 1-Yes	

Food security **Seguridad Alimentaria**

1. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted se preocupó porque los alimentos se acabaran en su hogar? 0-No 1-Si

2. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez en su hogar se quedaron sin alimentos? 0-No 1-Si

3. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez en su hogar dejaron de tener una alimentación saludable? 0-No 1-Si

4. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar tuvo una alimentación basada en poca variedad de alimentos? 0-No 1-Si

5. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar dejó de desayunar, almorzar o cenar? 0-No 1-Si

6. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar comió menos de lo que debía comer? 0-No 1-Si

7. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar sintió hambre pero no comió? 0-No 1-Si

8. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez usted o algún adulto en su hogar solo comió una vez al día o dejó de comer durante todo un día? 0-No 1-Si
9. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar dejó de tener una alimentación saludable? 0-No 1-Si
10. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar tuvo una alimentación basada en poca variedad de alimentos? 0-No 1-Si
11. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar dejó de desayunar, almorzar o cenar? 0-No 1-Si
12. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar comió menos de lo que debía? 0-No 1-Si
13. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez tuvieron que disminuir la cantidad servida en las comidas a algún menor de 18 años en su hogar? 0-No 1-Si
14. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar sintió hambre pero no comió? 0-No 1-Si
15. En los últimos 3 meses, por falta de dinero u otros recursos, ¿alguna vez algún menor de 18 años en su hogar solo comió una vez al día o dejó de comer durante todo un día? 0-No 1-Si

Did your household have difficulties getting enough food to eat during the past 12 months?
 0-No (continue to next question) 1-Yes; which months?(Tick all that apply)
 ¿En su hogar han tenido dificultades para obtener suficiente alimento para comer durante los últimos 12 meses?
 0-No (siga a la siguiente pregunta) 1-Sí; en que mes? (Marque todo el que corresponda)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec

Dietary Diversity Questionnaire

Please describe the foods (meals and snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink eaten in the morning.
 Por favor detalle los alimentos (comidas y bocadillos) que usted comió o bebió ayer durante el día y la noche, ya sea en casa o fuera de casa. Comience con la primera comida o bebida que se comió en la mañana.

Write down all food and drinks mentioned. When composite dishes are mentioned, ask for the list of ingredients. When the respondent has finished, probe for meals and snacks not mentioned.
 Anote todos los alimentos y bebidas mencionados. Cuando se mencionan los platos compuestos, pida la lista de ingredientes. Cuando el/la enuestado/a ha terminado, interroge en mas detalle por comidas y bocadillos que no hayan sido mencionadas

Breakfast Desayuno	Snack Bocadillo	Lunch Almuerzo	Snack Bocadillo	Supper Cena	Snack Bocadillo

--	--	--	--	--	--

Were any of these meals eaten at work?

0-No

1-Yes; which ones?

1-breakfast, 2-lunch, 3-supper, 4-snacks

¿Alguno de estos alimentos consumidos en el trabajo?

0-n

1-Sí; ¿cuáles?

1-desayuno, 2-almuerzo, 3-cena, 4-bocadillos

When the respondent recall is complete, fill in the food groups based on the information recorded above. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.

Quando el/la encuestado/a ha completado su respuesta, complete los grupos de alimentos basado en la información registrada anteriormente. Para algun grupo de alimentos no mencionado, pregunte al encuestado/a si algún alimento de este grupo se consumió.

Food Group Grupo de comida	Examples Ejemplos	0-No 1-Yes 0-No 1-Sí
Cereals Cereales	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + insert local foods e.g. other locally available grains maíz / maíz, arroz, trigo, sorgo, mijo o cualquier otro grano o alimento elaborado a partir de éstos (por ejemplo, pan, fideos, avena u otros productos de granos) + insertar alimentos locales por ejemplo, o pastas u otros granos locales	
Vitamin A rich vegetables and tubers Verduras y tubérculos ricos en vitamina A	potatoes that are orange inside + other locally available vitamin A rich vegetables (e.g. red sweet pepper) patatas que están dentro de naranja + otra localmente disponibles vitamina A ricas verduras (pimiento rojo, por ejemplo)	
White roots and tubers Raíces y Tubérculos Blancos	white potatoes, white yams, white cassava, or other foods made from roots papa blanca, ñame blanco, yuca blanca u otros alimentos de raíz	
Dark green leafy vegetables Verduras de hoja verde	dark green/leafy vegetables, including wild ones + locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach etc. verduras verde / hoja verde oscura, incluyendo las salvajes + disponibles localmente ricas en vitamina A como el amaranto, hojas de yuca, col rizada, espinacas, etc.	
Vitamin A rich fruits Frutos ricos en vitamina A	ripe mangoes, cantaloupe, apricots (fresh or dried), ripe papaya, dried peaches + other locally available vitamin A rich fruits mangos maduros, melón, albaricoques (frescas o secas), papaya madura, duraznos secos + otra localmente disponibles vitamina A ricos frutos	
Other fruits otras frutas	other fruits, including wild fruits otras frutas, incluidas las frutas silvestres	
Organ meat la carne de órganos	liver, kidney, heart or other organ meats or blood-based foods hígado, riñón, corazón y otros órganos carnes o alimentos basados en sangre	
Flesh meats	beef, pork, lamb, goat, rabbit, wild game, chicken, duck, or other	

Carnes	birds carne de res, cerdo, cordero, cabra, conejo, caza, pollo, pato, u otras aves	
Eggs Huevos	chicken, duck, guinea fowl or any other egg gallina, pato, gallina de Guinea o cualquier otro huevo	
Fish Pescado	fresh or dried fish or shellfish pescado o mariscos frescos o secos	
Legumes, nuts and seeds Legumbres, frutos secos y semillas	beans, peas, lentils, nuts, seeds or foods made from these frijoles, guisantes, lentejas, nueces, semillas o alimentos elaborados a partir de éstos	
Milk and milk products Leche y productos lácteos	milk, cheese, yogurt or other milk products leche, queso, yogur u otros productos lácteos	
Oils and fats Aceites y grasas	oil, fats or butter added to food or used for cooking aceite, grasas o mantequilla añadida a los alimentos o utilizada para cocinar	
Sweets Dulces	sugar, honey, sweetened soda, sweetened juice or sugary foods such as chocolates, candies, cookies and cakes azúcar, miel, gaseosa, jugo azucarado o alimentos dulces como chocolates, caramelos, galletas y pasteles	
Spices, condiments, beverages Especias, condimentos, bebidas	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages or local examples especias (pimienta negra, sal), condimentos (salsa de soja, salsa picante), café, té, bebidas alcohólicas o ejemplos locales	
Did you or anyone in your household eat anything (meal or snack) OUTSIDE the home yesterday? ¿Usted o alguien de su familia comió algo (comida o merienda) fuera de la casa ayer?		

32. Are you familiar with the term "food sovereignty"?

0-No (finished) 1-Yes (continue)

32. ¿Conoce el término "soberanía alimentaria"?

0-No (terminar) 1-Sí (sigue)

33. What does food sovereignty mean to you? (do not prompt, circle all that are mentioned)

1-home grown food 2-smallholder farmer empowerment 3-environmentally sensitive food production

4-Womens equality 5-No GMOs 6-farmer control over food system 7-Other (indicate)

33. ¿Qué significa la soberanía alimentaria para usted? (no influya la respuesta, circule todos los que se mencionan)

1-La producción de alimentos en casa 2 - el empoderamiento de los pequeños agricultores

3- la producción de alimentos sensibles al medio ambiente 4- igualdad para la mujer la 5-No OGMs 6- control del agricultor sobre el sistema alimentario 7-Otros (indicado)

34. Do you have a 1-very negative, 2-somewhat negative, 3-neutral, 4-somewhat positive, or 5-very positive view of food sovereignty?

34. ¿Tiene usted una opinión sobre la soberanía alimentaria que es 1-muy negativa, 2-algo negativa, 3-neutral, 4-algo positiva, o 5-muy positiva?

35. Do you feel that your household is food sovereign? 0-No 1-Yes 2-Don't know

35. ¿Siente usted que su hogar vive la soberanía alimentaria? 0-No 1-Sí 2-No sabe

36. Do you feel that your community is food sovereign? 0-No 1-Yes 2-Don't know

36. ¿Cree usted que su comunidad es la soberanía alimentaria? 0-No 1-Sí 2-No sabe

37. Do you feel that fish farming in your region contributes to Bolivian food sovereignty?

0-No 1-Yes 2-Don't know

37. ¿Cree usted que la piscicultura en la región contribuye a la soberanía alimentaria de Bolivia?

0-No 1-Sí 2-No sabe

Appendix 5: Key-Informant Questionnaire

Survey No. _____

Key Informant Interview Script General

Consentimiento: Entrevistador firma para confirmar la recepción de formulario de consentimiento
Consent: Interviewer signs to confirm the receipt of consent from participant

X _____

Participante Encuesta:

Survey Participant: _____

Título:

Title: _____ Organization Organización:: _____

Date Fecha: _____

Time Tiempo: _____

Location Localización: _____

Interviewer Entrevistador: _____

Thank you for taking the time to talk with me today. My name is Sean Irwin and I am a PhD candidate at the University of Victoria, Canada. I am conducting research for my dissertation on aquaculture in Bolivia and how it is affecting small-scale farmers. This work is a part of a project called *Pesces Para la Vida* that involves a partnership of four organizations here in Bolivia and two in Canada. I have asked for this interview because of your connection with and knowledge of aquaculture in Bolivia.

Gracias por tomarse el tiempo para hablar conmigo hoy. Mi nombre es Sean Irwin y soy un estudiante de doctorado en la Universidad de Victoria, Canadá. Estoy llevando a cabo la investigación para mi tesis sobre la piscicultura en Bolivia y cómo esta está afectando a los pequeños acuicultores. Este trabajo forma parte de un proyecto llamado *Peces Para la Vida*, que involucra una alianza de cuatro organizaciones aquí en Bolivia y dos en Canadá. He pedido esta entrevista debido a su vínculo con y su conocimiento sobre la piscicultura en Bolivia.

1. Please describe for me your role in Aquaculture in Bolivia.
Por favor explíqueme su papel en la piscicultura en Bolivia.

2. Please describe to me the sequence of activities that aquaculture fish go through from production to consumption, and who is involved along that chain.
Por favor explíqueme la secuencia de actividades por las cuales el pescado proveniente de la piscicultura pasa desde la producción hasta el consumo, y quien participa lo largo de esta cadena.

3. What roles do women have in the aquaculture value chain? What roles would you like to see women have in the chain?
¿Qué papel desempeñan las mujeres en la cadena de valor de la piscicultura? ¿Qué papel le gustaría a usted ver que las mujeres tengan en la cadena?

4. Do you think that aquaculture can be a livelihood that helps reduce rural poverty? Why and how?
¿Cree usted que la piscicultura puede ser un medio de vida que ayuda a reducir la pobreza rural? ¿Porque y como?

5. What is needed for small-scale fish farmers to make a better living?
¿Qué se necesita para que los acuicultores de pequeña escala tengan una mejor vida?

6. What is needed to get more small-scale farmers to start fish farming?
¿Qué se necesita para que más acuicultores de pequeña escala empiecen a criar peces?

7. Who should be responsible for improving aquaculture in Bolivia? Why? Who is currently taking the lead?
¿Quién debe ser responsable de la mejora de la piscicultura en Bolivia? ¿Por qué? ¿Quién está tomando esta iniciativa?

8. How is imported fish affecting the Bolivian aquaculture chain?
¿Cómo está afectando el pescado importado sobre la cadena de la piscicultura boliviana?

9. Do you think that Bolivian aquaculture could compete with aquaculture from other countries on the world market? 0-No 1-Yes
Why?

¿Cree que la piscicultura boliviana podría competir con la piscicultura de otros países en el mercado mundial? 0-No 1-Sí
¿Por qué?

10. What is the market potential for aquaculture in Bolivia and how do we get there?
¿Cuál es el potencial de mercado para la piscicultura en Bolivia y cómo podemos llegar allí?

11. What do you believe is the future of aquaculture in Bolivia?
¿Cuál cree que es el futuro de la piscicultura en Bolivia?

12. Please discuss your views on food sovereignty. What does it mean to you? What does it mean for aquaculture and rural development in Bolivia?

Por favor, presente sus puntos de vista sobre la soberanía alimentaria. ¿Qué significa para ustedes?
¿Qué significa para la piscicultura y el desarrollo rural en Bolivia?

13. Do you have any additional thoughts or comments about aquaculture and small-scale farmers in Bolivia?
¿Tiene algunos pensamientos o comentarios adicionales acerca de la acuicultura y los/las acuicultores/as de pequeña escala en Bolivia?



Certificate of Approval

PRINCIPAL INVESTIGATOR: Sean Irwin UVic STATUS: Ph.D. Student UVic DEPARTMENT: GEOG SUPERVISOR: Dr. Mark Flaherty	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: right;">ETHICS PROTOCOL NUMBER</td> <td>15-461</td> </tr> <tr> <td colspan="2">Minimal Risk Review - Delegated</td> </tr> <tr> <td style="text-align: right;">ORIGINAL APPROVAL DATE:</td> <td>14-Jan-16</td> </tr> <tr> <td style="text-align: right;">APPROVED ON:</td> <td>14-Jan-16</td> </tr> <tr> <td style="text-align: right;">APPROVAL EXPIRY DATE:</td> <td>13-Jan-17</td> </tr> </table>	ETHICS PROTOCOL NUMBER	15-461	Minimal Risk Review - Delegated		ORIGINAL APPROVAL DATE:	14-Jan-16	APPROVED ON:	14-Jan-16	APPROVAL EXPIRY DATE:	13-Jan-17
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APPROVAL EXPIRY DATE:	13-Jan-17										
PROJECT TITLE Investigating the contributions of aquaculture to poverty alleviation and food sovereignty in Bolivia RESEARCH TEAM MEMBER None DECLARED PROJECT FUNDING: IDRC; DFATD											
CONDITIONS OF APPROVAL											
<p>This Certificate of Approval is valid for the above term provided there is no change in the protocol.</p> <p>Modifications To make any changes to the approved research procedures in your study, please submit a "Request for Modification" form. You must receive ethics approval before proceeding with your modified protocol.</p> <p>Renewals Your ethics approval must be current for the period during which you are recruiting participants or collecting data. To renew your protocol, please submit a "Request for Renewal" form before the expiry date on your certificate. You will be sent an emailed reminder prompting you to renew your protocol about six weeks before your expiry date.</p> <p>Project Closures When you have completed all data collection activities and will have no further contact with participants, please notify the Human Research Ethics Board by submitting a "Notice of Project Completion" form.</p>											
Certification											
<p>This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Participants.</p> <div style="border-top: 1px solid black; width: 20%; margin: 0 auto; text-align: center;"> Dr. Rachael Scarth Associate Vice-President Research Operations </div>											

Certificate Issued On: 14-Jan-16

15-461 Irwin, Sean

Appendix 7: Verbal Research Consent Script

Investigating the contributions of aquaculture to sustainable rural livelihoods and food sovereignty in Bolivia

You are invited to participate in a study entitled **Investigating the contributions of aquaculture to sustainable rural livelihoods and food sovereignty in Bolivia** that is being conducted by Sean Irwin. This research is being undertaken as part of a PhD degree at the University of Victoria, Canada. Dr. Mark Flaherty is the research supervisor and you may contact him at flaherty@geog.uvic.ca if you have any questions or concerns about this study. Sean Irwin is a graduate student in the department of geography at the University of Victoria and you may contact him if you have further questions by emailing ___@uvic.ca

Purpose and Objectives The purpose of this research project is to investigate aquaculture in Bolivia, how it is affecting farmers, and how it can be improved.

Importance of this Research Research of this type is important because it can help improve opportunities for the aquaculture sector in Bolivia.

Participants Selection You are being asked to participate in this study because you participate in aquaculture, or could.

What is Involved I'm inviting you to do a one-on-one interview in person that will take about 30 minutes. If you are not free right now, we can arrange another time to meet. I will ask you questions about your livelihood activity and your family's wellbeing. I will take handwritten notes to record your answers as well as use an audio recorder to make sure I don't miss what you say. If you would like to participate but would not like the audio recorder used, please say so and it will not be used for this interview.

Inconvenience Participation in this study is not expected to cause any inconvenience to you, except for the time required to participate.

Risks There are no known or anticipated risks to you by participating in this research.

Benefits The potential benefit of your participation in this research includes the contribution your information will make to understanding how to improve projects that help farmers.

Voluntary Participation Your participation in this research must be completely voluntary. If you do decide to participate, you may withdraw at any time without any consequences or any explanation. If you do withdraw from the study your data will be destroyed.

Anonymity In terms of protecting your anonymity your name will not be used in either analysis or dissemination of results.

Confidentiality Your confidentiality and the confidentiality of the data will be protected by passwords on the computer and a locked cabinet for paper copies. Each will only be available to the lead researcher and supervisor.

Dissemination of Results It is anticipated that the results of this study will be shared with others in the form of a dissertation and scholarly publications.

Disposal of Data Data from this study will be disposed of after three years. Electronic information will be erased and paper copies will be shredded.

Contacts Individuals that may be contacted regarding this study include the lead researcher in charge of the study and the study supervisor. Contact information is available at the beginning of this form.

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (1-250-472-4545 or ethics@uvic.ca).

Consent questions:

- Do you have any questions or would like any additional details? *[Answer questions.]*
- Do you agree to participate in this study knowing that you can withdraw at any point with no consequences?
[If yes, begin the interview.]
[If no, thank the participant for his/her time.]

La investigación de las contribuciones de la acuicultura a los medios de vida rurales sostenibles y la soberanía alimentaria en Bolivia

Usted está invitado a participar en un estudio titulado La investigación de las contribuciones de la acuicultura a los medios de vida rurales sostenibles y la soberanía alimentaria en Bolivia que se llevan a cabo por Sean Irwin. Esta investigación se lleva a cabo como parte de un doctorado en la Universidad de Victoria, Canadá. Dr. Mark Flaherty es el supervisor de la investigación y usted puede ponerse en contacto con él en flaherty@geog.uvic.ca si usted tiene alguna pregunta o inquietud acerca de este estudio. Sean Irwin es un estudiante graduado en el Departamento de Geografía de la Universidad de Victoria y usted puede ponerse en contacto con él si tiene más preguntas por correo electrónico ___@uvic.ca

Finalidad y Objetivos El objetivo de este proyecto de investigación es investigar la acuicultura en Bolivia, cómo está afectando a los agricultores, y cómo se puede mejorar.

Importancia de esta investigación La investigación de este tipo es importante porque puede ayudar a mejorar las oportunidades para el sector de la acuicultura en Bolivia.

Los participantes de selección que le están pidiendo a participar en este estudio porque usted participar en la acuicultura, o podría.

Qué implica que estoy invitando a hacer una entrevista de uno-a-uno en persona, que tendrá unos 30 minutos. Si usted no es libre en este momento, podemos arreglar otro tiempo para reunirse. Yo le hará preguntas sobre su actividad de subsistencia y el bienestar de su familia. Voy a tomar notas a mano para registrar sus respuestas, así como utilizar una grabadora de audio para asegurarse de que no se pierda lo que dices. Si a usted le gustaría participar pero no desea que el grabador de audio usado, por favor dígalos y no va a ser utilizado por esta entrevista.

No se espera que la participación en este estudio de la inconveniencia de que causen molestias a usted, excepto por el tiempo necesario para participar.

Riesgos No hay riesgos conocidos o previstos a usted por participar en esta investigación.

Beneficios El beneficio potencial de su participación en esta investigación incluye la contribución de su información hará que para entender cómo mejorar los proyectos que ayudan a los agricultores.

Participación voluntaria Su participación en esta investigación debe ser completamente voluntaria. Si decide participar, puede retirarse en cualquier momento sin ninguna consecuencia o ninguna explicación. Si retira del estudio serán destruidos sus datos.

Anonimato En cuanto a la protección de su anonimato su nombre no será utilizado en cualquier análisis o difusión de los resultados.

Confidencialidad Su confidencialidad y la confidencialidad de los datos estarán protegidos por contraseñas en el ordenador y un armario cerrado con llave para copias en papel. Cada solamente estarán disponibles para el investigador principal y supervisor.

Difusión de los resultados que se prevé que los resultados de este estudio serán compartidos con los demás en la forma de una tesis y publicaciones académicas.

La eliminación de los datos Los datos de este estudio será eliminada después de tres años. La información electrónica se borrará y copias en papel será destruido.

Contactos Las personas que puedan estar en contacto con respecto a este estudio incluyen el principal investigador a cargo del estudio y el supervisor del estudio. La información de contacto está disponible a principios de este formulario.

Además, es posible comprobar la aprobación ética de este estudio, o plantear cualquier preocupación que pueda tener, poniéndose en contacto con la Oficina de Ética de la Investigación Humana de la Universidad de Victoria (1-250-472-4545 o ethics@uvic.ca).

Preguntas Consentimiento:

• ¿Tiene alguna pregunta o desea alguna información adicional? [Responder preguntas.]

• ¿Está de acuerdo para participar en este estudio sabiendo que puede retirarse en cualquier momento sin consecuencias?

[Si es así, comenzar la entrevista.]

[Si no, agradecer al participante por su / su tiempo.]