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# A Formative Assessment of the Vulnerability Context of Three Indigenous Communities in Rural Ecuador for Improved Intervention Design

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by
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ABSTRACT OF THE DISSERTATION

A Formative Assessment of the Vulnerability Context of Three Indigenous Communities in Rural Ecuador for Improved Intervention Design

by

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Doctor of Philosophy in Social Work

Brown School

Washington University in St. Louis, 2019

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Nearly 20 % of the current world population are small-scale producers living in rural areas who rely on agriculture and related activities to support their families (IFAD, 2016; World Bank, 2008). Despite the almost 76 billion USD of official development assistance committed to agriculture improvement projects and associated activities over the past decade, many of the intended beneficiaries remain poor and struggle to meet their basic needs. The lack of success in addressing rural poverty highlights the need for quality research focused on understanding what type of intervention/s could help rural communities sustainably improve their livelihood security.

The goal of this dissertation is to conduct a formative participatory assessment of the contextual facilitators and barriers to livelihood security in Guangaje Centro, Tingo Pucará, and Curinge, three rural indigenous communities in the Andes of Ecuador. Using mixed methods, the dissertation examines a range of factors, including economic and natural resource trends and the impact of seasonality on income and food availability, that are believed to be contributing to the diminished resiliency and increased livelihood vulnerability of the three study communities.

Study findings indicate that soil degradation linked to land overuse and erosion have led to decreasing agriculture production and economic hardship. Current planting and harvesting cycles suggest the likelihood of close to 10 months of food insecurity and increased climatic variability has exacerbated already existing periods of seasonal hunger. These issues are compounded by the fact that households have limited human, physical, and financial assets, which limits their resiliency during times of stress or shock. This challenging dynamic is believed to have negatively impacted the health of young children and their mothers and forced many community members to migrate to cities in search of work. The cultural changes associated with migration have led many participants to feel that they are losing their identity as indigenous people. Based on these findings, the author determined that an intervention centered on addressing the challenges of land overuse/soil fertility and increased climate variability through agroecology, improved water retention, and crop storage is likely to be acceptable, appropriate and feasible in the current context and positively impact the long-term resiliency of the study communities.

# Chapter 1: Introduction

One and a half billion people, nearly 20 % of the current world population, are small-scale producers living in rural areas who rely on agriculture and related activities to support their families (IFAD, 2016; World Bank, 2008). An additional 500 million to 1 billion people depend on the production of small-scale farmers for food and income generating opportunities through the sale and trade of their products (International Fund for Agricultural Development, 2016; World Bank, 2008). These statistics suggest that improved agricultural production among small holders could be an important tool to reduce poverty and promote sustainable development (Olinto, Beegle, Sobrado, & Uematsu, 2013; Pica-Ciamarra, Tasciotti, Otte, & Zezza, 2011; World Bank, 2008). Despite the nearly 76 billion USD of official development assistance committed to agriculture improvement projects and related activities over the past decade, many of the intended beneficiaries, particularly those residing in rural areas of low and middle income countries, continue to struggle to meet their basic needs (OECD, 2016). A report using the Multidimensional Poverty Index (MPI), which includes measures of health, education, and standard of living, to examine differences between rural and urban population across 105 countries, found that 85 % of those living in rural areas are still poor (Alkire, Chatterjee, Conconi, Suman, & Vaz, 2014). Higher rates of poverty are associated with malnutrition, lack of education, poor sanitation, and inadequate access to health care and other basic services (Alkire et al., 2014; Olinto et al., 2013).

The persistent poverty in rural areas of the world and the lack of success in addressing it highlights the need for quality research focused on understanding what type of intervention/s could help rural communities sustainably improve their livelihood security. A systematic review

conducted by the author found that rural small livestock development projects would benefit from the inclusion of formative research (Blackmore, Lesorogol, & Iannotti, 2018). Formative research gathers baseline information on the beneficiary population and context to hopefully improve future program design, delivery and/or project implementation (Chen, 2005; Coryn & Stufflebeam, 2014). Utilizing this information allows for the creation of more acceptable, appropriate and feasible projects and programs.

The focus on generating information that can be used by stakeholders to make decisions about program design and implementation places this type of formative assessment in the 'use' branch of evaluation theory (Christie & Alkin, 2013). 'Use' evaluations are centered on promoting social accountability, impacting policy, and creating change within organizations and institutions (Christie & Alkin, 2013). The pragmatist paradigm is often associated with 'use' evaluations because of the similar focus on providing practical information that can be applied to real-world settings and challenges (Chen, 2016; Mertens & Wilson, 2012; Patton, 2014; Tashakkori & Teddlie, 2003).

Pragmatism is typically viewed as the philosophical framework for mixed methods studies (Mertens & Wilson, 2012). One specific approach that captures many of the 'use'/pragmatist principles is participatory research, often referred to as Participatory Action Research (PAR) (Cullen & Coryn, 2011). Participatory development programming and research has been used by civil society organizations to push for greater involvement of beneficiaries in decisions affecting their communities and to hold local officials and funders accountable for project delivery (Chambers, 1997; Estrella & Gaventa, 1998; Narayan-Parker, 1994; Picciotto, 2003). Participatory assessments are also used to foster stakeholder ownership in the

management of services and to empower local communities to be involved in the decision making process (Guerra-Lopez & Hicks, 2015; Narayan-Parker, 1994). The involvement of many potentially differing perspectives requires a flexible, open ended process, one that allows for learning, problem solving, choice, and correction (Narayan-Parker, 1994). Research techniques associated with PAR include creating seasonal calendars, wealth/well-being matrices, coping strategies matrices, Rapid Diagnostic tools, agro-ecosystem analysis, Participatory Learning and Action, and Diagnosis and Design, among many other methods (Cullen & Coryn, 2011; Narayanasamy, 2009; Townsley, 1996).

The goal of this dissertation is to conduct a formative participatory assessment of the contextual facilitators and barriers to livelihood security in Guangaje Centro, Tingo Pucará, and Curinge, three rural indigenous communities in the Andes of Ecuador. The knowledge gained from the formative research is used to develop recommendations regarding the types of livelihood focused interventions and/or programs that would be acceptable, appropriate, and feasible for the population. It is hoped that this information will enable researchers and development practitioners to better understand what type of intervention/s could help rural indigenous communities of the Andes sustainably improve their livelihood security.

The three content chapters of the dissertation are structured on the sustainable livelihoods framework, which was first proposed by Scoones (1998) and subsequently adopted and modified by numerous development organizations (Bishop-Sambrook, 2005; DfiD, 1999; Dolberg, 2003; Hamilton-Peach & Townsley, n.d.). The sustainable livelihoods framework developed by DfiD (1999) is used in this dissertation. The framework, shown in Figure 1.1**,** provides a structure for recognizing the main factors that affect people's lives and the relationships among these factors

(DfiD, 1999). It also seeks to understand what lies behind people's livelihood choices so that the positive aspects can be reinforced and promoted and the negative aspects can be mitigated (DfiD, 1999).

While the framework contains multiple complex interactions, many of which are nonlinear, there are four main relationships that illustrate the level of understanding that can be gained from using the framework. The first relationship is between the vulnerability context, the external environment in which people live, and their livelihood assets, which are comprised of human, natural, financial, social, and physical capital (DfiD, 1999). The components that comprise these five capital types are discussed in detail in chapter 4.

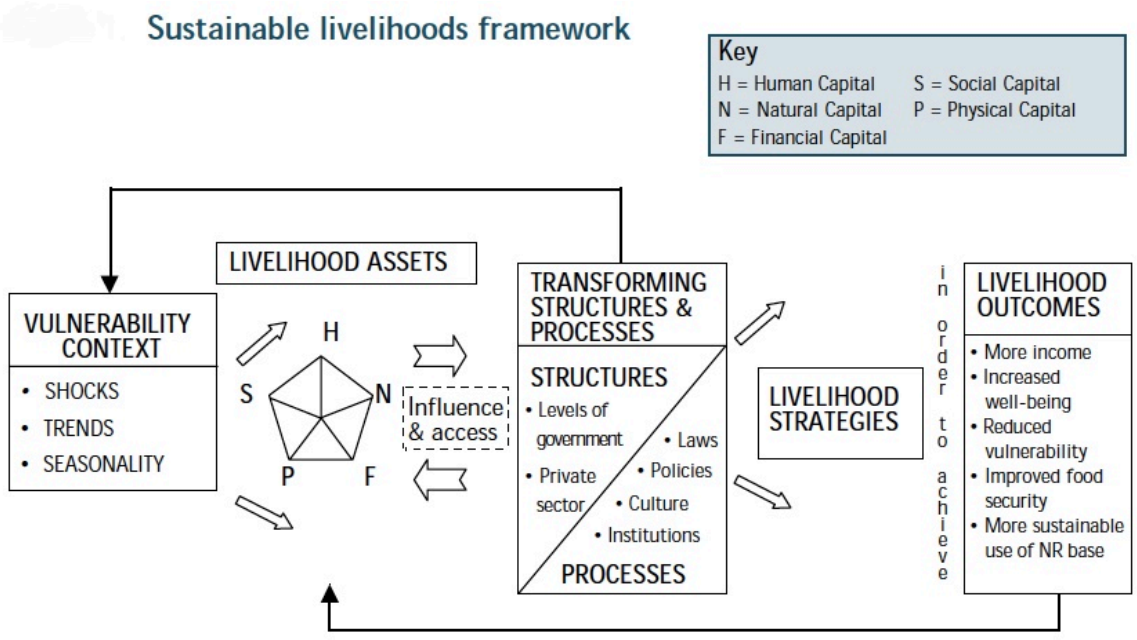


Figure 1.1 Sustainable livelihoods framework (DfiD, 1999, pg.1).

The second interaction involves livelihood assets and the institutions and policies that influence a range of transforming structures and processes. Government policies and local

institutions can create assets through investments in infrastructure and education but can also suppress the growth of social capital, determine access to natural and financial resources, and influence rates of physical asset accumulation (DfiD, 1999). The third relationship represents the impact policies and institutions have on the livelihood strategies that people decide to pursue. Governments and organizations can make certain livelihood choices more or less attractive and/or viable (DfiD, 1999). The final relationship is between livelihood strategies and livelihood outcomes. The combination of activities and choices that people make determine their achievement of some or all the livelihood outcomes (DfiD, 1999).

The focus of this dissertation is on better understanding one component of the sustainable livelihoods framework, the vulnerability context; the trends, shocks and seasonality factors of livelihood security that individuals and households have limited control over (DfiD, 1999). Trends can involve population fluctuations such as migration and population growth, changes in natural resource availability, alterations in local and national governance structures, variation in economic opportunities, and access and use of technology (DfiD, 1999). Trends can be benign or destructive and play an important role in the rates of return for the livelihood strategies that are chosen (DfiD, 1999). Seasonality encompasses shifts in prices, production, health, and employment, all of which impact people's ability to accumulate and develop assets (DfiD, 1999). Shocks can be natural disasters such as floods or drought, increased waterborne diseases and pests, crop failure from changes in rainfall patterns, and spikes in food prices (DfiD, 1999; World Bank, 2016). The death of the primary household income earner and conflict and war also create shocks to household stability and structure (DfiD, 1999). Shocks destroy assets and force people to make choices, such as abandoning their home or selling their land, actions which

negatively impact their chances of achieving positive livelihood outcomes and may lead to persistent poverty for the already poor or drive those on the edge into poverty (Dercon, Hoddinott, & Woldehanna, 2005; DfiD, 1999; Suryahadi & Sumarto, 2003).

The following chapters outline the design, significance, research strategy, and findings of a 'use' focused, mixed methods, formative, participatory study of the vulnerability context of communities in the parish of Guangaje, Ecuador. The first chapter examines the economic, development, and natural resource trends creating livelihood challenges for three rural indigenous communities and how those challenges are impacting the population's livelihood security and resilience. Study results indicate that soil degradation linked to land overuse and erosion have led to decreasing agriculture production and economic hardship. These problems have been further exacerbated by a lack of support from the local government. This challenging dynamic has led many community members to migrate to cities in search of work and negatively impacted participants' sense of identity and the health of young children and their mothers. Multiple interviewees were concerned that the consumption of traditional foods was decreasing, and the use of their native language was declining. Additionally, the high prevalence of low height-for-age (59.5 %), low weight-for-age (26.1 %), and anemia (78 %) in children under 5 and an anemia prevalence of 30 % among mothers highlights the severity of malnutrition among the population. These results suggest the need for an intervention that sustainably addresses the agricultural production and consumption challenges faced by the three communities.

The second chapter describes the impact of seasonality on the food and livelihood security of households in Guangaje. Findings suggest that the population is highly vulnerable to cyclical shifts in agricultural production and crop prices. Current planting and harvesting cycles

indicate the likelihood of close to 10 months of food insecurity. In addition, increased climatic variability has exacerbated food security issues by extending already existing periods of seasonal hunger. This degree of food vulnerability may help explain the population's poor nutritional outcomes and lack of dietary diversity. Adaptation to changing climate conditions may be complicated by the traditional practice of using lunar cycles to dictate crop planting and cultivation times. If farmers are focused on following the stages of the moon and not actual weather conditions, which are increasingly unpredictable, then there is likely to be misalignment between when the lunar cycle indicates that it is ideal to plant and the actual weather. Declining agricultural production and variability of crop prices has resulted in increased migration as households try to cover expenses. Though migration enables households to meet immediate consumption needs, it shrinks on-farm labor capacity, which may negatively impact future harvests and reduce the quantity and diversity of household food consumption. Greater crop diversity, better crop storage, water retention and irrigation systems, and disease resistant crops have the potential to decrease the impact of seasonality and increased climate variability on food and livelihood security. However, more research is needed to better understand the best approach and potential implications of these strategies.

Through the creation of a livelihood asset index, the third chapter seeks to better understand the degree of livelihood vulnerability and resiliency among study households. It also estimates and describes the different levels of livelihood vulnerability in the three study communities and across livelihood capital types. Results indicate that livelihood resilience in Guangaje is relatively low, especially in the categories of human, physical, and financial capital. There is also significant variability between communities. This variation appears to be linked to

differences in access to clean reliable sources of water, the presence of governmental and non-governmental organizations (NGOs), access to credit, and amount of productive assets. Of note is the high average social capital score for households in one of the communities, Tingo Pucará. Households in Tingo Pucará also had the highest composite asset score and the elevated level of social capital in this community, compared to the other two communities, appears to be playing a significant role. Improving social and financial capital, especially access to credit, and increasing human capital through improved educational attainment could be an effective approach for decreasing vulnerability and increasing livelihood resiliency.

The development of recommendations for an intervention strategy is structured around the conceptual framework of program rationale developed by Huey Chen (2005). Based on a thorough problem classification and grading process the author recommends that a future livelihood intervention in the parish of Guangaje focus on the challenges of land overuse/soil fertility and increased climate variability. There is limited evidence of more traditional land and soil management practices in Guangaje that could be strengthened to address these problems. Therefore, the intervention design will have to look to livelihood focused projects in other areas of Ecuador, the Andean region, and/or similar mountainous communities across the world for potential solutions and implementation strategies.

An ecologically sustainable approach that can be adapted to local contexts to address low crop productivity and soil degradation involves building up the soils organic matter through agroecology (Duru, Therond, & Fares, 2015; Wezel et al., 2014; Willett et al., 2019). Agroecology focuses on "enhancing diversity and complexity of farming systems via polycultures, rotations, agroforestry, use of native seeds and local breeds of livestock,

encouraging natural enemies of pests, and using composts and green manure to enhance soil organic matter thus improving soil biological activity and water retention capacity"(Altieri & Toledo, 2011, p. 588). Other common practices within agroecology include reduced tillage and expanding the use of intercropping, a multiple cropping practice involving growing two or more crops in proximity (Duru et al., 2015). Erosion control, planting appropriate nitrogen-fixing cover crops, and the introduction of more drought-tolerant varieties of staple crops could also positively impact soil quality and production. The introduction of new varieties of crops and agricultural practices would need to be done in close consultation with community members to ensure that the approach is acceptable and appropriate. The exact design and implementation of the agroecological intervention should be done using a participatory methodology that takes into account community level variability in the five livelihood capitals (Duru et al., 2015).

An approach that could be used to address the unpredictability of precipitation and shifting rainy seasons is being promoted by The Mountain Institute, an international non-governmental organization that, for the past 47 years, has worked to address the challenges faced by rural mountain communities and the delicate ecosystems that these communities rely on for their livelihoods. The Mountain Institute project in the Peruvian highlands is focused on creating a communal water retention pond and canal network that would fill during the rainy season and be used to water crops through drip irrigation and/or maintain the moisture of pastures during periods of low precipitation (The Mountain Institute, 2016). Similar water retention systems, dating back to 1,000 AD, have been found and restored in the highlands of Peru, suggesting that they could be applicable to similar areas of the Andean region including the highlands of Ecuador (The Mountain Institute, 2016). The project sites in Peru have experienced an increase

in the availability of local water during the dry season and improved livestock productivity (The Mountain Institute, 2016). The Mountain Institute's RETAMA project (Restoring Ancestral Technologies and Water Management) which includes the work in Peru, was awarded the 2018 St Andrews Prize for the Environment. This award recognizes organizations that are using innovative approaches to improve human well-being in tandem with environmental conservation. Though likely to involve a significant initial investment, improved water storage and irrigation infrastructure could have long term benefits for food and livelihood security in Guangaje.

The lack of success in addressing rural poverty highlights the need for quality research focused on understanding the types of intervention/s that could help rural communities sustainably improve their livelihood security. An important first step in the development of recommendations for livelihood focused interventions is conducting a thorough examination of the contextual factors that may be contributing to diminished resiliency and increased livelihood vulnerability. The sustainable livelihoods framework provides a structure for recognizing the main factors that affect people's lives and the relationships among these factors (DfiD, 1999). This dissertation focuses on better understanding one component of the sustainable livelihoods framework, the vulnerability context; the trends, shocks and seasonality factors of livelihood security, which impact the livelihood strategies that individuals and households are able to pursue (DfiD, 1999). After assessing these three key categories the author determined that an intervention centered on addressing the challenges of land overuse/soil fertility and increased climate variability through agroecology, improved water retention, and crop storage is likely to be acceptable, appropriate and feasible in the current context and positively impact the long-term resiliency of the study communities.

# Chapter 2: Livelihood Trends and Vulnerabilities

## 2.1 Introduction

Persistent poverty in rural areas across the world and the lack of success in addressing it highlights the need for quality research focused on understanding what type of interventions help rural communities sustainably improve their livelihood security. This study details a mixed methods formative assessment structured on the sustainable livelihoods framework and examines contextual facilitators and barriers to livelihood security in three rural indigenous communities in the Andes of Ecuador. Specifically, it characterizes population and resource trends that play a role in the ability of individuals and households to adapt and make progress towards more resilient livelihoods in the face of a changing economic, social, and ecological conditions.

A livelihood is composed of "the capabilities, assets (stores, resources, claims and access) and activities required for a means of living" (Chambers & Conway, 1991, p. 6). Having a secure livelihood means that an individual or group has the ability to cope with and recover from stress and shocks and maintain or enhance current and future capabilities and assets, while not undermining the natural resource base (Chambers & Conway, 1991). Livelihood security is similar to the concept of resilience, defined as a systems capacity to absorb disturbance, retain basic function and structure, and revitalize during and after times of stress (Quandt, 2018; Walker & Salt, 2006). Applied more specifically to livelihoods, resilience is the "capacity of all people across generations to sustain and improve their livelihood opportunities and well-being despite environmental, economic, social, and political disturbances" (Tanner et al., 2015, p. 23). The goal of this paper is to better understand the study population's barriers to achieving

resiliency and livelihood security. This understanding will enable the development of an acceptable, appropriate, and feasible livelihood-focused intervention that addresses the environmental, economic, social, and/or health challenges that they may face.

The sustainable livelihoods framework, shown in Figure 1.1**,** provides a structure for recognizing the main factors that affect people's lives and the relationships between these factors. As described in chapter 1, the framework enables understanding of what lies behind a person's livelihood choices so that the positive aspects can be reinforced and promoted and the negative aspects can be mitigated (DfiD, 1999). Though the framework contains multiple complex nonlinear relationships, there are four main relationships that illustrate the level of understanding that can be gained from it use.

The first relationship is between the vulnerability context, the external environment in which people live, and their livelihood assets, which are composed of human, natural, financial, social, and physical capital (DfiD, 1999). An individual's or household's livelihood assets can be augmented or reduced by the impact of shocks, local and national trends, and seasonality. The second interaction involves livelihood assets and the institutions, policies, structures, and norms that govern social interactions and processes (DfiD, 1999). Government policies and local institutions can create assets through investments in infrastructure and education but can also suppress the growth of social capital, determine access to natural and financial resources, and influence rates of physical asset accumulation. The third relationship highlights the impact policies and institutions have on the livelihood strategies that people decide to pursue (DfiD, 1999). Governments and organizations can make certain livelihood choices more or less attractive and/or viable. The final relationship is between livelihood strategies and livelihood

outcomes. The combination of activities and choices that people make determine their achievement of some or all the livelihood outcomes.

This study focuses on the vulnerability context and analyzes trends that are potentially creating livelihood challenges for the study population and how those challenges are impacting the population's livelihood security and resilience. Trends involve changes such as migration and population growth, shifts in natural resource availability, the involvement of local and national governments, economic opportunities, and access to and use of technology (DfiD, 1999). They can be positive, destructive, or benign and play an important role in the rates of return for the livelihood strategies that are chosen.

The following sections describe the research methodology, provide an overview of national level economic, development, and health trends, and detail research findings. A review of the literature suggests that historical exploitation, persistent unequal economic growth, and lack of investment in rural areas continues to play an important role in driving and exacerbating the challenges faced by study participants (Bilsborrow, Mcdevitt, Kossoudji, & Fuller, 1987; Commander & Peek, 1986; IFAD, 2011, 2014; Weismantel, 1988; World Bank, 2015). Study results indicate that soil degradation linked to land overuse and erosion have led to decreasing agricultural production and economic hardship. These challenges have been further exacerbated by a lack of support and assistance from the local government, as reported by study participants, leading many community members to migrate to cities in search of work. These trends are believed to have had a negative impact on participants' sense of identity and the health of young children and their mothers.

# 2.2 Materials and Methods

## 2.2.1 Study Site

The Ecuador Livelihood and Nutrition study (ELNS) was conducted in a rural area of the Ecuadorian Andes from September 2016 to January 2018. The communities of Guangaje Centro, Tingo Pucará, and Curinge were selected as the research location due to their rural mountainous location, perceived vulnerability to a range of economic, health, and natural resources challenges and a connection with collaborators at the University of San Francisco Quito (USFQ), which enabled and aided data collection efforts. The communities are in La Sierra, a belt of the Andes mountains that includes volcanoes and peaks with year-round snow (Brush, 1982). The average inhabited altitude is between 3,400 to 3,700 meters, and there is little protection from a climate that can quickly change from harsh sun to wind, fog, rain, and/or hail (Toaquiza et al., 2015). Temperatures range from the mid 70s Fahrenheit (21˚Celsius (C)) during the day to low 20s (-6˚C) at night (Luteyn, 1999). The ecosystem that surrounds the communities is a mountainous alpine tundra grassland called the *páramo* (Ulloa Ulloa, n.d.). Vegetation typically occurs "between the upper limit of continuous, closed-canopy forest (i.e., forest line or timberline) and the upper limit of plant life (i.e., snow line) and is characterized by tussock grasses, large rosette plants, shrubs with evergreen, coriaceous and sclerophyllous leaves, and cushion plants" (Luteyn, 1999, p. 1).

The parish of Guangaje, where the three communities are located, has a total population of a little over eight thousand spread across 39 communities (INEC, 2010; Toaquiza et al., 2015).

Nearly all (99 %) of the population identifies as indigenous Kichwa speakers[1] and over 91 % live in poverty[2] (INEC, 2010; Toaquiza et al., 2015). Tingo Pucará and Curinge are small communities with only 19 and 32 households respectively. In Tingo Pucará, most the homes are clustered around the top and sides of a mountain, the top of which, the *pucará*, served as a signaling point during the time of the Incas (Toaquiza et al., 2015). All the homes are within a 10 to 15-minute walk of each other. The common house in Curinge is also located at the top of a ridge, but most the homes are spread across the hillsides and into the valley below. It can take up to half an hour to walk to the farthest households. Both communities are about a 15-minute drive from the community of Guangaje Centro, though the road to Curinge is more treacherous due to ongoing erosion of the mountainside. Guangaje Centro is considerably larger, with 153 homes, though only about half are permanently occupied due to migration. Guangaje Centro serves as the economic, health, and education hub for the parish as it hosts the local Sunday market, health center, primary and secondary schools, and Catholic and Adventist churches. The average household size across all three communities is six people.

Subsistence agriculture and temporary male migration for wage labor are the primary means of livelihood. On average, households have a little over one acre of land under cultivation and almost all plant potatoes and fava beans and raise sheep and poultry (Toaquiza et al., 2015). Other crops of importance include barley, onions, *melloco*, *oca*, and *mashua* [native tubers]. Among the less commonly cultivated crops are *chocho* [lupine], *quinoa*, peas, and vegetables

[1] Over one million Ecuadorians, 7 % of the population, are indigenous/Amerindian (CIA, 2018). They are typically categorized by the language they speak. These languages include Kichwa, Paicoca, Shuar, Tsa´fiqui, Shiwiar, Waotededo, Sapara, Achuar, Andoa, Awapit, A´Ingae, Cha´palaa, and Zia pedee (Freire et al., 2014).

[2] The Ecuadorian National Census and Statistics Institute (INEC) uses a methodology developed by the Economic Commission for Latin America and the Caribbean (CEPAL) to determine poverty. The method covers five dimensions (1) economic capacity defined as the education level of the head of household and the ratio of household members working to total household members (2) access to basic education defined by the number of children between 6 to 12 years old who are not in school. The more children not in school, the poorer the household (3) floor and wall materials of the dwelling (4) access to proper sanitation and piped water (5) number of people per bedroom (INEC, 2019).

like a large leaf cabbage and *nabus* [field mustard]. Additional types of frequently raised livestock are llamas and guinea pigs. Some households also raise pigs and rabbits. Crop production is almost exclusively for home consumption. The only crops intended for sale are lupine and onions as well as occasional surpluses of potatoes and barley. There is a greater reliance on livestock sales for income generation. Sheep and pigs are the most frequently sold livestock type. Llamas are typically kept to carry and transport goods. Chickens are raised for their eggs, which are often eaten and occasionally sold, bartered, or gifted. The population eats chicken and sheep meat but usually only when there is a special occasion or event. Guinea pigs are eaten and are believed, along with eggs, to have curative and diagnostic capabilities[3] (Weismantel, 1988).

### 2.2.2 Study Design

To understand the livelihood challenges faced by the communities and the trends that may be behind those challenges, the research team conducted a series of qualitative interviews, focus groups, observations, and a quantitative household survey over a period of 15 months. An extensive literature review of historical and national level trends was also conducted to provide context for patterns identified in the study. A purposeful sampling methodology was used to select individuals for the qualitative interviews (Padgett, 2012; Palinkas et al., 2013). Researchers sought to conduct the quantitative survey in all households across the three communities. Sample size and demographic detail about interview participants and survey respondents can be found in Table 2.2 and 2.3 in the Results section. Human research oversight

[3] "The egg or *cuy* (guinea pig) is passed over the patient's body, and the illness then passes into the egg or into the body of the *cuy,* which dies during the process. While somewhat beneficial, this practice cannot usually effect a complete cure in itself, as the *cuy* or egg is 'too small' to hold all the sickness found within the ailing human body. A more important function is diagnosis: the healer opens the egg, or the *cuy*'s body, and can see the nature of the illness through the effects it has had on the egg yolk of the *cuy*'s internal organs" (Weismantel, 1988, p. 115).

and approval was provided by Washington University in St Louis (IRB #201606050) and the Universidad San Francisco Quito (IRB # 2016-111E).

### 2.2.3 In-depth Interviews

The key informant interviews focused on agricultural and food production activities and practices, consumption and dietary practices, and challenges households and communities currently face. The challenges question specifically probed for economic, environmental, and food security issues as well as any perceived trends regarding migration and changes community members have made to their traditional ways of making a living. The interviews with mothers of children under 5, which were conducted because of the study's focus on child nutritional status, asked similar questions but also included additional inquiries regarding child health and feeding practices. The interview guides were developed by members of the research team under the guidance of the committee chair, translated into Spanish by the author, and piloted in the field by the author and the field research coordinator. Minor changes in terminology and question intent were made after the pilot testing.

The interview team consisted of one interviewer (the author or the field research coordinator) and a field assistant who translated from Kichwa to Spanish when necessary. The field assistants Spanish/Kichwa translation capabilities were reviewed and approved by a professional Kichwa translator based in Quito. The interviews were audio recorded with the permission of the interviewees. Each recording and interview notes were assigned unique identification numbers by the field research coordinator, so the names of interviewees are not linked to the recording and/or interview notes. The interviews took place in a semi-private environment, typically an unused room in the individual's home or the common house and lasted

30 minutes to an hour. After each interview the interviewer reflected on the interview process and content and documented that reflection in the interview notes (Charmaz, 2014; Tolley, Ulin, Mack, Robinson, & Succop, 2016).

### 2.2.4 Focus Groups

The focus groups were used to gain multiple perspectives on agricultural and food production practices and better understand how the community is organized and functions. The research team continued to use purposeful sampling to recruit participants for the focus groups. The interview team and data collection approach were the same as the approach taken for the in-depth interviews except for the addition of a second note taker/translator to assure that the multiple voices of the focus groups were documented as accurately as possible.

### 2.2.5 Quantitative Survey

The quantitative household survey is modeled after the RAND Family Life Surveys (FLS).[4] This survey structure was chosen because of its reputation for being comprehensive and the author's prior experience using RAND surveys. Survey questions were adapted for local Ecuadorian context, reviewed by senior members of the research team, and then translated into Spanish. The quantitative survey underwent the same process of piloting as the qualitative interview and focus group guides. The survey gathers a range of social, economic, nutrition, health, and hygiene/sanitation information from each household. However, this chapter only uses the income, community participation, food consumption, and anthropometric data. The income data will enable a better understanding of households' current economic situation. Analysis of the

[4] A set of detailed household and community surveys conducted by the RAND corporation in developing countries.

anthropometric data allows for the identification of nutritional trends in the population, specifically the prevalence of child stunting, wasting, and underweight children and anaemia prevalence in children and mothers, all of which are important health indicators. The food consumption data, based on participant recall over the past week, facilitates the comparison of qualitative and quantitative responses to food consumption questions and the exploration of potential links to nutritional trends. The participation data was used to triagulate and better understand the involvment of governmental and non-governmental organizations in the communities.

The survey was conducted at every home in the three communities that consented to participate. The paper surveys were assigned unique identification numbers and the names of individuals in the household were not recorded to protect privacy. Data were collected by the field project team (the field research coordinator and field assistants). The author participated in the quantitative data collection during a visit to the communities in March 2017. The team typically visited 3 to 4 homes per day and spent 1.5 hours in each home.

The anthropometric data for all children under 5 and their mothers from the same community was gathered in 1 or 2 days in one location accessible to all the participants, typically the community common house or church. This approach was taken to minimize the variability that could occur from taking measurements in different locations over a period of several weeks and to eliminate the need to carry heavy equipment long distances between households. Height and weight measurements of children and mothers were collected using an Infant/Child/Adult ShorrBoard and a Seca digital scale-Model 874 (Iannotti, Henretty, et al., 2015). The field research team measured weight to the nearest .1 kg. The weight was first taken for the mother

alone and then the mother and child if the child was not yet able to stand. Recumbent length of children less than 2 years of age and standing height of children 2 to 5 years of age was measured to the nearest 0.1 cm. A HemoCue Hb 201+system[5] was used to determine hemoglobin (Hb) concentrations for the young children and mothers. Blood was collected in a sterile fashion with a finger stick and a microcuvette in one continuous process and tested in the HemoCue system (Iannotti, Henretty, et al., 2015).

### 2.2.6 Observations

The author conducted observations of activities in public spaces such as markets, household members behaviors and actions in and around the home and surrounding outbuildings, meal preparation and consumption, interactions between household members, and the physical assets in the home and their condition (Padgett, 2012). This information has been used to enrich understanding of the themes discussed in the interviews and focus groups.

### 2.2.7 Literature Review

A comprehensive review of research articles and grey literature (e.g. institutional reports, discussion papers, and working papers) was conducted to identify articles and reports focused on the history of economic growth, rural development, migration, and nutrition in Ecuador at the national level. The goal was to provide context for patterns identified in the study and be able to compare study results to the rest of the Ecuadorian population. The search was performed from April to August 2018 and included ScienceDirect, Academic Search Complete, PubMed, and Google Scholar databases. The search was global, but most records contained English language

[5] "The HemoCue Hb 201+system has been validated against standard laboratory techniques for measurement of Hb concentration in normal and anemic children, with and without Hb disorders" (Iannotti, Delnatus, et al., 2015, p. 1093).

sources or abstracts. Searches were conducted in Spanish on Google Scholar and the Ecuadorian website for the Facultad Latinoamericana de Ciencias Sociales [Latin American Faculty of Social Sciences] (FLACSO). Grey literature was found on the websites of international and government institutions including the World Bank, the Food and Agriculture Organization of the United Nations (FAO), and the International Fund for Agricultural Development (IFAD). Both simple and multi-field/advanced searches were used with the following search terms: 'Ecuador', 'economy' 'development', 'hacienda system', 'rural development', 'migration', 'rural/urban migration', 'indigenous', 'poverty', 'nutrition', 'smallholder farmer', 'livelihood', 'agriculture', 'agricultural production', 'ethnography'. To minimize the risk of not finding published work pertinent to this review, both forward and backward citation tracing of relevant papers and reports was utilized.

# 2.3 Analysis

## 2.3.1 Qualitative

The qualitative data analysis was completed in Nvivo for Mac (11.4.3). MP3 audio recordings of interviews and focus groups were downloaded from Box, a secure, HIPAA and FERPA compliant, data storage service provided by Washington University and used by the author and field research coordinator to store and share data. After being converted to a Nvivo accepted format the recordings were loaded into Nvivo, cases were created for each unique recording, and then assigned the appropriate classification attributes based on the demographic information collected at the time of the interview. An initial codebook was developed using the key informant, mother/father, and focus group interview guides. Main and child nodes were then created in Nvivo following the structure of the codebook.

The recordings were coded directly in Nvivo by the author, eliminating the need to transcribe and translate. Challenging and/or complex sections of the recordings were listened to multiple times to ensure that the appropriate and sufficient number of codes were used to capture the themes being discussed. On several occasions, the author decided that the initial code used was not correct. In those instances, the code was deleted, and the section recoded. Other times the author determined that there were multiple themes in one section and additional codes were added to that section.

A combination of deductive and inductive coding was used to analyze interviews. The author relied initially on a codebook that was developed using the interview guides. As new themes emerged throughout the coding process the author added the new code to the codebook and revisited previously coded recordings, recoding and/or adding the code if necessary. Code frequencies were examined by using the hierarchy charts tool in Nvivo. Overall coding hierarchies were explored as well as specific combinations of source and main nodes such as 'key informants' and 'community livelihood' or 'mothers/fathers' and 'food consumption.'

Interview notes written by the field research coordinator on the demographic info sheet of each interviewee were translated and transcribed by the author as were the observations from the author's field note book. While not analyzed in Nvivo, this data was used to enrich the Results section with additional description, anecdotes, and examples.

### 2.3.2 Quantitative

Data from the paper surveys were entered into an Excel spreadsheet by the field research coordinator. The data was then reviewed by the author, and the Excel spreadsheets with the raw data were imported into the statistical software R (3.5.0), cleaned, labeled, and otherwise

prepared for analysis. The World Health Organization (2006) Child Growth Standards were used to determine the prevalence of child stunting (HAZ < -2), wasting (WHZ < -2), and underweight children (WAZ < -2). As per standard practice, observations above 6 and below -6 standard deviations were excluded from the analysis. Per capita consumption and income variables were created by dividing the data by family size.

## 2.4 National Trends

Although situated in a very remote and rural part of Ecuador, the three study communities are not isolated from the economic, development, and health trends that are impacting the country and region. The following overview of national trends, based on an extensive literature review, provides context for patterns identified in the study and highlights the degree of livelihood insecurity among Guangaje's indigenous community compared to the rest of the Ecuadorian population.

### 2.4.1 The Economy

By most national level measures Ecuador has experienced significant economic growth and poverty reduction. The country has the eighth largest economy in South America and the number of people living on less than 1.90 USD a day has steadily decreased since the early 2000s (IFAD, 2014; World Bank, 2015). In 2015, 23% of the population lived below the poverty line, a drop of 41% from 2000 (World Bank, 2015). Ecuador's economic growth and poverty reduction has been driven primarily by large scale agribusiness (flowers, banana, and plantain cultivation) and oil exports (Carrión & Herrera, 2012; IFAD, 2014). These industries have led to more

employment opportunities, mainly in urban and semi-urban areas, and the expansion of conditional cash transfer programs for the poor[6] (IFAD, 2014).

However, an overreliance on two main industries as well as having to import most basic food stuffs has led to a lack of economic stability and resilience when there are fluctuations in global prices and markets (IFAD, 2014). A prime example of this is the recent dive in global oil prices, which has led to significant cuts in social programs and infrastructure projects as well as stagnation in poverty reduction (World Bank, 2015, 2017b). In the past several years there has also been little improvement in the Ecuador's Gini coefficient of .47, placing it among the top 30 most unequal countries in the world (World Bank, 2017).

### 2.4.2 Rural Development

Like poor rural populations worldwide, rural communities and small holder farmers in Ecuador are faced with a range of development issues and challenges. Over a third of Ecuador's population lives in rural areas where the poverty rate is 42%, nearly twice that of urban areas (IFAD, 2014). In the central Sierra region, where the three study communities are located, the poverty rate is as high as 90% and a third of the population lacks the money needed to cover basic needs (IFAD, 2011). Research has attributed these high poverty rates to factors such as unequal land distribution, limited access to credit, markets, and technology, natural resource degradation, and climate change (IFAD, 2011, 2014; World Bank, 2017a). Other causes include limited farm growth and productivity, the large number of middle men, limited infrastructure and

[6] The government cash transfer program began in 1998 with the objective of providing direct financial assistance to households below the poverty line (established by the Ministry of Social Development Coordination) who have children younger than 18 years of age, elderly, and/or a disabled family member (MIES, 2019; Tapia, 2018) According to recent news reports there is growing concern among some recipients that the government may be trying to shrink the size of the program by reducing the number of recipients (Tapia, 2018).

capacity for product handling and processing, few producer associations, and minimal management and organizational skills (IFAD, 2014).

The rural areas tend to have lower educational levels and limited access to basic public services (IFAD, 2011, 2014). The high elevation of rural mountainous areas and lack of basic infrastructure means communities and households also struggle with limited water access. There is evidence that a 2009 drought in the region led to the collapse of many households' traditional livelihood systems, suggesting there are limited safety nets in place to support communities' efforts to recover from extreme events (IFAD, 2011). Other factors leading to household vulnerability include the deterioration of soils from monoculture, excessive use of pesticides and herbicides, deforestation, and destruction of the *páramo* (IFAD, 2011).

According to data from the Global Land Degradation Assessment and Improvement (GLADA) project of the Global Environmental Facility (GEF), an additional 14.2% of land in Ecuador was degraded between 1982–2002 (Magrin et al., 2014). Fragile ecosystems, such as the *páramo* where the study communities are located, have been damaged by deforestation, agriculture, ranching and mining (Hayes, Murtinho, & Wolff, 2017; Rhoades, 2006). This damage reduces the environmental services that these ecosystems provide, such as water and soil nutrient retention and erosion control (Magrin et al., 2014). Land degradation can lead to outmigration as eroded and depleted soils make it challenging for the local populations to maintain a safe and secure livelihood (Gray, 2011; Gray & Bilsborrow, 2014). Slow environmental change like soil degradation is believed to affect far more people than rapid environmental change such as weather shocks and natural disasters (Gray, 2011; Gray & Bilsborrow, 2014; Sanchez, 2002).

As populations grow, family farming units are divided into smaller and smaller plots through inheritance practices (Bilsborrow et al., 1987; IFAD, 2011; Weismantel, 1988). This custom has resulted in high levels of labor intensity where, in some cases, "less than one-fourth of total available labor time is absorbed on the farm" (Bilsborrow et al., 1987, p. 193). To supplement on-farm income, households with small land holdings, typically two acres or less, enter into sharecropping, work as temporary laborers, and/or some family members migrate (Bilsborrow et al., 1987). Many households are dependent on the remittances of family members who have migrated for their survival. As noted by Weismantel (1988), "even people who take pride in indigenous ways themselves are raising their children to lead other lives, knowing that their land will support only one or two" (p. 83).

### 2.4.3 Migration

Rural-to-urban migration is a common phenomenon throughout Latin America (Romero, 2012; Villagrán, 2016). As noted in the previous sections, migration from rural areas tends to be driven by a range of overlapping factors at the macro (institutional/structural) and micro-(individual/household) level. These factors include land degradation, inequitable land distribution, inadequate rural employment opportunities as well as a lack of key services such as health care and education (Bilsborrow et al., 1987).

The factors driving migration patterns in Ecuador are similar. Throughout much of the 1960s, 70s, and 80s, migration out of the Sierra region of Ecuador was tied to the cycles of growth and weakening of agro-export, oil export, construction, manufacturing, and service sector (Bilsborrow et al., 1987; Commander & Peek, 1986; Peek, 1981; Peek & Antolinez, 1980; Proaño, 1978). The 1950s and 60s in Ecuador saw significant economic expansion resulting from

banana, sugar, rice, and other export crops (Bilsborrow et al., 1987). Large plantations were concentrated in the coastal regions, particularly around Guayaquil, the largest city and an industrial and maritime center. Because of the employment opportunities generated by this growth and to escape the exploitation of the *páramo* haciendas, there was a significant movement of people from the Sierra to the coast (Bilsborrow et al., 1987; Commander & Peek, 1986; Middleton, 1979; Weismantel, 1988).

The 1964 Land Reform Law, which abolished the *huasipungo*[7] system and allowed peasants to claim unused or underutilized land, and the 1970s oil-export boom changed the pattern of movement (Bilsborrow et al., 1987; Weismantel, 1988). Though the land reform did not significantly alter land distribution, it did change the relationship between the agrarian population and the land as the "seasonality of labor needs associated with expansion of certain crops led to some substitution of temporary for permanent labor on larger farms" (Bilsborrow et al., 1987, p. 93). The shift away from migration to the coast was also driven by an increase in oil related construction and service sector jobs in Quito, the capital and main city in the Sierra region (Bilsborrow et al., 1987).

While bringing prosperity to the urban areas, the oil boom of the 1970s only exacerbated the rural/urban structural disparities. Wage and employment opportunities deteriorated in the early 1970s, and there was little investment in basic service provision in rural areas (Bilsborrow et al., 1987; Commander & Peek, 1986). In 1974,

> "the percentage of dwellings with electricity was 84 in urban areas, 12 in rural; the percentage of population with less than 6 years of education (completed primary) was 30 in Quito and Guayaquil, 40 in other urban areas, and 70 in rural

[7] A servant labor/ feudalistic land tenure arrangement widely used in the Sierra. It grew out of the exploitive hacienda systems that was brought to the area by the Spanish during the colonial area, which began in the mid 1500s and persisted through the mid 1900s (Weismantel, 1988).

> areas; the percentage of births receiving medical attendance was 65 in urban areas, 15 in rural; and reported female labor force participation rates (ages 15-49) were nearly twice as high in urban as in rural areas" (Bilsborrow et al., 1987, p. 94).

As noted by the World Bank, Ecuador's inequality between sectors was one its biggest problems (Bilsborrow et al., 1987). The current economic and demographic data discussed in the previous sections indicates that this trend continues.

Even with the migration that occurred starting the in 1950s, over 50 % of Ecuador's population still lived in rural areas in the early 1980s (ENEMDU, 2015; Villagrán, 2016). This dynamic changed significantly over the next 30 years, and by 2015 only 32 % of the population lived in rural areas, with the largest change occurring between 1982 and 2001 (ENEMDU, 2015; Villagrán, 2016). During this period Ecuador's gross domestic product (GDP) per capita declined due to falling total factor productivity[8], suggesting that the migration might be linked to a heightened search for economic opportunities (Sanchez-Paramo, 2005). The country was also hit by a macroeconomic crisis in 1998/99, and the prices of tradable goods, often the source of livelihood for rural farming communities, declined relative to non-tradable goods (Sanchez-Paramo, 2005). This crisis is likely to have further exacerbated the challenges faced by rural households and contributed to the migration trend.

Environmental variability and climate changes have also been found to play a role in migration trends in Ecuador. A study conducted in the rural Andean highlands and the Pacific

[8] The portion of output not explained by traditionally measured inputs of labor and capital used in production.

coastal plain found that, overall, increased climate variability resulted in increased migration and that environmental effects played a larger role in the movement of land-poor households (Gray & Bilsborrow, 2014). However, the relationship is not consistently linear (Gray, 2009; Gray & Bilsborrow, 2014). There were cases of increased internal migration after periods of normal-to-high rainfall, which implies that "these households do not typically have the resources to invest in internal migration and that positive rainfall shocks enable them to escape from a poverty trap" (Gray & Bilsborrow, 2014, p. 12; Barrett, 2008). Given this nonlinearity, Gray and Bilsborrow (2014) suggest that rural households have some ability to respond and adapt to environmental change and stress that the migration dynamic varies across environments and subpopulations.

### 2.4.4 Nutrition and Anemia

Undernutrition in the first 2 years of life is a major determinant of stunting of linear growth and has long-term health and development consequences into adulthood (Black et al., 2013). Additionally, undernutrition "including fetal growth restriction, suboptimum breastfeeding, stunting, wasting, and deficiencies of vitamin A and zinc" has been linked to 45 % of child deaths, roughly 3.1 million deaths a year globally (Black et al., 2013, p. 1). Stunting is a complex problem requiring nutrition-sensitive interventions as well as nutrition-specific interventions that address the multiple underlying social, economic, and environmental factors (Black et al., 2013).

Children who are stunted before the age of 2 have been found to have poorer cognitive and educational outcomes later in life (Black, 2013; Walker et al., 2007; Walker, Chang, Powell, Simonoff, & Grantham-McGregor, 2007; WHO, 2014b). These outcomes can have significant negative economic consequences for the individual, their household, community, and country (WHO, 2014b). Compared to non-stunted individuals, stunted children are predicted to earn 20

% less as adults and stunting has been estimated to reduce a country's GDP by up to 3 % (Grantham-McGregor et al., 2007; WHO, 2014b; World Bank, 2005)

Nearly one-quarter of all children in Ecuador under the age of 5 are stunted, a prevalence that has not changed in a decade despite the country's overall improved economic growth (Freire et al., 2014; I. Walker et al., 2007). The prevalence doubles to 42 % for indigenous Ecuadorian children under 5, with rural mountainous regions seeing the highest stunting prevalence compared to other regions in the country (Freire et al., 2014; I. Walker et al., 2007; World Food Programme, 2015). Such elevated stunting prevalence is comparable to the prevalence in Afghanistan (41 %), the Central African Republic (41 %), and Guatemala (46 %) (World Bank, 2018).

Anemia can be caused by a range of health issues including nutrition (deficiencies in key vitamins and minerals), acute infections (hookworm, malaria), genetics (hemoglobinopathies), and chronic conditions and inflammation (Iannotti, Delnatus, et al., 2015). These conditions can result in hemoglobin (Hb) concentrations falling "below necessary levels to sustain cellular respiration and other vital processes"(Iannotti, Delnatus, et al., 2015, p. 1092). Anemia impairs health and well-being in women and increases the risk of poor maternal and neonatal outcomes such as low birth weight, miscarriages, stillbirths, and perinatal and maternal mortality (WHO, 2014a). In children, anemia can cause "potentially irreversible growth and development consequences" (Iannotti, Delnatus, et al., 2015, p. 1092). A reduction in the prevalence of anemia has been found to improve children's school performance, women's work productivity, and pregnancy outcomes in mothers and infants (WHO, 2014a).

Anemia continues to be an issue in Ecuador, especially among poorer populations (Freire et al., 2014). The 2012 ENSANUT-ECU study found the anemia prevalence in children under the age of 5 to be 25.7 %. This is a 4.9 % increase compared to the 1986 *Diagnostico de la Situacion Alimentaria, Nutricional y de Salud de la Poblacion Ecuatoriana Menor de Cinco Anos* (DANS) study [Diagnosis of the Alimentary, Nutritional and Health Situation of the Ecuadorian Population Younger than Five Years] and suggests that there are over 353,000 preschoolers who are anemic (Freire et al., 2014). This statistics means that a quarter of Ecuadorian children are starting school with a health-related handicap (Freire et al., 2014). The highest prevalence is in children who are in their first year of life with over half of all children between the ages of 6 and 11 months testing positive for anemia (Freire et al., 2014). Additionally, 40.5 % of all indigenous children under 5 years of age are anemic, the highest among all Ecuadorian population types, and 33.9 % of children less than 5 years of age living in poverty have anemia (Freire et al., 2014).

Ecuadorian women of child bearing age have an average anemia prevalence of 15.5 %. Indigenous women are second to Ecuadorian women of African descent in terms of the ethnic group with the highest prevalence (Freire et al., 2014). Poor Ecuadorian women have an anemia prevalence of 19.7 % but are second to middle income women, who have a prevalence of 20.4 % (Freire et al., 2014). High rates of stunting and anemia are indicators of economic and nutritional challenges and, in subsistence farming communities, are often related to issues of decreasing production and other agricultural problems (WHO, 2014b, 2014a).

### 2.4.5 Summary

The literature suggests that unequal economic opportunities and basic service delivery, historical labor exploitation, and natural resource degradation can play a significant role in driving and exacerbating the livelihood challenges of rural farming household in the Ecuadorian Sierra. These challenges include persistent poverty, low educational attainment, and poor child and maternal health outcomes. To try to alleviate this hardship, families and individuals have chosen to migrate to urban and more prosperous areas temporarily and/or permanently.

The following section describes the study results and details how the study populations' livelihood approaches and challenges fit within the country-level context and trends. The results indicate that soil degradation due to land overuse and erosion have led to decreasing agriculture production and economic hardship. These challenges have been further exacerbated by local governments reported lack of interest in supporting and assisting the three communities. This dynamic has led many members of the community to migrate to cities in search of work. The chapter argues that household's agricultural and economic challenges have had a negative impact on participants' sense of identity and the health of young children and their mothers.

## 2.5 Results

### 2.5.1 Data Type and Quantity

Table 2.1 shows the types and quantity of data collected. The qualitative sample size is based on well-regarded qualitative research, which has found that saturation, or the point at which new data does not alter the emerging themes or provide additional in-depth understanding, is typically reached at around 15-20 interviews (Charmaz, 2014). The 109 quantitative surveys conducted constitutes all consenting inhabited households in the three communities.

Table 2.1

*Data type and quantity*

| Data Type | Quantity |
|---|---|
| Key informant interviews | 8 |
| Mother/father interview with children < 5 years | 24 |
| Focus groups | 3 (n=16, 8, 6) |
| Observations | 10 |
| Household survey | 109 |

## 2.5.2 Demographic Characteristics

As shown in Table 2.2, most interview participants were women.

Table 2.2

*Interview and focus group demographics*

| | Key informants | Mother/father | Focus groups |
|---|---|---|---|
| **Sex** | | | |
| Female | 3 | 23 | 22 |
| Male | 5 | 5 | 8 |
| **Age range** | | | |
| 20-29 | 2 | 10 | 6 |
| 30-39 | 1 | 13 | 16 |
| 40-49 | 5 | 5 | 5 |
| 60-69 | | | 2 |
| 70-79 | | | 1 |
| **Occupation** | | | |
| Farmer | 4 | 24 | 28 |
| Doctor | 1 | | |
| Midwife | 1 | | |
| Community health worker | | 1 | |
| Agronomist | 1 | | |
| Catechist | 1 | | |
| Construction | | 1 | 1 |
| Housewife | | 1 | |
| Bus/van Driver | | 1 | 1 |
| **Education level** | | | |
| None | 1 | 5 | 7 |
| Elementary | 2 | 20 | 21 |
| High school | 3 | 3 | 2 |
| University | 2 | | |

In the case of the interviews with parents of children under 5 years of age, this was primarily by design as it was assumed mothers were likely to have more in-depth knowledge regarding the feeding and care of young children. Of the five men who did participate in the mother/father interviews, one man was the sole informant in the interview and the other four men spoke jointly with the woman because they were in the home at the time of the interview and/or wanted to participate. Despite the research team's efforts, there was a gender imbalance in the focus groups. This difference was because men were often working in the cities and/or women were more accustomed to meeting due to participation in women's groups.

Interview and focus group participants were typically in their 20s or 30s. This age range is reflective of the study's focus on individuals with young children. There was some diversity in the key informants' occupations but mothers/fathers and focus groups almost exclusively identified as farmers. A similar pattern emerged for education level. Key informants were relatively evenly spread across different levels of education, likely reflective of their varying occupations. The mothers/fathers and focus groups participants typically had an elementary level education. None had gone to university, a couple had completed high school, several had no formal education.

The summary statistics for the household survey, shown in Table 2.3, paint a similar picture. There were close to 33% more women than men, most participants reported working in agriculture, and the majority have an elementary level education. The high number of individuals who identified as being in school reflects the number of school age children in the three communities. The age structure matches the rest of Ecuador, with the 10 to 19 age group having the highest population (CIA, 2018). Catholicism is the most practiced religion, though it should

be noted that the community of Tingo Pucará is almost entirely Adventist. Annual per capita income from agriculture is less than non-agricultural sources suggesting that agriculture is mainly for consumption not sale.

Table 2.3

*Household survey summary statistics*

| Variable | | Obs. | Mean | Std. Dev | Median |
|---|---|---|---|---|---|
| **Sex** | | | | | |
| | Female | 264 | | | |
| | Male | 199 | | | |
| **Family size** | | 463 | 5.6 | 2.5 | 6 |
| **Age range** | | | | | |
| | Less than 10 | 108 | | | |
| | 10-19 | 142 | | | |
| | 20-29 | 40 | | | |
| | 30-39 | 47 | | | |
| | 40-49 | 35 | | | |
| | 50-59 | 33 | | | |
| | 60-69 | 28 | | | |
| | 70 and older | 27 | | | |
| **Occupation** | | | | | |
| | Agriculture | 159 | | | |
| | Housewife | 4 | | | |
| | In school | 207 | | | |
| | Construction | 29 | | | |
| | Community government | 1 | | | |
| | Other | 14 | | | |
| | None | 47 | | | |
| **Education level** | | | | | |
| | None | 132 | | | |
| | Elementary | 221 | | | |
| | High school | 110 | | | |
| **Religious affiliation** | | | | | |
| | Catholic | 335 | | | |
| | Adventist | 75 | | | |
| | Other | 49 | | | |
| | None | 4 | | | |
| **Annual per capita agriculture income (USD)** | | 321 | 26.47 | 51.75 | 15.00 |
| **Annual per capita nonagricultural income (USD)** | | 392 | 228.08 | 239.48 | 150.00 |
| **Weekly per capita food consumption (USD)** | | 462 | 21.30 | 19.17 | 15.93 |
| **Monthly other per capita consumption (USD)** | | 453 | 16.99 | 19.30 | 11.30 |
| **Annual other per capita consumption (USD)** | | 441 | 134.33 | 88.26 | 113.33 |

The per capita annual non-agriculture income amount primarily reflects the monthly cash transfer of 60 USD that many households reported receiving from the national government cash transfer program[9]. Due to the limited agricultural income, households are clearly reliant on the government cash transfers to meet their consumption needs.

Total per capita income amounts to 254 USD per year, which indicates that, on average, individuals are living on .70 USD per day. Even individuals in the highest income households are still only living on 1.50 USD per day. Nationally, the percent of the population living on less than 1.90 USD a day at 2011 international prices is 3.6 % (World Bank, 2017b). In the parish of Guangaje 100 % of the population appears to be living on less than 1.90 USD per day. These statistics confirm the severity of poverty in the region and inequality with the rest of the country.

### 2.5.3 Declining Agricultural Production

A recent local government report that focused on the parish of Guangaje noted that "the communities of the Guangaje parish continue to suffer reductions in their population, highlighting a serious problem…that the lands are quite eroded and not very productive" (Toaquiza et al., 2015, p. 9). This sentiment is reflected in the conversations with key informants and mother/father's, who cited decreasing agriculture production as the biggest challenge faced by community members. Discussions highlighted the lack of rain, a changing overall climate[10], and perceived poor soil quality as the primary reasons for the decline.

[9] The government cash transfer program began in 1998 with the objective of providing direct financial assistance to households below the poverty line (as established by the Ministry of Social Development Coordination) who have children younger than 18 years of age, elderly, and/or a disabled family member (MIES, 2019; Tapia, 2018) According to recent news reports there is growing concern among some recipients that the government may be trying to shrink the size of the program by reducing the number of recipients (Tapia, 2018).

[10] Climate trends and the impact of climate variability on food production are discussed in detail in chapter 3.

In the Tingo Pucará focus group a male participant had the following to say about what the declining production has meant to households in the community:

> 'In the times before, in the 80s and 70s, when you planted 50 pounds of fava beans you got 10, or 7, or 8 100-pound sacks. So, you had sufficient production and sufficient food. You had enough to sell. You could sell six or seven 100-pound sacks and from that you had money. Now, since the soil is tired, there isn't enough production. You just have enough to eat daily. So about, about 80 to 90 % is just for personal consumption to feed your family and you're only able to sell 5 to 10 %. For this reason, there are economic crises at the level of the *parroquia* [parish] Guangaje.'

The declining production and its repercussions, particularly in Guangaje Centro, was noted by an agronomist who worked throughout the parish for an international NGO until being severely injured in an auto accident. He stated:

> 'In Guangaje Centro, because of the situation of the land, the land is sandier, the production is low, and …there is less land around because there are a lot of them, and some have land that is quite far away… production is only for consumption. Consumption and around 20 % is for selling all the rest is for consumption. And in Guangaje Centro there are a lot of people that migrate to find work in construction as bricklayers, hauling cargo, whatever they can get in the city, mainly in Latacunga, Quito, and Ambato.'

The following discussion with a husband and wife in Guangaje Centro highlights the sense of loss and agricultural decline that many interviewees expressed.

*Interviewer:* What was it like when you were young, when your parents oversaw this place, what differences do you see?

*Mother/father* (male): Well, to see what it was before, I believe, it has gotten worse totally. Before, from what I can remember, there were more crops here. There were fava beans, potatoes, *mellocos*, there was more of this type of thing. For example, talking about animals, they had a lot of sheep, the pens were full. They had chickens, guinea pigs, pigs, llamas. And they were full, the roads were full. And now this doesn't exist, now there isn't any. All of this has ended.

*Mother/father* (female): The crops, they don't produce like they used to. Before we didn't use chemical fertilizers. Since we had sheep and other animals, it was just with this that we planted. There wasn't any of these fertilizers or chemicals. Just with this (animal dung) we maintained our crops. But now the seeds don't produce and now there isn't much pasture and the water is drying up.

For many community members, it is becoming harder to find good pasture and some households must herd their flocks of sheep over an hour from the community to find sufficient grass. They are even struggling to provide adequate grass and grain for their guinea pigs and poultry. Many families would like to increase their number of chickens, but they cite poor barley harvests, the primary food source, and lack of money to buy feed as the principal barriers to poultry production.

### 2.5.4 Soil Quality and Land Use

The link between declining agricultural production and poor soil quality made by the interview and focus group participants is supported by a basic soil quality analysis[11] conducted by the author in 10 different locations and elevations. The tests were performed in accordance with the Rapitest instructions and the GPS location of each test was collected and stored on a Garmin eTrex 30x. The soil tests revealed that each test location was either depleted or deficient in nitrogen, indicating that the soil is severely lacking in organic material, which significantly impacts plant growth, development, and productivity. The soil was also low in potassium, another important nutrient for the quality and quantity of crop yields (International Plant Nutrition Institute, 1998). Soil PH levels ranged from slightly acidic to neutral, which is

[11] Rapitest soil testers were used for this analysis.

generally considered a positive finding, though potatoes, an important crop in this region, typically have higher productivity in more acidic soil. Phosphorus levels tended to be sufficient at lower elevations but were depleted higher up, closer to where the communities were located. Insufficient phosphorous can severely stunt plant growth (International Plant Nutrition Institute, 1999).

Several maps included in the report by Toaquiza et al. (2015) provide a picture of soil quality issues across the entire parish of Guangaje and where the study communities fit within the broader parish environment. Figure 2.1 shows a map of soil/land use. The location of communities is represented by yellow dots. The black rectangle highlights the location of Guangaje Centro, Tingo Pucará, and Curinge.

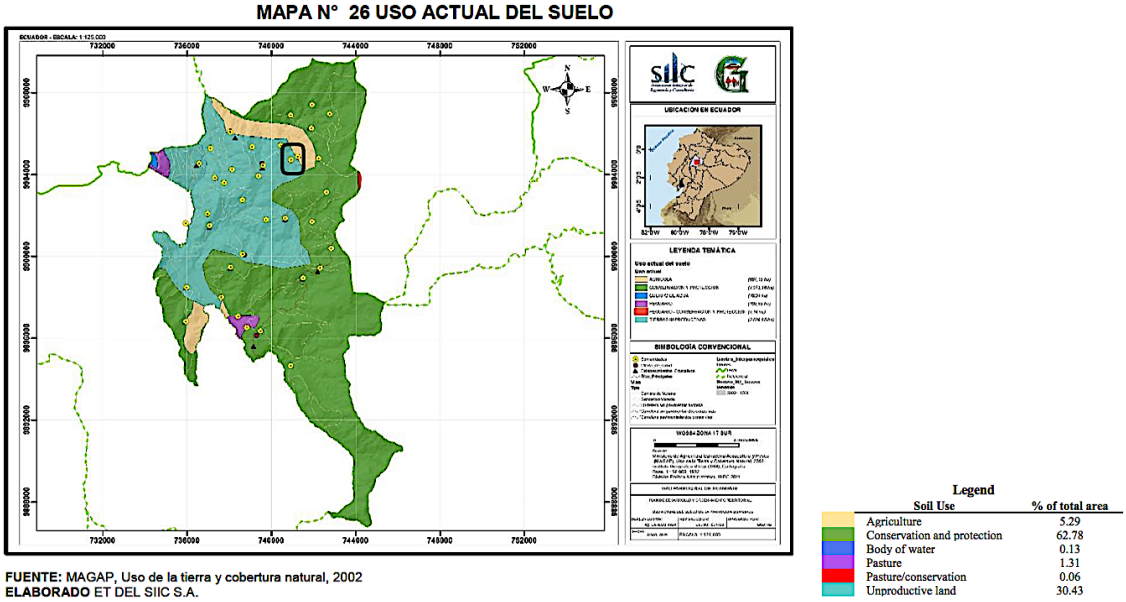


Figure 2.1. Actual soil use in the parish of Guangaje (Toaquiza et al., 2015, p. 71)

As shown in Figure 2.1, around 30 % of the entire parish has been designated as being unproductive land. This percentage is striking given the populations reliance on subsistence

agriculture and indicates significant natural resource degradation. Based on the author's observations of extensive agricultural use (livestock pasture and crop cultivation) in the areas surrounding the three study communities, the low percentage of land designated as agricultural (5.3 %) and high percentage (62.8 %) under conservation and protection seems inaccurate. This discrepancy suggests either issues with the data used to create the map and/or there has been a significant expansion of agricultural activities into protected areas of the *páramo* in the years since the map's creation in 2002. The potential expansion of areas of cultivation means that households are increasingly tilling virgin *páramo,* which decreases the habitat of native plant and animal species and destroys the *páramo's* natural water absorption and retention function, furthering issues of soil quality and ecosystem health (Hess, 1997; Ulloa Ulloa, n.d.).

Though the conclusions that can be drawn from the map about current conditions in Guangaje are limited because it was created over 15 years ago and the Toaquiza et al. (2015) report does not provide detail about how the determination of soil use was made, it does help to illustrate that the study communities are located in or at the edge of an area that has been deemed by Ecuador's national agronomy agency (MAGAP) to have low potential productivity. The fact that this determination matches study participants stated perceptions and experience with declining agricultural production provides validity to this conclusion. The map also highlights the severity of the low productivity issue in the parish. Nearly half of all communities in Guangaje are located in the low productivity area so a sustainable solution to this problem has the potential to benefit a large number of households.

A potential reason for the low productivity, according to Toaquiza et al. (2015), is that the soil in the unproductive areas is comparatively sandier than the soil in surrounding areas

making it susceptible to erosion from wind and water, which depletes the soil of organic material. The lack of organic material is supported by the soil quality analysis conducted as part of the study. Figure 2.2 shows how different areas of Guangaje are utilized and the areas that have experienced the most erosion, as determined by MAGAP. As in Figure 2.1, the black rectangle highlights the location of Guangaje Centro, Tingo Pucará, and Curinge. The area in gray, which represents eroded land, mirrors the area of low productivity land shown in Figure 2.1. This suggests that erosion could be a contributor to the agricultural production issues identified by the study participants.

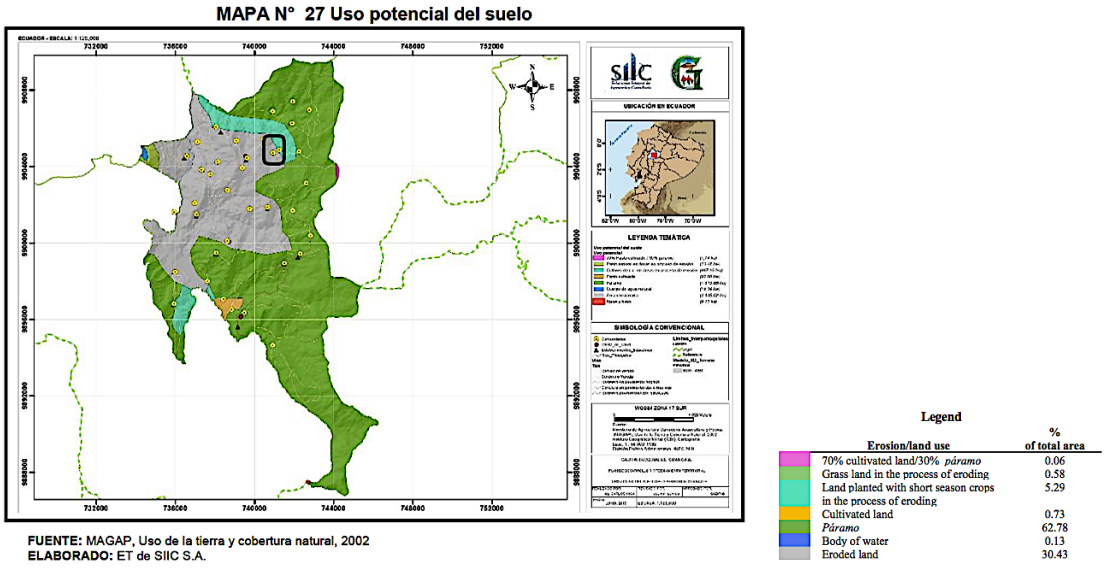


Figure 2.2. Areas of erosion and potential soil use in the parish of Guangaje (Toaquiza et al., 2015, p. 72)

Without longitudinal soil quality data, it is not possible to determine with certainty if the current soil quality issues have always been present or if the soil and land conditions have been worsening over time. However, interview participants comments about the productivity of the

land in the 70s and 80s suggests that the soil depletion and fertility issues have been increasing compared to previous generations.

The degradation has potentially been perpetuated by the lack of observed erosion and soil management practices, such as terracing or the use of barriers, in the study area. Other factors that have been found to be contributing to land degradation in similar regions of the Ecuadorian Andes include households being forced to move into poorer land and farm already cultivated land more intensely due to a combination of population growth and land scarcity (Hayes et al., 2017; Rhoades, 2006; Weismantel, 1988). It is unclear whether the lack of soil management practices in Guangaje is something that has diminished over time or if perhaps were never utilized. The absence of this type of infrastructure differs from the discovery of ancient water retention systems in the highlands of Peru or terracing found in the southern Ecuadorian province of Chimborazo (The Mountain Institute, 2016). A similar lack of agricultural engineering typically associated with ancient Incan civilizations was also observed in the neighboring parish of Zumbagua (Weismantel, 1988).

The author was not able to find much information about the settlement of the Guangaje area and the examination of ancestral agriculture practices was not part of the initial study design, so those questions were not asked. Literature about the settlement of Guangaje is limited. The literature that does exist suggests that prior to Spanish colonization the indigenous population that lived in what is now Cotopaxi province, where Guangaje is located, had no need to farm at high elevations, where erosion is a significant issue, and may have only used the *páramo* for occasional hunting or grazing of livestock (Weismantel, 1988). As noted by Weismantel (1988), during the Spanish colonial era "the spread of Spanish landholdings, along

with ever-increasing tribute and *mita* (forced labor) demands, pushed many Indians up from maize-growing lands into the *páramo*" (p. 62).

It is possible that the land of Guangaje did not become populated and/or significantly utilized until the establishment and growth of the hacienda economy in the 1700s (Weismantel, 1988). The minimal information that is available about the creation of the parish of Guangaje states that it was established in 1861 and for the next hundred years was dominated by livestock (mainly sheep) focused haciendas and the elite nonindigenous families that ran them (Municipio Pujilí, 2013). The key function of the haciendas in the area around Guangaje "was to provide wool for the great *obraje* [workshops] at Callo, near Latacunga as well as other workshops in the province of León" (Weismantel, 1988, p. 64). In order to have workers for the hacienda, the Spanish created a debt peonage labor system that 'gave' indigenous populations a place to live and in exchange they were required to work for the hacienda (Weismantel, 1988). The majority of haciendas were "capital-poor but land-rich" and so "labor had to be acquired without cash investment; hence the establishment of a system whereby the hacienda could exchange land for labor. Legal sanctions that kept peons on the land, plus a social system that provided them with few alternatives, served as additional reinforcements" (Weismantel, 1988, p. 63). Given that significant land reform, which dismantled the hacienda system, did not happen until the 1960s, it is probable that more intensive smallholder farming has only been occurring in the Guangaje area for the past 60 years.

This limited settlement and land tenure history suggests that there is likely not a long history of permanent crop cultivation in Guangaje and that land management practices, such as terracing, may never have been developed and/or utilized. It is likely that a combination of the

factors described in this section have contributed and/or continue to contribute to the soil fertility challenges faced by households in Guangaje. More research is needed to better understand the rate of erosion and soil depletion over time in the area and the history, cultural practices, and demographic changes that may have contributed to or be exacerbating this process.

### 2.5.5 Lack of Government Involvement

A challenge that was discussed in the focus groups but was not mentioned in the interviews was a lack of support from the local government. There was a lot of frustration about the perceived limited involvement of the local government in trying to assist the communities and households. Focus group participants said it was challenging to communicate needs to local government officials and they felt that assistance was only provided when it enabled the local government to meet their own predetermined objectives. As highlighted by a Tingo Pucará focus group participant, the community/government relationship appears to depend on the type of support that the authorities have decided to provide.

> 'In terms of the authorities in charge of the *canton*, the *parroquia*, the province, it depends how they have contact with us. For example, if they are going to be helping finance, there's a discussion about the work, what is wanted and needed in the community, so we are in contact. But if they are not going to share or give help for some type of social service then you can't really build a trusting relationship or have any type of contact.'

That same participant went on to say that the community has made a concerted effort to build relationships with MAGAP, the national agronomy agency, and with the mayor's office, and those relationships have been constructive. Additionally, households' monthly cash transfer of 60 USD could make them feel more positively about the national government, though this was never mentioned by any of the study participants. Most challenges appear to be with the level of

government that is between the national and local level, as highlighted by this quote from the Tingo Pucará focus group:

> 'In terms of the parochial government, not very much, maybe 50 %, because they haven't taken us into consideration in their meetings. When they have meetings, they don't share the announcement with us, and they are meeting without a way to enter/have a seat at the table… we can't say we don't have contact, but something is lacking.'

Focus group members in Guangaje Centro mentioned a similar dynamic, that parochial government officials do not meet with community members and that the president of the community is not leading or organizing any type of projects. In Curinge there has been even less contact. When asked about working with the local government, a focus group participant responded, "we have never had meetings with parochial government or with the mayor's office, nothing. The mayor says he is going to help us, but he has given nothing up to now." The community had asked for support for the construction of the water system they are building to bring the drinking water source closer to their homes. Another female focus group participant mentioned that "we don't have any help from the mayor, when we ask, they don't give anything. It is just with the engineers (Engineers Without Borders is help to construct the water system) that come, that's all we are working with."

The lack of government involvement highlights the limited institutional support the study communities appear to receive. Additionally, the support that is provided may not address the community's needs as community members have a limited voice and role in decision making. This perceived gap is supported by responses to community participation questions in the quantitative survey. None of the 109 households surveyed reported receiving visits from a state

agronomist in the past year, indicating very limited agriculture-related support and guidance at a time when agricultural livelihoods appear to be deteriorating. The research team attempted to interview the regional Ministry of Agriculture extension worker but were unsuccessful in coordinating an interview time as the extension worker was rarely in the communities. The one time the author could briefly speak with her, she mentioned that she was the only agronomist assigned to the entire parish, suggesting a lack of funds to hire additional people and the low priority being placed on the livelihoods of the rural indigenous population. MAGAP has built a center for mechanization in Tingo Pucará, which houses machinery for tilling such as rototillers and plows intended to be pulled behind tractors. The machinery does not appear to be used often, which is understandable given the steep mountainous terrain. Residents express pride that the center exists, but it is not clear what problem the center for mechanization was trying to solve and in fact it may be doing more harm than good. As indicated in the section on soil quality and land use, the increased tillage of land may be contributing to the problem of erosion and declining agricultural productivity.

The government's lack of belief, awareness, or willingness to address serious issues facing the communities in Guangaje was also evident during discussions with the director of the government run health center. When asked about child nutrition in the parish, the director mentioned that, while the households do have a limited diet, they do not have an issue with stunting because the indigenous population is genetically small. Though there have been documented evolutionary adaptions', such as larger lungs, to high altitude environments among Andean populations, the factors driving height have consistently been found to be associated with poverty (Brutsaert, Soria, Caceres, Spielvogel, & Haas, 1999; Leonard, 1989).

The belief that indigenous Andean children are genetically small is also contrary to the WHO's recommendation and advice regarding child growth standards (WHO, 2006). The WHO Child Growth Standards "depict normal growth under optimal environmental conditions and can be used to assess children everywhere, regardless of ethnicity, socio-economic status and type of feeding" (WHO, 2006. p. 76). This means that irrespective of genetics, all children under that age of 5 should be achieving the specified growth standards if they are receiving optimal nutrients and living in optimal conditions. If children are below the WHO Growth Standards, it is an indication of malnutrition and poverty and cannot be excused because they are from a population that is perceived to be genetically small.

The health centers' stance on child nutrition together with the lack of attention from government agronomists, and the limited voice community members appear to have in project planning and decision making, indicates that the government has minimal resources and/or desire to work with the communities to improve their well-being and livelihood. It also suggests that the communities have a limited institutional safety net that could help them through times of stress or shock. Though the 60 USD a month that most households reported receiving from the government is not insignificant, it means that families are highly dependent on a government policy that is susceptible to shifts in political agendas and/or economic downturns at the national level that could lead to a decline in funding for the program. This dynamic heightens households' vulnerability to a range of potential shocks including climate variability, crop failure, political changes, and other economic challenges.

### 2.5.6 Migration and Identity

All key informants cited migration as another way that the population earns a living and many of the women who were interviewed stated that the money men earn while working in the cities is playing a crucial role in the ability of families to meet their needs. The type of migration participants described is similar to what has been occurring in the Sierras since at least the 1950s (Bilsborrow et al., 1987; Commander & Peek, 1986; Peek, 1981; Peek & Antolinez, 1980; Proaño, 1978; Villagrán, 2016). It typically involves the men in the household traveling to urban centers and working in construction for several months or longer depending on opportunities. The men return to the community on the weekends, if at all. This pattern means that most of the agricultural tasks and management of the household fall to the women and children to complete, at least during the week.

Farming and temporary migration were viewed by the participants as being equally important to the family's survival, but permanent migration to the cities, specifically among youth, was a concern to numerous interviewees. Many felt that this phenomenon was increasing, but the research team was not able to find specific statistics to verify this potential trend. One physical manifestation of the degree of migration is that during the quantitative survey close to half of the homes in Guangaje Centro were found to be vacant or abandoned. Most of the property owners were said to live in the closest cities, Latacunga and Pujilí, and returned to their property infrequently, if at all. Reasons for permanent migration mentioned by interviewees include lack of arable land, lack of income earning opportunities, limited livelihood options for youth, and a declining interest among youth to make a living in agriculture.

Most of the concern around the level of migration in the parish was that it was contributing to the loss of the population's indigenous culture. A key informant in Tingo Pucará stated:

> 'Sometimes when the husband finds he must go to a different place to find work, he says 'no, how am I just going to keep working by myself', so he takes his kids, they rent a home in the city. And so, the home in the community is left abandoned. Number one, it is hard, the other things it is sadness. To leave abandoned the house where you have lived. Number one. Second, what was a large community with a participating population, it diminishes the organization. Third, the children are also affected when they leave for the city. They don't maintain their culture, their own identity, and they don't speak their own language, the mother language of Kichwa. They don't have the same type of respect like they would if they were in the country. Their entire life changes.'

Not only does out-migration change those who leave, the exposure to previously unknown goods trickles down to those who remain. The men working temporarily in cities "internalize new systems of thought…in the brutalizing experience of searching the cities for work, and in the words, gestures, and clothes of the *ingenieros* and work bosses they learn to admire and yearn to imitate" (Weismantel, 1988, p. 149). These new systems and ideas are brought back home, potentially reshaping what households' value and spend their money on.

One space were the population's current material and food aspirations are on display is the Sunday market, held in the center of Guangaje Centro. As noted by Weismantel (1988), markets are a symbol of what is desired and are often where women are exposed to commodities of the 'city' as they infrequently travel outside of the parish. The Guangaje market is made up of a two-story building constructed by the mayor three years ago and numerous stalls in a small plaza located between the market building and the church. Stalls selling meat, cheese, and bread are located on the first floor of the market building. The second floor has a small eating area,

similar to a food court in a mall, with small white tables each with four blue plastic chairs. The day the author observed the market, the whole floor smelled of fried food.[12] On either side of the eating area there are stalls divided by tile walls where women were making and selling different types of food. Most people in the food court area were eating plates of fried chicken, rice, a potato or two, and a salad of iceberg lettuce and a few slices of tomato.

In the plaza, there were close to 10 stalls selling factory made clothes, women's and men's shoes, and rubber boots. Another five stalls offered bags of grain, rice, noodles, and corn. Two stalls were selling crates of brown eggs, and one had goods like soap, sugar, oil, plates, cases of soda, crackers, and candy. A man sitting in the back of his truck parked at the edge of the market sold tall stalks of sugar cane. Only one of the stalls in the plaza offered vegetables and fruit. The produce included wilted celery, tomatoes, avocados, wilted iceberg lettuce, broccoli, small orange carrots, grapes in plastic packaging, and bananas. None of the produce could have been grown in Guangaje because of the cold climate. It and all the other food and goods would have been brought in from urban or larger agricultural areas of the coast and lowlands. The only area where the author observed trade of local commodities was along the outskirts of the market where people were selling a small number of livestock and materials for sheep corrals. During the hour-long observation period, most of the people in the market were women, either elderly or with young children. There did not appear to be much of a pattern in what people were buying, though the stalls with the clothes typically had the most people around them.

[12] Frying is the most expensive forms of preparing food as it requires the use of oil and/or grease. Fried dishes are *seco* [dry] and distinctive from the traditional cuisine of soups and gruels (Weismantel, 1988).

Exposure to new and different goods and foods is not inherently negative but what people do or do not eat can be an expression of a changing identity, culture, and status (Barthes, 1968; Hugh-Jones, 1978, 1979; Weismantel, 1988). The consumption of white rice is a prime example. According to Weismantel (1988), rice was brought from the coast to the Sierra by the 'white' (nonindigenous) merchants of the Inter-Andean Valley and sold alongside expensive processed goods such as white sugar and cooking oil. No documentation was found indicating exactly when rice first appeared in the Sierras but it is likely associated with the periods of more extensive migration to coastal areas in the 1950s and 60s. Ethnographic research conducted in a region close to the parish of Guangaje suggests that rice had taken on symbolic importance by at least the early 1980s (Hess, 1997; Weismantel, 1988). Given its prominence in the diets of nonindigenous Ecuadorians, rice has come to symbolize prosperity and the 'white' system of food preparation and consumption (Hess, 1997; Rhoades, 2006; Weismantel, 1988). For the indigenous population rice is a luxury, part of a lifestyle to aspire to and something to serve a special guest (Weismantel, 1988). While staying in Guangaje, almost all the meals the author and research coordinator were served included white rice.

Eating and serving white rice can also be a way for younger generations to assert their identities and a "contradistinction to what they see as old and ignorant lives" (Rhoades, 2006; Weismantel, 1988, p. 147). Multiple interviewees were concerned that households are consuming less of the traditional foods, such as tubers, and more of processed foods like rice and noodles. A mother in Guangaje Centro mentioned that "the youth, they don't eat barely, nothing, now it's changed, they don't eat this…now they eat rice, noodles, that's it." A male key informant in Guangaje Centro had a similar sentiment. He stated that "the majority, now eat this

(food from the city like rice). They didn't know to eat this before. They didn't know products from the city. But now a lot of people know so now it's rice, soup with noodles, this is what they make."

Food consumption, specifically foods associated with the nonindigenous world, have come to represent change and a shifting identity. For some, this change may be deemed necessary as they strive for greater assimilation and potentially less discrimination while trying to earn a living in urban areas. Consuming 'white' goods from the 'city' is also a clear way to demonstrate a certain social status in a community where most households are struggling to survive. For others, these changes are a reminder that the traditional means of livelihood are becoming undesirable and untenable and that the conceptualization of what it means to be 'indigenous' may be shifting. For all community members, the economic strain placed on households due to decreasing agricultural production, the value placed on less nutritious processed food, and the exposure to new ways of living through migration can have negative health outcomes, specifically for the youngest members of the community.

### 2.5.7 Nutrition

Households in all three communities have very limited diets. Focus groups and interview participants mentioned potatoes as the most frequently consumed food type. Potatoes were followed by different types of grains including *morocho*[13], *machica*[14], rice, and barley. These foods are most commonly consumed in the form of soups or warm gruels. In addition to potatoes, soups often contain onions and a few vegetables like locally grown cabbage or carrots

[13] A roughly milled corn typically eaten as a warm sweet gruel or in soups.
[14] Toasted and ground wheat or barley typically consumed as a warm sweet gruel.

purchased from the market. Soups may also include a small amount of quinoa but typically no meat. If there is meat it is likely to be mutton due to the high number of sheep raised in the parish. In general households eat what they produce, so will also consume fava beans and the traditional tubers (*melloco*, *mashua*, and *oca*). Lupines are almost exclusively reserved for sale and are rarely consumed.

If they have chickens, and the chickens are laying, households will eat eggs. Eggs are typically consumed scrambled then fried or dropped into soups. Households usually do not buy eggs. Some interviewees mentioned a strong aversion to industrially produced eggs[15] as they are perceived as being contaminated and poisoned by growth hormones. They also did not like that the eggs sold at the Sunday market and small shops are not freshly laid because they could be rotten. Several interview participants also expressed the belief that vaccinating chickens makes the meat taste bad. Since large scale poultry production facilities are assumed to vaccinate their chickens and/or give them steroids, the same participants said they did not like eating industrially produced chicken. Despite the stated aversion, eggs were available for sale at the Sunday market, suggesting some amount of demand though the author did not observe anyone purchasing them.

The food items that interview participants most frequently talked about purchasing from the market include lard/oil, salt, sugar, and rice. Around a third of the stalls at the Sunday market were selling these types of goods. Interviewees mentioned that they will sometimes buy meat, but it is viewed as being very expensive. One trend noted by interviewees is the purchase and consumption of rice and noodles. Noodles are often added to soups and are relatively

[15] Eggs sold at small shops and the market often come from large-scale egg production facilities in the lowlands. Participants prefer local free range eggs.

inexpensive and filling. Rice is not consumed as frequently due to the expense but, as described in the Migration and Identity section, has symbolic importance due to its association with being nonindigenous.

The per capita food consumption data from the household survey, shown in Table 2.4, is consistent with the diets reported in interviews and focus groups. The data in Table 2.4, which is organized from high to low mean consumption value, was calculated by first asking the survey respondent to estimate the monetary value of each food group that was purchased by members of the household, produced by the household, or gifted to the household in the past week.

Table 2.4

*Weekly per capita food consumption*

| Variable | Obs. | Mean | Std. Dev | Median |
|---|---|---|---|---|
| **Grains** (rice, corn, quinoa, barley, wheat flour) | 463 | 6.18 | 7.51 | 4.17 |
| **Tubers** (potato, *melloco*, *mashua*, *oca*,) | 463 | 5.74 | 8.03 | 3.33 |
| **Beans** (fava, lupine, lentils, other beans) | 463 | 3.06 | 8.68 | 0.25 |
| **Meat** (guinea pig, beef, goat, sheep, pig, poultry, intestines, liver, dried meat) | 463 | 1.37 | 2.08 | 0.83 |
| **Drink ingredients** (sugar, tea, coffee, chocolate, *panela*) | 463 | 1.21 | 1.12 | 1.00 |
| **Vegetables** (cucumber, squash, carrots, greens, onion, tomato) | 463 | 0.67 | 0.76 | 0.50 |
| **Fruits** (*ayrampu*, grapes, oranges, *tomate de arbol*, melon, banana) | 463 | 0.61 | 0.53 | 0.50 |
| **Oil/fat** (frying oil, pig fat, butter) | 462 | 0.56 | 0.60 | 0.42 |
| **Other food consumption** (crackers, bread, potato chips, sweets, noodles) | 463 | 0.48 | 0.46 | 0.33 |
| **Fish** (fresh fish, dried fish) | 463 | 0.39 | 0.82 | 0.20 |
| **Eggs** (chicken, duck, quail) | 463 | 0.37 | 0.52 | 0.17 |
| **Milk** (fresh milk, condensed milk, powdered milk) | 463 | 0.33 | 2.28 | 0.00 |
| **Spices** (salt, pepper, cilantro, *achio*te) | 463 | 0.32 | 0.25 | 0.25 |
| **Sugary drinks** (soda, fruit juice) | 463 | 0.14 | 0.43 | 0.00 |
| **Alcohol** (beer, wine, other alcoholic drinks) | 463 | 0.00 | 0.00 | 0.00 |
| **Tobacco** (cigarettes, cigars, tobacco) | 463 | 0.00 | 0.00 | 0.00 |

Consumption values are in USD and includes food that has been produced, purchased, and/or received as a gift or through barter in the last week

These three amounts were then added together and divided by the number of household members to create a per capita variable of the weekly value of food consumed, which is used as a proxy for quantity consumed.

Most consumption is grains and tubers, confirming that diets are very starch heavy. Using the product prices shown in Table 2.5, which were documented over the course of the study, it is estimated that each household member eats the equivalent of 9.5 pounds of grains and 22 pounds of tubers on average each week. These quantities are likely to vary by the number of children and adults in the household. The amount of starch being consumed is considerably more than the average 3 pounds of beans, most likely fava beans as this was a crop mentioned frequently in the interviews, and .5 – 1 pounds of meat that are consumed. No one mentioned eating lentils, though they were served to the author.

Table 2.5

*Product prices*

| **Product** | **Price/lb. USD** |
|---|---|
| Sheep | 3.00 – 3.25 |
| Pork | 2.50 – 3.25 |
| Chicken | 1.00 – 1.50 |
| Fava | 1.00 – 1.20 |
| Lentils | 1.17 |
| Oil | 1.00 |
| Sugar | 1.00 |
| *Panela* | 0.95 |
| Oranges | 0.73 |
| Rice | 0.65 |
| *Morocho* | 0.65 |
| Tomatoes | 0.60 |
| Wheat flour | 0.45 – 0.60 |
| Oatmeal | 0.57 |
| Onions | 0.55 |
| Plantains | 0.50 |
| Salt | 0.50 |
| Noodles | 0.45 |
| Potatoes | 0.25 – 0.30 |

Local chicken eggs are typically sold for .25 USD each, so the mean weekly per capita consumption value of .37 USD indicates that, on average, household members are only consuming the equivalent of slightly over one egg per week. The low levels of consumption may be tied to cost and/or the households' lack of poultry or the poultry not laying. There is minimal fruit and vegetable consumption, about a pound of each food group. Drinking warm sweet teas and herb-flavored water is common and is reflected in the 1.21 USD average per capita consumption of ingredients used to make drinks. Given how frequently eating noodles was mentioned in the interviews, it was surprising to not see higher per capita consumption in the 'other food consumption' category that includes noodles, though the monetary value reported in Table 2.4 is equivalent to about a pound of noodles per person per week. There was no reported alcohol consumption, which seems potentially inaccurate as the author observed a small shop in Guangaje Centro that had cases of beer for sale. Men were also observed drinking on Sunday around the edges of the market. Women were the primary respondents for the household survey, so perhaps they did not know of drinking by male family members or were reluctant to report it.

Because this is a baseline study it is not possible to say with accuracy how diets in Guangaje have changed over time. However, there is extensive food consumption documentation from an anthropological study conducted in the mid 1980s by Weismantel, (1988) in a community called Zumbagua, which is about a 41 minute drive west of Guangaje. Zumbagua has a higher population, but the altitude and climate is similar to the communities in Guangaje and, based on Weismantel's description, the means of earning a livelihood appear to be the same. Due to these similarities, it is assumed that the communities are relatively comparable.

As described by Weismantel, (1988), diets in Zumbagua were heavy in locally grown potatoes, barley, and fava beans. Purchased starches included noodles, oatmeal, wheat flour, plantains, and different forms of corn. Lentils, lupines, starchy peas, squash, and quinoa were consumed but infrequently. Meals would occasionally include locally raised meat from sheep, llama, goat, pig, guinea pig, chicken, or rabbit. Diets of the very poor consisted primarily of barley gruel and an amount of potato that fluctuated with the harvest. Families that were not struggling quite as much tended to consume more potatoes and, infrequently, rice.

The similarity between the diets in Zumbagua during the 1980s and the current population of Guangaje suggests that the reported decline in agricultural production in Guangaje has had more of an impact on household's ability to generate income than on their food consumption. Additionally, households in Zumbagua were eating processed foods like noodles, oatmeal, wheat flour, and rice, so this type of consumption is not likely to be a new trend in Guangaje, though the area is slightly more remote, and these food items could have taken a longer time to arrive. What interview participants who highlighted the noodle and rice consumption may be noting is a potential increase in the amount and/or frequency that these types of foods are consumed. Data that would allow the exploration of this possibility was not collected so it will have to be left to future research.

The limited dietary diversity, especially meat, vegetable, and fruit consumption, that has persisted in this region over that past 30 years is an indicator of the economic stagnation the parish has experienced. As discussed previously, many community members felt that poor soil quality and soil degradation were to blame for the limited agricultural surplus. The repercussions

of insufficient income, lack of economic growth, and minimal diets, particularly on the children of Guangaje, are highlighted and discussed in the next paragraphs.

The lack of adequate diet is evident in the prevalence of low height-for-age (stunting) and weight-for-age (underweight) in children under 5 (Table 2.6 and 2.7).

Table 2.6

*Prevalence of low height-for-age (stunting) in a sample of 42 children, by sex and age group*

| Age Group (months) | Sex | Number below cut-off (-2 SD) | Number in age group | Percentage below cut-off |
|---|---|---|---|---|
| < 6 | Boys | 1 | 1 | 100.0 |
| | Girls | 1 | 1 | 100.0 |
| | Combined | 2 | 2 | 100.0 |
| 6-11.99 | Boys | 1 | 2 | 50.0 |
| | Girls | 0 | 1 | 0.0 |
| | Combined | 1 | 3 | 33.3 |
| 12-23.99 | Boys | 1 | 4 | 25.0 |
| | Girls | 1 | 4 | 25.0 |
| | Combined | 2 | 8 | 25.0 |
| 24-35.99 | Boys | 2 | 4 | 50.0 |
| | Girls | 5 | 7 | 71.4 |
| | Combined | 7 | 11 | 63.6 |
| 36-47.99 | Boys | 3 | 4 | 75.0 |
| | Girls | 1 | 2 | 50.0 |
| | Combined | 4 | 6 | 66.6 |
| 48-59.99 | Boys | 2 | 3 | 66.6 |
| | Girls | 7 | 9 | 77.7 |
| | Combined | 9 | 12 | 75.0 |
| Total | Boys | 10 | 18 | 55.5 |
| | Girls | 15 | 24 | 62.5 |
| | Combined | 25 | 42 | 59.5 |

Nearly 60 % of all children under 5 are stunted. The overall stunting prevalence (59.5 %) is nearly 20 % higher than the estimated stunting prevalence for all indigenous Ecuadorian children under 5 and more than double the prevalence rate for all children in Ecuador younger than 5 years old (Freire et al., 2014). The prevalence of underweight children under the age of 5

in Guangaje (26.1 %) is lower than that of stunting but still high compared to all Ecuadorian children under 5 (6.4 %) (Freire et al., 2014).

Table 2.7

*Prevalence of low weight-for-age (underweight) in a sample of 42 children, by sex and age group*

| Age Group (months) | Sex | Number below cut-off (-2 SD) | Number in age group | Percentage below cut-off |
|---|---|---|---|---|
| < 6 | Boys | 0 | 1 | 0.0 |
| | Girls | 1 | 1 | 100.0 |
| | Combined | 1 | 2 | 50.0 |
| 6-11.99 | Boys | 0 | 2 | 0.0 |
| | Girls | 0 | 1 | 0.0 |
| | Combined | 0 | 3 | 0.0 |
| 12-23.99 | Boys | 1 | 4 | 25.0 |
| | Girls | 3 | 4 | 75.0 |
| | Combined | 4 | 8 | 50.0 |
| 24-35.99 | Boys | 1 | 4 | 25.0 |
| | Girls | 4 | 7 | 57.1 |
| | Combined | 5 | 11 | 45.4 |
| 36-47.99 | Boys | 0 | 4 | 0.0 |
| | Girls | 0 | 2 | 0.0 |
| | Combined | 0 | 6 | 0.0 |
| 48-59.99 | Boys | 0 | 3 | 0.0 |
| | Girls | 1 | 9 | 11.1 |
| | Combined | 1 | 12 | 8.3 |
| Total | Boys | 2 | 18 | 11.1 |
| | Girls | 9 | 24 | 37.5 |
| | Combined | 11 | 42 | 26.1 |

As per standard practice, the analysis does not include several extreme cases where z scores were below -6 standard deviations as this could overly skew the data and might be the result of mismeasurement. However, for two cases, twins that had height-for-age z scores of -9.19 SD and -9.06 SD and weight-for-age z scores of -5.98 SD and -6.62 SD, the research team was confident that the measurements were correct. The twins were born to a handicapped woman who had been raped. The woman was not able to care for both children because of her handicap, so one child was being cared for by the woman's sister. In addition to the anthropometric

measurements indicating that the twins were stunted and underweight, their faces were visibly sunken, and their skin was sallow. The health clinic was aware of the twins and their state of malnutrition, but it was unclear if anything was being done to address the issue other than standard checkups. This case is mentioned as an example of how extreme malnutrition can be in the parish.

Several key informants noted child malnutrition and overall child wellbeing as major challenges. They believed that families, and children specifically, do not eat enough nutrients. This theme did not come up during the interviews with mothers/fathers or during the focus groups, which could suggest a lack of recognition, awareness, and/or willingness to acknowledge the degree of malnutrition among the children in the parish, though this question was not specifically asked. In addition to agricultural production and economic issues, some contributors to malnutrition that were mentioned by participants included poor sanitation, lack of family planning contributing to large family sizes, and that young children are often left with grandparents or on their own when both parents decide to migrate to cities in search of work.

The anemia prevalence among mothers and children under 5 was also found to be high. Anemia is defined as Hb < 11.0 g/dL and severe anemia as Hb < 7.0 g/dL (Iannotti, Henretty, et al., 2015; Nestel, 2002; WHO, 2011). During data collection, if the first reading was below 7.0 g/dL a second finger prick and reading was conducted. If the second reading was also below 7.0 g/dL the research team recommended that the individual visit the local health clinic as soon as possible. At elevations of more than 1,000 m hemoglobin concentrations increase as an adaptive response to the lower oxygen levels (Nestel, 2002). To account for this adaptation, a reduction of

2.5 g/dL was made when interpreting the results in accordance with the recommended reduction for an elevation of 3,500 m (Nestel, 2002).

The analysis indicates that 15 out of the 42 women with children under 5 years of age had anemia. This is a prevalence of 30 %, nearly twice the average anemia prevalence of women of child bearing age in Ecuador (Freire et al., 2014). One woman was found to have severe anemia. The anemia prevalence among the 42 children under 5 years was 78 %, close to double the national prevalence for indigenous children under 5. Eighteen of the 24 girls (75 %) and 15 of the 18 boys (83 %) had anemia. Two boys and one girl had severe anemia, indicating a prevalence of 7 %. Though these prevalence's are high, the sample size is small, which limits the extent of conclusions that can be drawn based on the findings.

As noted previously, anemia can be caused by a range of health issues including nutrition (deficiencies in key vitamins and minerals), acute infections (hookworm, malaria), genetics (hemoglobinopathies), and chronic conditions and inflammation (Iannotti, Delnatus, et al., 2015). The high prevalence of stunting in children under 5 suggests that malnutrition linked to a diet low in animal source foods, which are a source of iron and zinc, may be the primary cause of anemia in the study population (Iannotti, Delnatus, et al., 2015). Acute infections such as malaria are not a concern given the study locations high elevation and the lack of mosquitos. As far as the research team was able to determine, hemoglobinopathies and chronic diseases are not prevalent in the study population. However, these conditions were not specifically tested for so further investigation may be warranted.

The mothers were very interested in knowing the results of their children's Hb analysis, which suggests that they are aware that anemia is an important indicator of their child's health,

though they were not specifically asked this question. Conversations with the director of the health clinic revealed that, due to limited resources, the clinic does not have the ability to conduct anemia assessments of mothers or children on a regular basis. This may help explain why the mothers appeared very committed to having their child tested as it was an opportunity to get information they rarely, if ever, have access to. No follow-up questions were asked about what, if anything, the mothers intended to do with the results, so we are not able to extrapolate further regarding how the mothers interpreted the results and what actions they might take to address anemia in their children or themselves.

## 2.6 Study Limitations

A major challenge during the data collection stage of the study was that most of the women who were interviewed only spoke Kichwa. This language barrier meant there was a heavy reliance on the field assistants to translate from Spanish to Kichwa and vice versa. The author has confidence in the field assistant's translations because their abilities were evaluated by a professional translator, but the conversations that they translated are subject to their interpretation of what was said and intended to be communicated by those being interviewed.

Another limitation is that the quantitative survey was conducted with the mother and/or female head of household. This may limit the accuracy of some of the data collected, especially information related to their spouse's income and other household expenses that they may not manage. On some occasions the woman's spouse was present and contributed when the woman was unsure. However, this was generally not the case. For diet and nutrition questions mothers and/or primary care givers are generally preferred given their knowledge of household food consumption, specifically in regard to younger children. Because mothers and/or the female head

of household were the primary survey respondents, the quality and reliability of the diet and nutrition data is believed to be high.

There may be a potential accuracy issue with the per capita food consumption data as it relied on the ability of participants to recall spending over the past week on different categories of goods. To assist with the difficulty in remembering spending, the research coordinator and assistants asked participants about specific goods that made up the consumption categories and then added that spending together. Additionally, the per capita food consumption variables were not weighted so differences between child and adult consumption are not taken into account.

An examination of trends typically involves a longitudinal study. One of the main structural limitations of this study is that it is a cross section of life in the parish of Guangaje, which limits the ability to make conclusions about how livelihoods and challenges differ from the past. Additionally, the study relied on participant's recollections of what life used to be like and those memories are unlikely to be completely accurate. To gain clarity about how livelihoods may have been changing in the communities, the study incorporated historical data and literature to create a multidimensional picture of what life was like in the past and how it compares to the current dynamic. One example is the use of the Weismantel (1988) ethnography, which provided critical cultural and food consumption information. Another way the study attempted to triangulate and verify trends was by interviewing different stakeholders and comparing the types and frequencies of the themes they discussed.

It is hoped that additional evaluations of livelihood trends and challenges can be conducted in the future and that this study, with its relatively small sample size, can become part of a larger panel data set. Having panel data would help with the generalizability of findings and

provide an improved means to analyze how livelihoods in Guangaje and the challenges that community members face have changed over time.

## 2.7 Conclusion

There is a long history of oppression, poverty, and struggle for survival among the indigenous populations of the Ecuadorian Sierra. The literature suggests that unequal economic opportunities, limited basic service delivery, historical labor exploitation, and natural resource degradation can play a significant role in driving and exacerbating the livelihood challenges of rural subsistence farming households in the Ecuadorian Sierra. These challenges include persistent poverty, low educational attainment, and poor child and maternal health outcomes. To try to alleviate this hardship, families and individuals have chosen to migrate to urban and more prosperous areas temporarily and/or permanently.

Study results indicate that households in the parish of Guangaje have and continue to experience a similar pattern of struggle. Households are extremely poor, living on an average .70 USD per capita per day. Soil degradation linked to the overuse of land, lack of soil management practices, and erosion have added to this already taxing existence by negatively impacting agriculture production. These challenges have been further exacerbated by the local government's lack of interest in supporting and assisting the three communities. The range of livelihood challenges in the parish of Guangaje has led many members of the community to migrate to urban areas in search of work.

Due to the decreased production, households are typically eating everything that they produce, and there is little to no surplus to sell at market, making them reliant on money earned in construction outside of the community, cash transfers from the national government, or the

sale of livestock to cover expenses. The limited dietary diversity, especially lack of animal source foods, vegetable, and fruit consumption, that has persisted in the region over the past 30 years is an indicator of the degree of economic stagnation in the parish.

The repercussions of the lack of income and economic growth and minimal diets can be seen in the high prevalence of low height-for-age (stunting) and low weight-for-age among children under the age of 5. The anemia prevalence among children younger than 5 and their mothers is also high compared to the national average. This means that many children are starting life with lower cognitive potential, which could result in poorer educational outcomes and income earning ability later in life. Women with anemia have poorer pregnancy outcomes including an increased risk of low birth weight, miscarriages, stillbirths, and perinatal and maternal mortality and have been found to have lower economic productivity. These negative outcomes become part of a feedback loop of continued poverty and malnutrition.

As traditional means of earning a livelihood become less viable and the migration trend continues, those who remain are left feeling that their identity as indigenous people is fading. One of their strongest identifiers is language. Many of the women who were interviewed still primarily speak Kichwa, but Spanish is the language of instruction in schools, and to be successful in the world outside of the community those who leave must speak Spanish. Another identifier is food preparation and consumption. Multiple interviewees were concerned that households are consuming less traditional foods, such as tubers and fava beans, and more processed foods like rice and noodles, which has both cultural and nutritional ramifications.

The populations of Tingo Pucará, Curinge, and Guangaje Centro face a range of livelihood challenges that have persisted over time and, in some cases, intensified due to

heightened vulnerability to land degradation and economic conditions. Interventions designed to address these challenges need to be multidimensional and transdisciplinary. One focus should be on increasing the productivity of household's small plots of land. This could be done by building up the soil's organic matter through agroecology, erosion control, expanding the use of intercropping[16], and planting appropriate nitrogen-fixing cover crops (Altieri & Toledo, 2011; Duru et al., 2015; Teixeira et al., 2018; Wezel et al., 2014; Willett et al., 2019). Agroecology focuses on "enhancing diversity and complexity of farming systems via polycultures, rotations, agroforestry, use of native seeds and local breeds of livestock, encouraging natural enemies of pests, and using composts and green manure to enhance soil organic matter thus improving soil biological activity and water retention capacity"(Altieri & Toledo, 2011, p. 588). The introduction of more drought-tolerant varieties of potato, barley, and fava beans could also be beneficial, but would need to be done in close consultation with community members to ensure that the introduction is acceptable and appropriate.

Land inheritance practices, detailed in section 2.4.2, and family size need to be examined and discussed with community members. The average family size is six, which means there is not enough land for all the children to stay and farm even if they wanted to. It may be a challenging topic to introduce due to the predominance of Catholicism in the parish, but increased family planning could decrease the current stress on land and other natural resources such as the limited water supply. It would be important to involve religious leaders in these discussions to have a better sense of where they stand and what they might support.

[16] A multiple cropping practice involving growing two or more crops in proximity.

Families typically use livestock as a form of savings. When there is a family health crisis or other emergency a sheep, llama, pig, or guinea pig is sold to cover expenses. An intervention focused on improving livestock health and productivity could improve income security, protein intake, and household resiliency to shocks and other stresses. If managed properly, livestock can be an important part of an agroecological food system due to their ability to provide nutrients that can be added back into the soil. A livestock intervention would need to include a component focused on improving pastures and growing fodder for feed so that the lands resources and the *páramo* ecosystem is not further depleted and destroyed.

# Chapter 3: The Impact of Seasonality on Food and Livelihood Security

## 3.1 Introduction

Rural smallholder[17] farmers "represent 75 % of the worlds farms, comprise 60 % of the agricultural workforce worldwide, and provide 80 % of the food consumed in the developing world" (Donatti et al. 2018, p. 1). Although these farmers play a key role in the global food system, they make up the majority of the world's food-insecure people (Bacon et al., 2014; FAO, WFP, & IFAD, 2012; Sibhatu & Qaim, 2017; Vaitla, Devereux, & Swan, 2009). Many poor rural farmers and their families go hungry due to their vulnerability to a range of factors including population, resource, and climate trends, household shocks, and seasonality (DfiD, 1999; World Bank, 2008, 2016). A better understanding of the factors and processes that influence farmers' ability to cope and adapt to seasonal change is critical to the development of acceptable, appropriate, and feasible assistance programs (Below, Schmid, & Sieber, 2015).

Despite its importance, the seasonal factors that facilitate or impede a farmers' ability to achieve food and livelihood security are often not well documented or understood (Below et al., 2015). This lack of knowledge can lead to the creation of unsustainable programs that do not meet the needs of farmers and their families. This chapter details a qualitative study that examines the seasonality of food availability and income earning opportunities in three indigenous communities in the Andes of Ecuador. An understanding of local seasonality and its

[17] There is no widely accepted definition for a smallholder farmer but most definitions focus on agricultural production for both consumption and income, the cultivation of areas less than 10 ha, and the reliance on family labor to meet production needs (Donatti et al., 2018).

impact on food and livelihood security will enable the development of a livelihood-focused intervention that addresses the environmental, economic, social, and/or health challenges faced by the study population (Below et al., 2015; Smit et al., 2001).

Seasonality is an intrinsic aspect of the livelihoods of all rural small-holder farmers (Chambers, Longhurst, & Pacey, 1981; Ellis, 2000). It encompasses the cyclical shifts in prices, production, health, and employment and affects the timing of trading activity, which can be particularly important for staple crops with a single annual harvest and short timeframe for sale. It also produces variation in on-farm and off-farm returns to labor (Ellis, 2000). As noted by Ellis (2000), "seasonality causes changes in occupation to occur as labor time is switched from lower to higher return activities" (p. 5). During peak periods of farming activity, such as planting and harvesting, the amount of time invested in on-farm activities is high. As on-farm activity declines, there is often a shift to off-farm activity by one or several members of the household "as temporary labor markets spring into being, for example, to harvest a grain or tree crop, or to move recently harvested produce from farms into stores or distribution centers" (Ellis, 2000, p. 5). Because seasonality can impact all aspects of household food and livelihood security, it is viewed as a has key component of the sustainable livelihoods framework's vulnerability context (DfiD, 1999). As discussed in chapter 1, the framework provides a structure for recognizing the main factors that affect people's livelihoods and the relationships between these factors (DfiD, 1999). This paper continues to use the sustainable livelihoods framework as a guide for organizing and understanding the impact of seasonality on the livelihoods of rural small-holder farmers.

As in chapter 2, this paper uses a definition of livelihood security that is based on the work of Chambers & Conway (1991). Livelihoods are composed of "the capabilities, assets (stores, resources, claims and access) and activities required for a means of living" (Chambers & Conway, 1991, p. 6). Having a secure livelihood means that an individual or group has the ability to cope with and recover from stress and shocks and maintain or enhance current and future capabilities and assets, while not undermining the natural resource base (Chambers & Conway, 1991). An outcome of livelihood security is reduced vulnerability to stresses and shocks and improved food security (DfiD, 1999). Food security "exists when all people, at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (Bacon et al., 2014, 134).

Poor smallholder farmers tend to be the most vulnerable to changing climate due a dependence on rain-fed agriculture, small land holdings, and a lack of assets and saving that would allow them to change livelihood practices (Harvey et al., 2017). The increased frequency and intensity of climate shocks coupled with the variability of rainfall patterns negatively impacts agricultural production, decreasing the resources available for investment in farm and other livelihood activities (Magrin et al., 2014; Marengo et al., 2014). Changing climates are also likely to lead to increased "price volatility for agricultural commodities, and reduce food quality" (Marengo et al., 2014, p. 66). Smallholder farmers in the Andean region of South America are expected to be increasingly impacted by climate change (Hannah et al., 2013). Multiple climate models and emission scenarios indicate that by 2050 the Andes will experience significant loss in agricultural productivity and ecosystem degradation (Hannah et al., 2013). Intergovernmental Panel on Climate Change (IPCC) models suggest that climate change could significantly affect

water management systems and food and energy security in South America (Hannah et al., 2013; Marengo et al., 2014). The IPCC reports also show that climate change in South America has already resulted in alterations in the frequency, intensity, and duration of weather extremes (Magrin et al., 2014; Marengo et al., 2014).

Climate shocks and increased climate variability may exacerbate food insecurity by extending already existing periods of seasonal hunger, which is defined as a "cyclical pattern of reduced food availability and access" associated with cycles of income earning opportunities, weather, changing markets, and political and economic trends (Bacon et al., 2014, p. 134; Vaitla et al., 2009). Longer periods without food means households must rely on any and all crop stores to survive. This often results in people consuming most or all of their harvest, leaving little to nothing available to sell to cover expenses. Families may even be forced to consume next year's seeds, which only adds to the household's economic and nutritional hardship (Vaitla et al., 2009). Typically, the majority of families in poor rural communities are affected by seasonal hunger, which means that "mutual support networks are undermined" and the "household level food deficits translate to general shortages at the local economy level" causing significant increases in local food prices (Vaitla et al., 2009, p. e1000101).

A common coping mechanism for seasonal hunger and seasonality more broadly is short-term migration of one or several family members to urban centers in search of work (Ellis, 2000). However, the nature of seasonality means that labor markets experience an influx of hungry people looking for employment which drives down wages (Vaitla et al., 2009). For those able to find work, "working for wages to obtain food for immediate needs comes at the expense of neglecting one's own farm, thereby compromising future harvests. The net result is that

households are forced to reduce the diversity and quantity of food they consume, setting the stage for macro- and micronutrient deficiencies" (Vaitla et al., 2009, p. e1000101). Regional and/or national political instability or economic downturns can add to the duration and intensity of the lean months by shifting or changing the timing of income from off-farm employment and remittances (Bacon et al., 2014). Due to the stress that seasonal hunger can place on rural farming households, an understanding of local seasonality is an important component of development programming aimed at improving resiliency as it can shed light on key livelihood vulnerabilities that need to be addressed (Bacon et al., 2014; Below et al., 2015; DfiD, 1999; Scoones, 1998).

Crop and farm system diversification is another approach that households can use to mitigate the production and price risks associated with seasonality (Ellis, 2000; Ignaciuk, Sitko, Scognamillo, Alfani, & Kozlowska, 2017; Waha et al., 2018). By diversifying, adding new crops or cropping systems to their agricultural production, small-holder farmers can increase the types of potential foods that can be harvested and be more successful in meeting their consumption needs (Ignaciuk et al., 2017; Waha et al., 2018). Diverse cropping systems "such as mixed cropping and field fragmentation take advantage of complementarities between crops, variations in soil types and differences in micro-climates that ensure risk spreading with little loss in total income"(Ellis, 2000, p. 5). More diversity can result in better agricultural production and minimize the impact of changing environments "because a broader range of functions and responses to change will stabilize the system" (Waha et al., 2018, p. 3390). However, the ability to diversify is dependent on the households access to resources, which can make it particularly challenging for poor farming households to implement without some initial outside assistance

(Ignaciuk et al., 2017). Additional limiting factors include "unfavorable soils, labor, input, and land constraints or because of their remote location without access to extension services that provide support for new crops or crop management techniques" (Waha et al., 2018, p. 3397). Before programs promoting diversification are implemented there should be a thorough documentation of contextual facilitators and barriers to program implementation and sustainability.

This paper details the results of a qualitative study that examined the seasonality of food availability and income earning opportunities in three indigenous communities in the Andes of Ecuador. The paper describes the types of crops that are planted and the cycle of cultivation and harvest, length and intensity of periods without harvest, and the variability of agricultural and nonagricultural income earning. Study findings are used to create a rich description of the seasonal vulnerability that may be contributing to the negative health and nutrition trends described in chapter 2. It also examines the climatic variability that may be impacting seasonal hunger. In addition, the paper highlights the unpredictability of income earning that makes it challenging for study participants to achieve livelihood security. The goal is to characterize the processes that shape farmers' ability to adapt to livelihood challenges and identify vulnerabilities in their current livelihood approaches. This range of understanding will facilitate the development of an acceptable, appropriate, and feasible intervention that addresses the study populations environmental, economic, and health challenges.

The following sections describe the research methodology and detail research findings. Results indicate that the subsistence farming population of Guangaje is highly vulnerable to cyclical shifts in agricultural production and crop prices. One of the primary challenges

influencing this vulnerability is the increased unpredictability of precipitation, which impacts planting seasons and the length of time before crops are ready to be harvested. The composite seasonal calendar shows that households could be food insecure for close to 80 % of the year. We argue that this degree of food vulnerability may explain the poor nutritional outcomes and lack of dietary diversity discussed in chapter 2. Households use a range of strategies, such as crop storage and the selling of livestock, to survive periods of low to no harvest. However, many families lack the means to properly store any surplus harvest or to maintain enough livestock to meet all their consumption needs. This dynamic perpetuates a cycle of subsistence and food and livelihood vulnerability.

# 3.2 Materials and Methods

## 3.2.1 Study Site

Data for this paper comes from the Ecuador Livelihood and Nutrition study (ELNS), which was conducted in a rural area of the Ecuadorian Andes from September 2016 to January 2018. The communities of Guangaje Centro, Tingo Pucará, and Curinge were selected as the research location due to their rural mountainous location, perceived vulnerability to a wide range of economic, health, and natural resources challenges, and a connection with collaborators at the University of San Francisco Quito (USFQ), which enabled and aided data collection efforts.

As described in the chapter 2, the communities are in La Sierra, a belt of the Andes mountains that includes volcanoes and peaks with year-round snow (Brush, 1982). The parish of Guangaje, where the three communities are located, has a total population of a little over eight thousand spread across 39 communities (INEC, 2010; Toaquiza et al., 2015). Nearly all (99 %)

of the population identifies as indigenous Kichwa speakers[18] and over 91 % live in poverty[19] (INEC, 2010; Toaquiza et al., 2015). Tingo Pucará and Curinge are small communities with 19 and 32 households respectively. Guangaje Centro is considerably larger, with 153 homes, though only about half are permanently occupied due to migration. Guangaje Centro serves as the economic, health, and education hub for the parish. It hosts the local Sunday market, health center, primary and secondary schools, and Catholic and Adventist churches.

According to our survey data, subsistence agriculture and temporary male migration for wage labor are the primary means of livelihood. On average, households have between a half to one acre of land under cultivation and almost all plant potatoes and fava beans and raise sheep and poultry (Toaquiza et al., 2015). Other crops of importance include barley, onions, *melloco*, *oca*, and *mashua* [native tubers]. Among the less commonly cultivated crops are *chocho* [lupine], *quinoa*, peas, and vegetables like a large leaf cabbage and *nabus* [field mustard]. Additional types of frequently raised livestock are llamas and guinea pigs. Some households also raise pigs and rabbits. Crop production is almost exclusively for home consumption. The only crops intended for sale are lupine and onions as well as occasional surpluses of potatoes and barley. There is a greater reliance on livestock sales for income generation. Sheep and pigs are the most frequently sold livestock type. Llamas are typically kept to carry and transport goods. Chickens are raised for their eggs, which are often eaten and occasionally sold, bartered, or gifted. The population consumes chicken and sheep meat but usually only when there is a special occasion

[18] Over one million Ecuadorians, 7 % of the population, are indigenous/Amerindian (CIA, 2018). They are typically categorized by the language they speak. These languages include Kichwa, Paicoca, Shuar, Tsa´fiqui, Shiwiar, Waotededo, Sapara, Achuar, Andoa, Awapit, A´Ingae, Cha´palaa, and Zia pedee (Freire et al., 2014).

[19] The Ecuadorian National Census and Statistics Institute (INEC) uses a methodology developed by the Economic Commission for Latin America and the Caribbean (CEPAL) to determine poverty. The method covers five dimensions (1) economic capacity defined as the education level of the head of household and the ratio of household members working to total household members (2) access to basic education defined by the number of children between 6 to 12 years old who are not in school. The more children not in school, the poorer the household (3) floor and wall materials of the dwelling (4) access to proper sanitation and piped water (5) number of people per bedroom (INEC, 2019).

or event. Guinea pigs are eaten and are believed, along with eggs, to have curative and diagnostic capabilities[20] (Weismantel, 1988).

### 3.2.2 Study Design

To understand the seasonal shifts in food availability and income generation opportunities that may be impacting individuals' and households' food and livelihood security, the research team conducted a series of qualitative key informant interviews (n=15), focus groups (n=3), and observations (n=6). The interview sample size is based on well-regarded qualitative research, which has found that saturation, or the point at which new data does not alter the emerging themes or provide additional in-depth understanding, is typically reached at around 15-20 interviews (Charmaz, 2014). A focus group was conducted in each of the three study communities ensuring representation of information and perspectives for the entire study area. The average focus group size was 14 participants. A purposeful sampling methodology was used to select individuals for the interviews and focus groups (Padgett, 2012; Palinkas et al., 2013). The research team sought into include both men and women who had significant experience working in agriculture in Guangaje. Demographic detail about interview participants can be found in Table 9 in the Results section. Six observations were the total the author was able to conduct during visits to the study site.

### 3.2.3 In-depth Interviews

The in-depth key informant interviews were semi-structured and focused on the cycle of crop planting and harvesting over the course of a year, length and intensity of periods without harvest, livestock lifecycles, and annual variability in income earning opportunities. The key informants

[20] See footnote 4 in chapter 2 for more detail.

included community leaders and farmers who were willing to participate. The interview guides were developed by the author under the guidance of the committee chair, translated into Spanish by the author, and piloted in the field by the author and the field research coordinator. Minor changes in terminology and question intent were made after the pilot testing.

The interview team used the same interview methodology described in chapter 2. The author and/or the field research coordinator and a Kichwa speaking field assistant conducted the interviews. The interviews were audio recorded if permitted by the interviewee. If audio recording was not permitted one of the research team members took detailed notes. The recordings and/or interview notes were assigned unique identification numbers by the field research coordinator and the names of interviewees were not linked to the recording and/or interview notes.

### 3.2.4 Focus Groups

The focus groups were used to gain multiple perspectives on seasonality, better understand strategies that participants use to cope with common challenges they face and gain insight into how participants perceive the well-being of their community. As this chapter is focused on better understanding seasonal shifts in food availability and income generation opportunities, only the seasonality component and associated coping strategies have been included for analysis.

Seasonality was captured through the creation of a seasonal calendar that was made during the focus group with information provided by focus group participants. A seasonal calendar is participatory rural appraisal (PRA) methodology used to gather data that identifies seasonal patterns, variations in economic and production activities and challenges, illness/disease, migration, natural events, and other phenomena that impact individuals,

households, and communities (ICPAC & World Food Programme, 2017; Narayanasamy, 2009; World Bank, n.d.). A seasonal calendar can shed light on variations in vulnerability, risk, and access to assets and resources and can play an important role in understanding seasonal distribution and differences between events and activities that occur throughout the year (ICPAC & World Food Programme, 2017; World Bank, n.d.).

The creation of the seasonal calendar involved participants naming the main seasons of the year, identifying when the year starts and ends, detailing their principal activities throughout the year, the challenges that they have to overcome, and the duration of each challenge and/or life event. The research team probed for changes in the weather (rain, drought, hot/cold periods), changes in employment opportunities, times for planting and harvesting crops, the life cycle of livestock (breeding, birthing, sale, consumption), changes in crop/livestock/basic goods prices, social and/or political events, and common illnesses (humans and animals). All information was documented on large sheets of paper by members of the research team.

### 3.2.5 Observations

The author conducted six written observations of agricultural spaces (crop fields, livestock pens, and crop storage areas) during visits to key informants for interviews. The observations focused on describing the types of crops planted and being harvested, how planting and harvesting occurred, where areas of cultivation are located, and how/where food is processed and stored. They took place in pastures, plots of land used for cultivation, and in and around buildings and sheds used to store crops that had been harvested or to house animals. This information has been used to enrich understanding of the themes discussed in the interviews and focus groups.

## 3.3 Analysis

### 3.3.1 Recordings and Interview Notes

The author used the same analytical approach described in chapter 2. The only change was that the field research coordinator conducted the first round of coding in Nvivo for Mac (11.4.3), which the author then reviewed and revised as necessary. A combination of deductive and inductive coding was used to analyze interviews. The field research coordinator relied initially on a codebook that was developed by the author using the interview guides. As new themes emerged throughout the coding process the field research coordinator and author added the new code to the codebook and revisited previously coded recordings, recoding and/or adding the code if necessary. Code frequencies were examined by using the hierarchy charts tool in Nvivo. Overall coding hierarchies were explored as well as specific combinations of sources and main nodes such as 'key informants' and 'season change' or 'community' and 'crops planted and harvested.'

### 3.3.2 Seasonal Calendar

Data from each of the three seasonal calendars created during the focus groups were transferred by the field research coordinator and the author from the large pieces of paper to individual word documents. The author then created a composite seasonal calendar that merged the data from each community into a seasonal calendar representative of Guangaje parish. Inconsistencies between calendars were resolved using the authors written observations and photographs taken by the author of the planting, cultivation, and or harvesting of crops during visits to the study area at different months of the year and the work of Morales (2015) and Valdivieso (2012), which detail agricultural practices in the Ecuadorian Andes.

# 3.4 Results

## 3.4.1 Demographic Characteristics

As seen in Table 3.1, most interview and focus group participants were women. This is due to the fact that men were often working in the cities and/or women were more accustomed to meeting due to participation in women's groups.

Table 3.1

*Interview and focus group demographics*

| | Key informants | Focus groups |
|---|---|---|
| **Sex** | | |
| Female | 12 | 32 |
| Male | 8 | 8 |
| **Age range (yrs.)** | | |
| 20-29 | 4 | 6 |
| 30-39 | 5 | 12 |
| 40-49 | 4 | 9 |
| 50-59 | 3 | 5 |
| 60-69 | 3 | 4 |
| 70-79 | 1 | 4 |
| **Occupation** | | |
| Farmers | 17 | 40 |
| Herders | 2 | |
| Construction workers | 1 | |
| Students | 2 | |
| **Education level** | | |
| None | 7 | 18 |
| Elementary | 9 | 21 |
| High school | 4 | 1 |

5 of the 15 key informant interviews included 2 informants, either husband/wife or parent/child

Due to the male migration, women do a lot of the farming and livestock management, which makes them important key informants regarding crop and livestock seasonality. The age range for key informants was relatively evenly spread, most focus group participants were between the ages of 20 and 49. Almost all participants identified as being farmers. Those who identified as herders were also farmers. It is not known if those who identified as herders had

more livestock than the average household or of they just wanted to highlight the diversity of what they do. Study participants most frequently had an elementary level education followed closely in number by those with no formal education. Several participants had attended or completed high school, but they were in the minority especially in the focus groups.

### 3.4.2 Seasonal Calendar

Table 3.2 shows the common planting seasons for crops typical of the Ecuadorian Andes (Valdivieso, 2012). We were not able to find typical planting season information for all crops cultivated in Guangaje so the list of crops in Table 3.2 is not exhaustive. However, the calendar does provide a frame of reference for what cultivation cycles in the Sierra are believed to be based on available literature.

Table 3.2

*Planting and harvest seasons for traditional crops*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Crops, S=sowing, H=harvest** | | | | | | | | | | | | |
| potato | | | | H | S/H | | | | | | S/H | |
| *mashua* | | | H | | S/H | S | | | | | S/H | |
| *melloco* | | | | H | | | | | | | S | |
| *oca* | | | | H | | | | | | S | | |
| *chocho* (lupine) | S/H | S | | | | | | | | | H | S/H |
| fava beans | | | | H | | | | | | S | | |
| quinoa | S | | | | H | | | | | | S | |
| squash | | | | H | | | | | | | S | |
| corn | | | | H | | | | | | | S | |

The basic crop calendar is used to make comparisons to what is actually happening in Guangaje. It is important to note that the exact timing of crop cultivation is highly dependent on the local microclimate, which can vary significantly across the Sierra (Valdivieso, 2012). Some regions may conform to the basic crop cultivation and harvest seasons seen in Table 3.2. In other

areas it may be possible to plant certain crops year-round or planting/harvesting may earlier or later. The basic crop calendar indicates that most planting and harvesting happens in two distinct time periods. The majority of planting occurs October through January and harvesting starts in April and continues through June.

Crop cultivation cycles in Guangaje are not as clearly defined (Table 3.3). A lot of planting appears to be happening in January but there is also significant planting activity in October and November. The harvest times of different crops in Guangaje is more dispersed throughout the year. Unlike the basic crop calendar, the months with the highest amount of potential harvest are August and September. In the basic crop calendar most harvesting is occurring two months earlier in April and May. The difference between the two calendars may be due Guangaje having a distinct microclimate and/or changing weather patterns are forcing study participants to adjust their cultivation cycles. Climate variability in Guangaje is discussed in detail in section 3.4.4.

One of the main challenges the Guangaje calendar demonstrates is the seasonality of food vulnerability. This valuation was made by counting the number of potential crop harvests per month. Months with 0 or 1 crop harvest were deemed to be a time of high food vulnerability, 2 to 3 harvests were considered to be a time of moderate food vulnerability, and 4 or more harvests were categorized as low food vulnerability (Waha et al., 2018). A similar categorization approach was taken to determine the months that have the greatest frequency of crop disease and therefore greater crop vulnerability. A distinction is made between food vulnerability when all potential crops are planted/harvested and when only the most frequently planted crops (potato, lupine, fava bean, barley, and tubers) are cultivated.

Table 3.3

*Seasonal calendar for Guangaje*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Climate events** | rain/wind | | rain | | sun/dry | | wind/dry/sun | | wind/dry/sun | cold | cold/rain/hail | |
| **Food vulnerability** all crops | high | | | low | moderate | high | moderate | | low | moderate | low | |
| **Food vulnerability** staple crops[21] | | | high | | | | moderate | | low | | high | |
| **Crop vulnerability**[22] | low | | moderate | | high | | moderate | | low | | moderate | |
| **Crops**[23] | | | | | | | | | | | | |
| potato[24] | S | | G | H/D | H/S | | S | | H/G | H | S/D/H | S/D/H |
| *chocho* (lupine) | S/H | | | G/D | | | | | G | | | |
| fava bean | S/G | | G/D | | G | | H | | S/H | S | | G |
| barley | S | | | G/D | | G | H/D | | S/H | S | | G/D |
| *mashua,oca,melloco* (native tubers) | S | | | G/D | | G | S/H | | S/H | S | | G |
| corn, *morocho* (type of corn)[25] | | G | | H/D | | | | | | S/D | | D/G |
| peas | S | | G | H | H/D | | S | | G | H | S/H | S/H |
| lentils | S | | | G | | G/D | | | G | | H | H |
| quinoa | S/G | | G/D | | G | | | | S/H | S | | S/G |
| squash | | G | | H | S | D | | | G | | | |
| bean | | G | | H | | | | | | S | S/D | G |
| vegetables[26] | | | | | | | | | S | G | H | H |

[21] Potato, lupine, fava bean, barley, *mashua, oca, melloco*

[22] Based on disease frequency. The most common disease is *lancha* [late blight]. It typically appears during the rainy season. Crops are also negatively impacted by frost, wind, and worms that attack plant roots and fruit

[23] S=sowing, G=growing, H=harvest, D=disease.

[24] Planted and harvested throughout the year

[25] Only grown at lower elevations in Curinge

[26] Typically planted in small gardens close to the home. The PI only observed three of these small gardens. Contents may include radishes, lettuce, beets, carrots, shallots, chard, cabbage, turnip, coriander, celery, parsley, chives. Participants noted that they would plant vegetables and herbs if given the seeds. SWISS Aid had given seeds in the past.

### 3.4.3 Food and Crop Vulnerability

As shown in the seasonal calendar (Table 3.3), if all potential crop types are planted, households are likely to experience 7 months of high to moderate food vulnerability[27]. The periods of the year when families are most food-insecure are January to March, which is the main rainy season and when the majority of crops are being planted, and in June, during the dry season right before five major staple crops are harvested. The interviews and focus groups indicated that households tend to only plant the staple crops, potato, lupine, fava bean, barley, and native tubers, due to limited agricultural land, land/climate suitability, and/or lack of labor to help with cultivation. This means that the period of high to moderate food vulnerability is closer to 10 months, suggesting that families are food-insecure for nearly 80 % of the year. This degree of food vulnerability could help explain the poor nutritional outcomes and lack of dietary diversity discussed in chapter 2.

Crop disease puts an additional strain on an already fragile food production system. The most common disease is *lancha* [late blight], a water mold that attacks the plants roots and causes it to be unable to absorb nutrients. This in turn negatively impacts the plant's ability to grow and produce appropriately (Torres, Taipe, & Andrade-Piedra, 2011). Late blight is most common during the rainy season and, according to study participants, most frequently affects potatoes, lupines, and fava beans, three important crops for consumption and sale (lupines). As shown in the seasonal calendar (Table 3.3), some of the periods of highest crop vulnerability, the last month of the rainy season (April), coincide with a time of high food vulnerability. In April and May households are preparing to harvest potatoes, which could be the only crop that has

[27] The lupine harvest was not counted towards potential food consumption as lupines are typically planted for sale.

been planted. If the potatoes have been affected by late blight families may have little to no food until July or August. Several of the key informants mentioned using chemicals to prevent disease but the majority said they do not use any type of fungicide, primarily because they do not have the financial resources to buy it. Several of the staple crops are also directly impacted by weather events. Potatoes, barley, fava beans, the native tubers, and corn were all mentioned as being susceptible to frost and hail damage. The warming temperatures noted in the previous section could result in a decline in the impact of frost and hail, but fungal diseases like late blight, which infects and destroys the leaves, stems, fruits, and tubers of crops, could have more opportunity to get established and spread.

Households use a range of strategies to survive during the periods of low to no harvest. Families with the infrastructure and capacity will store crops that are not immediately consumed. The stored food will last a varying amount of time depending on quantity harvested and the size of the family. According to a male key informant in Tingo Pucará, "favas, barley, it lasts about half a year, just a little bit of time…potatoes they will last about 2 months, maximum. They [potatoes] become moist and they all rot…and after that we have to buy seeds." The key informants point about the challenges of storing harvest is an important one. Even if there are crops that can be stored there is no guarantee that they will still be able to be consumed or planted when needed due to postharvest fungal diseases, rodents, and weevils. The most sophisticated storage arrangement observed by the author was plastic sacks of fava beans and barley kept in a locked room with cement block walls located between the house and a shed that housed guinea pigs and doves. The room looked dry, but the sacks were placed on a dirt floor, which could allow the transfer of moisture into the sacks.

Most storage observed by the author consisted of a sack or aluminum pots of potatoes or other crops packed into the dark corner of a kitchen. The quantities stored did not look like they would last the families more than a couple days. However, this may be because the potatoes were being harvested over an extended period of time, which is possible as the Guangaje seasonal calendar indicates that potatoes are harvested throughout August to December. Numerous study participants mentioned that they do not produce enough to store crops for lean times even if they wanted to. A female key informant in Guangaje Centro noted that " we don't store, we harvest, and we finish it [eat]. We use the *bono* [government cash transfer] and we plant again. A male key informant, also from Guangaje Centro, stated that "I plant about 200$m^2$. We eat everything, we don't have anything stored…we store just a little bit of seeds for the next date that we need to plant." The inability to produce enough food to save for future lean times and planting and the lack of adequate crop storage highlights the severity of food insecurity in Guangaje and the need for interventions to address these challenges. If no action is taken the poor nutritional outcomes and lack of dietary diversity documented in chapter 2 are likely to persist and potentially worsen.

The difference between the amount of food vulnerability when all crops are planted, and the planting of only staple crops underlines the importance of crop diversification and the role that increased diversification could play in decreasing food vulnerability in Guangaje. During observations of plots of land used for cultivation the author saw limited evidence of intercropping and mixed cropping. Most areas under cultivation appeared to be about a half-acre or less in size. If located along the mountainside, where there was a significant slope, fields had a vertical orientation and were longer than they were wide. Fields near the top of ridges were more horizontal, assumedly due to the decreased slope. There was typically only one crop planted per

field, usually potatoes, lupines, fava beans, or one of the native tubers. The only observed multipurpose use of a large cultivated plot was the pasturing of sheep in an area that had recently been harvested, assumedly to fertilize the land with their manure, which was a practice mentioned frequently during the interviews. The sheep ate the weeds and grass that had grown up between the rows and seemed generally uninterested in the dry pods and stems of the remaining crops. There was some diversity in the use of the half acre size plots. In one observation a fava bean field was bordered by a potato field and pasture. The author also observed lupine fields bordered by pasture and fava beans, and a melloco field that had pasture on all sides except for a narrow strip of *quinoa*. There were occasionally smaller plots closer to the home that had a minimal amount of mixed cropping. These typically had *col* [a type of cabbage], *nabo* [turnip], peas, a few onions, and a small amount of intermixed fava beans, quinoa, and barley. It was not clear if the beans and grains had sprouted from accidentally dropped seeds or had been intentionally planted.

As noted in the introduction, crop and farm system diversification is an approach that households can use to mitigate the production and price risks associated with seasonality (Ellis, 2000; Ignaciuk et al., 2017; Waha et al., 2018). Diversification enables small-holder farmers to increase the types of potential foods that can be harvested and be more successful in meeting their consumption needs (Ignaciuk et al., 2017; Waha et al., 2018). The lack of observed crop diversification in Guangaje, especially mixed cropping within the same plot, suggests that this is a strategy that could help decrease seasonal household food vulnerability. As discussed in chapter 2, literature about traditional agricultural practices in Guangaje is limited so it is unknown if there is a history of these practices. Additionally, the focus of the initial study design

was not on ancestral agriculture practices so questions regarding historical intercropping were not asked. More research is needed to better understand the rationale behind current cropping systems in Guangaje and to further explore the relationship between crop diversification and household nutritional status and consumption.

### 3.4.4 Climate Variability and Agricultural Production

Intergovernmental Panel on Climate Change (IPCC) reports show that climate change in South America has resulted in alterations in the frequency, intensity, and duration of weather extremes (Magrin et al., 2014; Marengo et al., 2014). From 1901 to 2012, temperatures have increased between 0.5 to 3 ºC, with mean warming at nearly 0.1ºC/decade (Marengo et al., 2014; Vuille et al., 2008). These changes have been identified in both the tropical regions and the Andes, where only 2 of the last 20 years have been below the 0.1ºC/decade average increase (Marengo et al., 2014; Villacís, 2008; Vuille et al., 2008). The most recent IPCC report states that an increase of 0.1ºC/decade will likely result in a global temperature increase of at least 1.5 ºC above pre-industrial levels between 2030 and 2052 (IPCC, 2018). This relatively small amount of change is predicted to increase, potentially irreversibly, climate-related risks for natural and human systems (IPCC, 2018).

The parish of Guangaje has been impacted by both shifts in temperature and precipitation. The typically warmer months of January to April have become slightly cooler (Figure 3.1). However, the months of May through December have become warmer. The total difference in average monthly temperature between the two time periods is an increase of .35 ºC in 1991-2015. That represents a rise of slightly more than 0.1ºC/decade and suggests that

Guangaje is on pace to potentially experience irreversible ecological damage due to global warming by the end of the next decade.

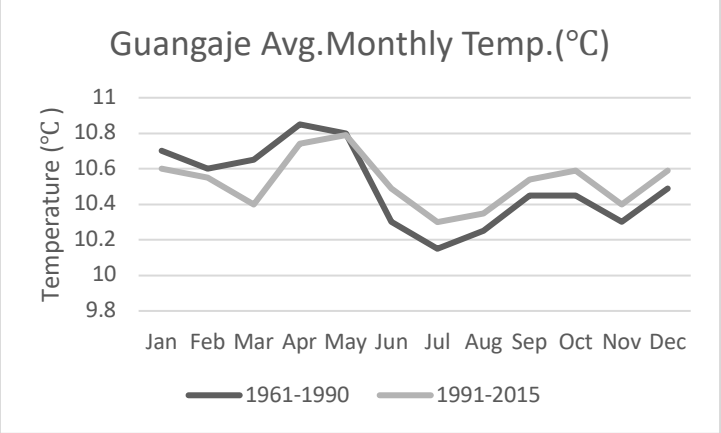


Figure 3.1. Average monthly temperature (ºC) in Guangaje 1961-2015, (World Bank, 2017a).

More immediate impacts of rising temperatures include an increase in the amount of moisture evaporating from the surface of the earth, resulting in dryer soils, which in turn lead to less productive crops and diminished grasslands (Seager et al., 2018; Wertz, 2018). Warmer temperatures can also mean greater proliferation and frequency of crop disease (Chakraborty & Newton, 2011; Elad & Pertot, 2014). Increased temperatures can change "microbial communities in the soil and canopy pathosystems[28], possibly altering the currently observed beneficial effects of these communities…changes will affect the measures farmers use to effectively manage disease, as well as the feasibility of particular cropping systems in particular regions" (Elad &

[28] A subsystem of an ecosystem defined by the phenomenon of parasitism.

Pertot, 2014, p. 99). Guangaje farmers may be forced to change when they plant certain crops which could result in decreased production as planting and harvesting cycles are altered.

There have also been changes in precipitation, which coupled with the temperature could result in a significant decline in soil moisture. From 1991 to 2015 it appears to have, on average, rained less over a longer period and more over a shorter period compared to the previous 29 years (Figure 3.2). Though the difference in total monthly rainfall between the two time periods is minimal, even small changes to the duration and intensity of rainfall can have a negative impact on agricultural production by forcing adjustments to the timing of planting and harvesting, altering crop flowering times, and reducing crop yields (Hatfield et al., 2018; Marengo et al., 2014). The creation of a seasonal calendar that captures local variability can help demonstrate these potential negative impacts.

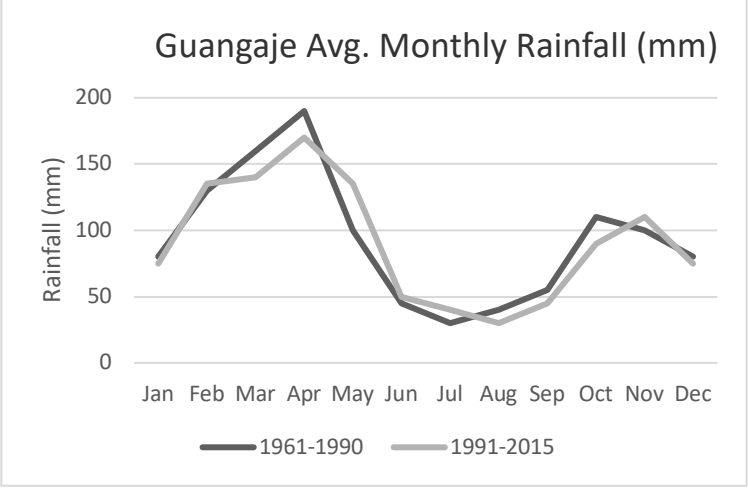


Figure 3.2. Average monthly rainfall (mm) in Guangaje 1961-2015, (World Bank, 2017a).

The Guangaje seasonal calendar (Table 3.3) illustrates that a dry season that extends into September and October could impact the planting schedules of fava beans, barley, and native

tubers, three of the study population's staple crops, potentially making it impossible to have multiple plantings per year and decreasing the amount of food available to be harvested. A decrease in rain in March and April would negatively affect the growth and development of a majority of crops planted in and around the communities including potatoes, which are the population's main food source. Potatoes grow well in semi-dry conditions, but an irregular water supply can cause uneven and unstable growth, which decreases the quality and quantity produced (Marengo et al., 2014). Increased climate variability was observed by a majority of the key informants and focus group participants who noted that changes have primarily been occurring in the past 5 years. Specifically, they mentioned that the periods of no rain are getting longer, and dry season seems to be extending into the month of September. The shift in the dry season can be seen in Figure 3.2.

Multiple key informants noted that the decline in the amount of rain has negatively impacted the quality and quantity of crops and grasslands used to pasture livestock. A female key informant in Guangaje Centro stated that "before we harvested much bigger potatoes, much more favas, now they [potatoes] are very little, so small…it's because there is no rain and they all dry up, the potatoes, the favas, everything dries up. When there is rain, then yes [they grow]…when I was young it rained much more, now there is no rain." A male key informant from Guangaje Centro had similar observations about the lack of rain and the negative impact on the availability of food for his family and livestock. He explained that " in the past 5 years, it has not rained in three of those years. Everything dried up. The plants for the animals got short, all the crops that we planted failed…there was no food, I had to find work and then buy food." A mother in Curinge noted the following about changing weather patterns:

*Mother* (female): Before, when I planted the rain would follow and I was able to produce more. In terms of production, right now, it does not rain enough. The production is not sufficient. We do not have a lot of crops, but we have some, enough to be able to maintain the family.

*Interviewer:* So, the most difficult thing is the climate changes?

*Mother* (female): Yes, the crops do not produce like they did before.

Focus group participants in Tingo Pucará also mentioned the lack of rain as well as an increased variability in the seasons, which makes it challenging to know when to plant and harvest.

*Tingo Pucará focus group* (male/female): The time of the rain is changing…things are changing month by month, there is more variability…when I was young, there was tremendous rain, streams, rivers, a lot of rain…now sometimes it rains, sometimes it doesn't rain, and the crops dry up. The rain is not guaranteed, you're thinking about rain and then it hails, there's wind…before it rained a lot, now it doesn't rain like before…before there were seasons…it was better before, the crops produced more, there were more plants for the animals, now there are no plants for the animals

Another factor that may be complicating agricultural production as climate change shifts growing seasons is the fact that households frequently use the lunar cycle to determine when and what they plant. If farmers are focused on following the stages of the moon and not actual weather conditions, which are increasingly unpredictable, then there is likely to be misalignment between when the lunar cycle indicates that it is ideal to plant and the weather. Some study participants, like a key informant in Curinge, used a combination of both lunar phases and climate conditions to determine when to plant.

*Curinge key informant* (male): You have to take a look at the moisture, what the conditions [climate] are, if they are good or they are not good. All of this you have to look at. You also have to look at the moon because there is the waning moon, full moon…there are 4 seasons of the moon. In the full moon we can plant potatoes, fava, *mashua*, and *melloco*. In the new moon, you

cannot do anything, you can't plant, weed, nothing. When it is a dark moon [waxing] then we can plant barley, we can plant favas. In all the seasons of the moon we are looking at the characteristics of the time period to determine the day that we can plant.

The focus group participants in the Guangaje Centro on the other hand talked primarily about using the moon.

*Interviewer:* When you are thinking about what you are going to plant and when you will plant? what do you use? Do you use a calendar of the months or something else?

*Guangaje Centro focus group* (female): The calendar of the months and the moon…if you plant potatoes in a dark moon [waxing] they will fill with worms[29].

*Interviewer:* So, you work with the moon?

*Guangaje Centro focus group* (female): Yes, what month you will plant in also depends on if you have seeds to plant. If there are no seeds you don't plant.

*Interviewer:* So, planting depends on if you have seeds or not and on the moon. How does planting with the moon work? Can you explain?

*Guangaje Centro focus group* (female): Planting is best when there is half a moon [waning or waxing moon].

*Interviewer:* And how do you know when to harvest? Is that with the moon as well?

*Guangaje Centro focus group* (female): No, harvesting is done whenever the crops are ready. The moon is only for planting.

[29] This is most likely potato tuberworm, also known as potato tuber moth or tobacco splitworm (*Tecia solanivora* and *Phthorimaea operculella*)(Gill, Chahil, Goyal, Gill, & Gillett-Kaufman, 2014; Torres, Montesdeoca, & Andrade-Piedra, 2011).

Focus groups participants in Tingo Pucará also discussed using the moon to determine when to plant crops.

*Tingo Pucará focus group* (female/male): Planting depends on the moon.

*Interviewer:* Can you explain more about how planting with the moon works?

*Tingo Pucará focus group* (male): Yes, when it is a new moon you can't plant or do anything in agriculture…you also can't bathe or wash clothes.

*Interviewer:* When do you plant?

*Tingo Pucará focus group* (male): When there is a lot of moon [full]…when the moon is clear and bright.

*Tingo Pucará focus group* (female): When it's a dark moon [waxing] you can start to plant onions.

*Tingo Pucará focus group* (male): The moon is for planting…when it is a waxing moon that's when you can weed and do other cultivation…a full moon is also when you can plant barley.

The reflections of key informants and focus group participants point toward more unpredictable and changing seasons. This change has resulted in a decline in agricultural production that has a direct impact on the amount of food available to households and their livestock. Focus group and interview participants were not probed further about the use of lunar cycles so it is unknown what their logic is for using the moon phases. A Food and Agriculture Organization (FAO) report focused on the cultivation of Andean crops indicated that the tilling and planting of crops on specific days of the lunar cycle is thought to help seed germination, prevent the presence of disease, make weeding more effective, and assist in the overall growth and development of the crop (Valdivieso, 2012). The traditional practice of using lunar phases to

dictate crop planting and cultivation limits potential adaptation to changing climatic conditions that no longer align with previously ideal planting times. The reliance on lunar cycles could make households more susceptible to climate variability and increase their food and livelihood vulnerability.

### 3.4.5 Price Variability

Although households consume most of what they produce, onions and lupines are grown for sale. Families in Curinge also sell beans and lentils. Both key informants and focus groups participants highlighted the annual variation in onion and lupine prices as a major challenge to their livelihood security as they are not able to accurately predict what they might be able to earn from year to year. Onions have experienced the greatest price variation (Table 3.4).

Table 3.4

*Average annual crop and livestock prices in Guangaje*

| **Prices** USD | **2015** | **2016** | **2017** |
|---|---|---|---|
| Lupines (lbs.) | 0.93 – 1.63 | 0.60 – 0.75 | 0.64 – 0.69 |
| Onions (*mola* [sack]) | 16.50 – 26.50 | 17.50 – 32.50 | 12.50 – 27.50 |
| Lentils (lbs.) | 0.25 | 0.32 | 0.40 |
| Bean (lbs.) | 0.50 | 0.75 | 1.00 |
| Sheep (each) | 40.00-50.00 | 40.00-50.00 | 40.00-50.00 |
| Llamas (each) | 60.00 | 60.00 | 60.00 |

Average prices across the three communities have been as high as $32.50/*mola* [full arm load roughly equivalent to amount that can stuffed into a large sack] and as low as $12.50/*mola*, less than half the highest price. Lupine prices have been slightly more stable but experienced a 35-54 % decline between 2015 and 2016. Lentil and bean prices appear to be slowly increasing, which could be an incentive for households to diversify the types of cash crops they grow.

Several interview participants mentioned that sheep and llama prices have been fairly constant over the past several years, which can make selling livestock to generate income more predictable. However, households appear to primarily sell livestock (sheep and llamas) with longer gestation periods and fewer young produced than other livestock such as guinea pigs, rabbits, pigs, which are typically kept to be consumed during special occasions/celebrations or used in a *randi randi* [exchange of good and/or services]. If the life cycle of sheep and llamas is interrupted due to illness, inability to reproduce, or other reason it could take households longer to recover this asset, compared to animals like guinea pigs which have a much shorter reproduction cycle and potential to produce up to 8 young per pregnancy. Families could be exposed to greater livelihood vulnerability during this period.

In order to get the best price some households will try to delay selling their lupines until the price increases. A female key informant in Curinge stated that "yes, we know how to store the lupines until it [price] increases…when you harvest the price is low. A time after the harvest is finished it will increase. We wait anyway we can, selling sheep, or a llama." Assuming the family is able to get a price that is higher than the reported average annual price, taking this approach makes sense as the local breed of sheep typically sells for the equivalent of $0.69 - $0.70 USD per pound. The strategy described by the key informant highlights a disadvantage faced by households with few or no sheep to sell. Families with limited livestock or other means to delay the sale of crops until prices are more favorable will likely be forced to sell soon after harvest when prices are low. The lack of resources to wait for the best price perpetuates a cycle of subsistence and food and livelihood vulnerability.

The decline and/or increased variability in crop prices comes at a time when prices for purchased food and other goods are reportedly increasing. As demonstrated by the follow quotes, the gap between income and expenses puts a significant strain on households' food and livelihood security.

*Tingo Pucará key informant* (female): what we have to buy, everything is more expensive. What we have to sell, the prices are low…salt, oil, *panela* [block of unprocessed sugar], all of this has increased…A year ago salt was .50 USD to .60 USD now it is .80 USD. Oil was at 1 USD now it is 2 USD.

*Tingo Pucará key informant* (male): Rice now costs 35 USD, five years ago it cost 10 USD, prices just keep increasing and increasing…noodles used to cost 4 USD now they cost 6 USD, each year prices increase and increase…is it the government that does this? or something else? we don't know.

*Curinge key informant* (female/male): Rice use to be 25 to 28 USD and now rice is much more expensive. The same with oil and salt…what we cultivate in the field is cheap, sometimes the prices increase sometimes they decrease but what we grow to sell is never enough make up for these increases. For example, before the lupines were selling for 40 USD the *quintal* [100 pounds] and now it is closer to 80 USD, but that increase is not enough to make up for the increases in other goods that we need.

The declining agricultural production and the variability of crop prices means that members of the household often need to migrate to earn money to cover expenses and other consumption needs. This migration does not appear to be tied to a specific time of the year. Study participants describe episodic migration linked to a network of family and friends already working in the cities. If they get a call from one of those family members or friends that there is an opportunity to work on a construction site or other form of day labor then someone, usually the male head of household and/or older son, will temporarily migrate. If there are no known opportunities family members tend to stay put and hope that their agricultural production and the

government's monthly cash transfer (60 USD) is enough to get them through periods of food insecurity.

The fact that there is temporary migration of primarily male members of the household raises the possibility that the observed limited crop diversification may be tied to the household labor shortage this migration creates. As noted in the introduction, "working for wages to obtain food for immediate needs comes at the expense of neglecting one's own farm, thereby compromising future harvests. The net result is that households are forced to reduce the diversity and quantity of food they consume, setting the stage for macro- and micronutrient deficiencies" (Vaitla et al., 2009, p. e1000101). When the male and female head of household are both in the community interview participants stated that the work load is shared evenly. The dynamic that the PI observed was that the women and children primarily tended livestock and did household chores while the men were more frequently seen planting, weeding, and harvesting crops. When the men migrate, women and younger children are left to perform all household and agriculture activities. With so much to do women may only have the time and energy to plant the staple crops, which, as shown in the seasonal calendar, exposes households to close to 10 months of food insecurity and decreases the household's dietary diversity.

## 3.5 Conclusion

The subsistence farming population of Guangaje is highly vulnerable to cyclical shifts in agricultural production and crop prices. One of the primary factors influencing this vulnerability is the increased unpredictability of precipitation and warming temperatures, which exacerbate food security issues by extending already existing periods of seasonal hunger. According to study participants, climate variability has caused shifts in planting seasons and negatively

impacted the ability of crops to fully develop and produce a product they can harvest. This dynamic is potentially complicated by some households' reliance on lunar cycles to dictate crop planting and cultivation times. The use of lunar phases limits potential adaptation to changing climatic conditions, making households more susceptible to climate variability and increasing their food and livelihood vulnerability.

The results of the composite seasonal calendar indicate that households could be food insecure for close to 80 % of the year. This degree of food vulnerability may help explain the poor nutritional outcomes and lack of dietary diversity discussed in chapter 2. The seasonal calendar also shows that crop disease puts an additional strain on an already fragile food production system. The warming temperatures could result in a decline in the impact of frost and hail but fungal diseases like late blight could have more opportunity establish and spread.

Households use a range of strategies to survive during periods of low to no harvest. Families with the infrastructure and capacity store crops that are not needed for immediate consumption. However, many households lack adequate space and/or storage conditions. This could result in stored crops becoming inedible due to rot or insect or rodent infestations. Numerous study participants said that they do not produce enough food to save for future lean times or seeds for the next planting season. If crops fail to produce enough food and all food stores have been consumed, households will frequently sell livestock to meet consumption needs. The sale of livestock is also used as a way to prevent the sale of crops immediately after they are harvested in the hope that prices may increase as supply declines. Families with limited livestock or other means to delay the sale of crops until prices are more favorable will likely be forced to

sell soon after harvest when prices are low. The lack of means to wait for the best price perpetuates a cycle of subsistence and food and livelihood vulnerability.

The declining agricultural production and the variability of crop prices means that household members, usually the men, often migrate to earn money to cover expenses and other consumption needs. This migration does not appear to be tied to a specific time of year. Because it is unknown when there might be an opportunity to find work outside of the community households cannot rely on migration as a way to survive periods of seasonal hunger. When the men of the home migrate the women and younger children are left to perform all household and agriculture activities. With so much to do women may only have the time and energy to plant the staple crops, which, as shown in the seasonal calendar, exposes households to close to 10 months of food insecurity. This scenario highlights how migration could be negatively impacting future harvests and reducing the quantity and diversity of household food consumption.

The lack of observed crop diversification in Guangaje, especially mixed cropping within the same plot, suggests that this is an approach that could help decrease household seasonal hunger. However, before implementing this type of strategy more research is needed to better understand the reasons behind current cropping systems and to further explore the relationship between crop diversification and household nutritional status and consumption.

One approach that could address the unpredictability of precipitation and shifting rainy seasons is the creation of a communal water retention pond and canal network that would fill during the rainy season and could be used to water crops through drip irrigation and/or maintain the moisture of pastures during periods of low precipitation (The Mountain Institute, 2016). Similar water retention systems, dating back to 1,000 AD, have been found and restored in the

highlands of Peru (The Mountain Institute, 2016). The project sites in Peru have experienced an increase in the availability of local water during the dry season and improved livestock productivity (The Mountain Institute, 2016). Though likely to involve a significant initial investment, improved water storage and irrigation infrastructure could have long term benefits for food and livelihood security in Guangaje. Rehabilitation and conservation of the *páramo* grasslands, which has a natural water absorption and retention function, would aid efforts to capture precipitation (Hess, 1997; Ulloa Ulloa, n.d.)

Collaboration with the *Centro Internacional de la Papa* (CIP) [International Potato Center] in Ecuador could help facilitate the implementation of solutions to address crop diseases, especially late blight and the postharvest storage of tubers. CIP has helped develop numerous varieties of blight resistant potatoes (Torres, Taipe, et al., 2011). Using resistant varieties is one of the most effective ways to manage blight. It also limits the need to use fungicide, which reduces the farmers costs and is healthier for the farmer, consumer, and the environment (Torres, Taipe, et al., 2011). While potentially very beneficial, more research is needed to better understand the acceptability and appropriateness of introducing blight resistant crops into the parish of Guangaje.

CIP also was a wealth of information and expertise regarding the various physical, physiological and pathological factors that reduce the quantity and quality of harvested tubers. Interventions that aim to address the documented issues with postharvest storage would benefit from this expertise. A majority of households likely do not have the resources to build proper crop storage facilities so any training workshops on proper storage approaches and techniques should be paired with the provision of materials and equipment for this type of infrastructure.

# Chapter 4: An Assessment of Livelihood Resilience

## 4.1 Introduction

Poor subsistence farming households are highly vulnerable to a range of stressors and shocks including climate change, political instability, and economic volatility (Christopher B Barrett & Constas, 2014). Due to the rural poor's reliance on agriculture, negative shocks are frequently associated with environmental and ecological changes (IFAD, 2016; World Bank, 2008, 2016). Shocks can be natural disasters such as floods or drought, increased waterborne diseases and pests, crop failure from changes in rainfall patterns, and spikes in food prices (DfiD, 1999; World Bank, 2016). The death of the primary household income earner can also create shocks to household stability and structure as households are forced to adapt to a decline in income earning potential (DfiD, 1999). Shocks destroy assets and force people to make choices, such as abandoning their home or selling their land, which can negatively impact their chances of achieving positive livelihood outcomes and may lead to persistent poverty for the already poor or drive those on the edge into poverty (Dercon et al., 2005; DfiD, 1999; Suryahadi & Sumarto, 2003).

A growing body of literature suggests that households with greater and more diverse livelihood assets tend to be more resilient[30] and less vulnerable[31] in times of stress and shock (Alinovi, Mane, & Romano, 2010; Carter & Barrett, 2006; Hodbod & Eakin, 2015; Lybbert,

[30] Resilience refers to the "capacity over time of a person, household or other aggregate unit to avoid poverty in the face of various stressors and in the wake of myriad shocks" (Barrett & Constas, 2014, p. 14626).

[31] Vulnerability is the "prospective immediate impact of a shock , reflecting the likelihood that some disturbance leads to a change of state to an undesirable position, given one's capacity to mitigate or cope with the shock" ((Barrett & Constas, 2014, p. 14627).

Barrett, Desta, & Coppock, 2004; Moser & Felton, 2007; Quandt, 2018; Thulstrup, 2015). For the purposes of this paper livelihood assets are defined in terms of the five livelihood capitals, human, natural, social, financial, and physical, that are believed to be needed for a sustainable livelihood (DfiD, 1999; Scoones, 1998). Human capital is comprised of the skills, knowledge, and ability to work that enable individuals to pursue different livelihood strategies (DfiD, 1999). Natural resources that are used to support livelihoods, such as trees, land, water, biodiversity, and air quality, are all components of natural capital (DfiD, 1999). Financial capital captures people's ability to tap into a range of financial resources, including savings (cash, livestock, jewelry), income, access to credit, remittances, and financial support from the state (DfiD, 1999).

Though not well defined, social capital typically represents the social resources that people rely on to achieve their livelihood objectives. Social resources could include vertical and horizontal networks, belonging to a formalized group, such as a religious or community group, and/or other relationships that involve trust and/or reciprocity (DfiD, 1999). Finally, physical capital is made up of the basic infrastructure and goods needed to support livelihoods (DfiD, 1999; Moser & Felton, 2007). Infrastructure includes "affordable transport, secure shelter and buildings, adequate water supply and sanitation, clean affordable energy, and access to information" (DfiD, 1999, p. 13). Figure 4.1 shows a table created by Amy Quandt (2018) that provides additional detail about how the five livelihood capitals have been conceptualized by various authors.

The five livelihood capitals "constitute a stock of capital that can be stored, accumulated, exchanged, or allocated to activities to generate an income, means of livelihoods, and other benefits" (Quandt, 2018, p. 255).

The five livelihood capitals as described by various authors.

| Type of Capital | Scoones (1998) | Tacoli (1999) | Campbell et al. (2001) | Adato and Meizen-Dick (2002) | Erenstein et al. (2010) |
|---|---|---|---|---|---|
| *Natural Capital* | Environmental services, natural resource stocks such as soil, water, air | Freshwater availability, land management, agricultural space, land | Soil fertility, water resources, forest resources, grazing resources, land quantity and quality | Land, water, forests, marine resources, air quality, erosion protection, and biodiversity | Annual rainfall, soil capability index, farm size, herd size |
| *Financial/Economic Capital* | Capital base including cash, credit, savings and basic infrastructure and production equipment and technologies | Infrastructure and tools/equipment | Credit, savings, remittances | Savings, credit, as well as inflows such as state transfers and remittances | Farm size, herd size, bank facilities, credit societies |
| *Human Capital* | Skills, knowledge, ability of labor, and good health | Labor including skills, knowledge, ability to work | Knowledge, sills, health, labor availability | Education, skills, knowledge, health, nutrition, and labor power | Female literacy, immunizations, work participation, population density |
| *Social Capital* | Social resources including networks, social claims, affiliations, associations | Access to markets, representation and access to the 'state' | Adherence to rules, relationships of trust, mutuality of interest, leadership, kin and ethnic networks, social organizations | Networks that increase trust, ability to work together, access to opportunities, reciprocity; informal safety nets; and membership in organizations | Cooperative societies, self-help groups |
| *Physical Capital* | Included in financial capital | Included in financial capital | Households assets, agricultural implements, infrastructure | Transportation, roads, buildings, water supply, sanitation, energy, technology and communication | Irrigated area, farm mechanization, distance to nearest town, access to paved roads |

Figure 4.1. Description of the five livelihood capitals (Quandt, 2018, p. 255)

When facing shocks, households often sell physical capital or spend financial capital as a coping strategy to maintain stable consumption, an approach often referred to as asset smoothing (Carter & Barrett, 2006; Giesbert & Schindler, 2012; Zimmerman & Carter, 2003). Having more physical capital can lead to the generation of financial capital, which in turn can facilitate an increase in human capital by enabling households to have the resources to send their children to school or receive other types of training that improve their future income earning potential.

The type and degree of natural capital available to households, especially subsistence farmers, can also dictate the ability to generate financial capital (Quandt, 2018). Larger more fertile lands with access to water for irrigation allow for increased production while a lack of land for crops and pasture and a reliance on rainfall can significantly limit a households ability to gain livelihood sustainability (Harvey et al., 2017; Magrin et al., 2014). Having higher social capital, such as participation in community or religious groups can enable households to expand their social safety net and potentially draw on social norms of obligation and reciprocity in times of need (Moser & Felton, 2007). Based on the range of supporting literature, our paper assumes that a quantification of the five livelihood capitals can be used as a measure of overall livelihood

assets and an indicator of a household's ability to respond to and recover from shocks and improve their livelihood resilience.

Building on the findings of chapters 2 and 3, which provide extensive description of the range of vulnerabilities faced by indigenous populations in the Ecuadorian Andes, this paper uses a livelihood asset index to better understand the degree to which households in the parish of Guangaje may or may not be resilient to shocks and stressors. Our goal is to estimate and describe the level of livelihood resilience in the parish and the extent of any variability between communities and across livelihood capital types. The knowledge and understanding resulting from the asset index analysis will be used to inform the recommendations for interventions that can begin to address the range of challenges faced by the three communities. A focus on assessing community variability will enable a better understanding of specific community level strengths and weakness that could play a role in determining the acceptability, appropriateness, and feasibility of targeted interventions. Additionally, strengths identified in one community could potentially be built upon and expanded to improve the livelihood resilience of households in other communities.

The following sections describe the research methodology and detail research findings. Results indicate that overall livelihood resilience in the parish of Guangaje is relatively low, especially in the areas of human, physical, and financial capital. There does appear to be variability in assets by community. Average livelihood resilience in the community of Curinge is significantly lower than Tingo Pucará and Guangaje Centro across all five livelihood capitals and the composite asset index. This suggests that households in Curinge have less potential livelihood resiliency and greater vulnerability to shocks and stressors compared to households in

Tingo Pucará and Guangaje Centro. The significant differences between communities appears to be linked to Curinge's lack of a clean reliable water source, limited presence of governmental and non-governmental organizations (NGOs), poor access to credit, and a lack of productive assets compared to the other two communities. Of note is the high average social capital score for households in Tingo Pucará. Households in Tingo Pucará also have the highest composite asset score and the elevated level of social capital in this community, compared to the other two communities, appears to be playing a significant role. Improving social capital in Guangaje Centro and Curinge, especially access to credit, could prove to be an effective approach to increasing livelihood resiliency in these two communities.

# 4.2 Materials and Methods

## 4.2.1 Study Site

As with chapter 2 and 3, data for this paper comes from the Ecuador Livelihood and Nutrition study (ELNS), which was conducted in three rural communities, Guangaje Centro, Tingo Pucará, and Curinge, from September 2016 to January 2018. The communities are in La Sierra, a belt of the Andes mountains that includes volcanoes and peaks with year-round snow (Brush, 1982). The parish of Guangaje, where the three communities are located, has a total population of a little over eight thousand spread across 39 communities (INEC, 2010; Toaquiza et al., 2015). According to a local government report, nearly all (99 %) of the population identifies as indigenous Kichwa speakers[32] and over 91% live in extreme poverty[33] (INEC, 2010; Toaquiza et

[32] Over one million Ecuadorians, 7 % of the population, are indigenous/Amerindian (CIA, 2018). They are typically categorized by the language they speak. These languages include Kichwa, Paicoca, Shuar, Tsa´fiqui, Shiwiar, Waotededo, Sapara, Achuar, Andoa, Awapit, A´Ingae, Cha´palaa, and Zia pedee (Freire et al., 2014).

[33] The Ecuadorian National Census and Statistics Institute (INEC) uses a methodology developed by the Economic Commission for Latin America and the Caribbean (CEPAL) to determine poverty. The method covers five dimensions (1) economic capacity defined as the education

al., 2015). Tingo Pucará and Curinge are small communities with 19 and 32 households respectively. Guangaje Centro is considerably larger, with 153 homes, though only about half are permanently occupied due to migration. Guangaje Centro serves as the economic, health, and education hub for the parish. It hosts the local Sunday market, health center, primary and secondary schools, and Catholic and Adventist churches.

According to our survey data, subsistence agriculture and temporary male migration for wage labor are the primary means of livelihood. On average, households have between a half to one acre of land under cultivation and almost all plant potatoes and fava beans and raise sheep and poultry (Toaquiza et al., 2015). Other crops of importance include barley, onions, *melloco*, *oca*, and *mashua* [native tubers]. Among the less commonly cultivated crops are *chocho* [lupine], *quinoa*, peas, and vegetables like a large leaf cabbage and *nabus* [field mustard]. Additional types of frequently raised livestock are llamas, guinea pigs, pigs and rabbits. Crop production is almost exclusively for home consumption. The only crops intended for sale are lupine and onions as well as occasional surpluses of potatoes and barley. There is a greater reliance on livestock sales for income generation. Sheep and pigs are the most frequently sold livestock type. Llamas are typically kept to carry and transport goods. Chickens are raised for their eggs, which are often consumed and occasionally sold, bartered, or gifted. The population consumes chicken and sheep meat but usually only when there is a special occasion or event. Guinea pigs are

level of the head of household and the ratio of household members working to total household members (2) access to basic education defined by the number of children between 6 to 12 years old who are not in school. If more children are not in school the household is determined to be poorer (3) floor and wall materials of the dwelling (4) access to proper sanitation and piped water (5) number of people per bedroom (INEC, 2019).

consumed and are believed, along with eggs, to have curative and diagnostic capabilities[34] (Weismantel, 1988).

### 4.2.2 Study Design

To better understand the degree to which households in Guangaje may or may not be resilient to shocks and stressors and the livelihood capital areas where they might be most vulnerable, we created a household livelihood asset index based on the Household Livelihood Resilience Approach (HLRA) methodology described by Quandt (2018). The index utilized data from ELNS household survey. The survey gathers a range of quantitative social, economic, nutrition, health, and hygiene/sanitation information from each household. However, this paper only uses variables relevant to the creation of the index. Detail about all variables included in the index can be found in Table 4.1 in the Analysis section.

The ELNS survey is modeled after the RAND Family Life Surveys.[35] This survey structure was chosen because of its reputation for being comprehensive and the authors prior experience using RAND surveys. Survey questions were adapted for the local Ecuadorian context, reviewed by senior members of the research team, translated into Spanish, and piloted in the field by the author and the field research coordinator. Minor changes in terminology and question intent were made after the survey piloting. The survey was conducted at every home in the three communities that consented to participate (n=109). The total number of occupied households across the three communities is estimated to be 128 so the study sample size represents the inclusion of 85% of households in the study area. Households who did not consent to participate typically did not provide a reason why they did not want to take part. The research

[34] See footnote 4 in chapter 2 for more detail.

[35] A set of detailed household and community surveys conducted by the RAND corporation in developing countries.

team respected their decision and did not ask additional questions. One man who was asked about participating stated that he thought it would be a waste of time and that he had not seen any benefits come from taking part in surveys. Demographic information about survey respondents can be found in Table 2.3 of chapter 2. The paper surveys were assigned unique identification numbers and the names of individuals in the household were not recorded to protect privacy. Data were collected by the field research team (the field research coordinator and field assistants). The author participated in the quantitative data collection during a visit to the communities in March 2017. The team typically visited 3 to 4 homes per day and spent 1.5 hours in each home.

## 4.3 Analysis

Data from the paper surveys were entered into an Excel spreadsheet by the field research coordinator. The data was then reviewed by the author and the Excel spreadsheets with the raw data were imported into the statistical software R (3.5.0), cleaned, labeled, and otherwise prepared for analysis. The creation of the livelihood asset index was completed in four stages (1) selecting the indicator variables (2) rescaling the indicator variables (3) creating an index for each livelihood capital and (4) creating a composite index.

The selection of indicator variables was informed by the literature reviewed in the Introduction section of this paper, especially the work of Moser & Felton (2007) and Quandt (2018). The selection of specific indicators was also dictated by the questions available in the ELNS data set. A list of selected indicators organized around the five livelihood capitals can be seen in Table 4.1.

Table 4.1

*Indicators of household livelihood capital assets*

| Asset/Capital Type | Indicator variable |
|---|---|
| Human (H) | Labor availability (# of household members between 18 – 55) |
| | Education (average level of schooling[36] attained by household members) |
| Natural (N) | Land for cultivation (yes/no) |
| | Land for pasture (yes/no) |
| | Water source - piped[37] (yes/no) |
| Social (S) | Participation[38] in community groups (yes/no) |
| | Participation in cooperatives/collectives (yes/no) |
| | Participation in NGO programs/activities (yes/no) |
| | Jointly headed household[39] (yes/no) |
| | Has a religious affiliation (yes/no) |
| Financial (F) | Access to loans/financing (yes/no) |
| | Annual per capita agriculture income (USD) |
| | Annual per capita nonagricultural income (USD) |
| | Large livestock[40] (# of livestock) |
| | Small livestock[41] (# of livestock) |
| | Value of owned farm tools (USD) |
| | Land for cultivation (yes/no) |
| | Land for pasture (yes/no) |
| | Crop storage infrastructure (yes/no) |
| | Animal sheds (yes/no) |
| | Television (yes/no) |
| | Refrigerator (yes/no) |
| | Bike/motorbike (yes/no) |
| Physical (P) | Value of owned farm equipment (USD) |
| | Home ownership |
| | House size |
| | Number of rooms |
| | Home roof material |
| | Home wall material |
| | Home floor material |
| | Electricity (yes/no) |
| | Toilet type |
| | Stove type |
| | Television (yes/no) |
| | Refrigerator (yes/no) |
| | Bike/motorbike (yes/no) |
| | Animal sheds (yes/no) |
| | Crop storage infrastructure (yes/no) |

[36] No education, elementary, or high school. There was no one with a university level education.

[37] Indicates a cleaner and less time consuming source of water

[38] Participation in the last 12 months

[39] Marital status was either 'married' or '*juntado'* (living together but not officially married)

[40] Sheep, llamas, and cows

[41] Pigs, guinea pigs, rabbits, goats, poultry, fish, doves, ducks, turkeys

The ELNS study was not originally designed as an asset/resiliency focused study and some questions that would have been ideal to include like size of agricultural land (natural capital), access to irrigation (physical capital), and general family level health (human capital) where not asked.

A challenge of the raw survey data was that the majority of the selected indicators were on different scales. This made it impossible to combine, average, and analyze the indicators in a meaningful way. To address this issue all responses were converted to a 0 to 1 scale using the R 'rescale' function from the 'scales' package (Quandt, 2018). 0 was designated as the least desirable response, 1 the most desirable, and values in-between were within the 0 to 1 range (for example 0, .35, .66, .94, 1) (Quandt, 2018). Variables with binary responses (yes/no) were not rescaled as they were already in a usable format. The 0 to 1 rescaling approach assumes that the higher the score, the higher the livelihood capital/asset, and the greater the potential for livelihood resilience (Quandt, 2018).

Once the indicator variables of each capital type were on the same scale the scores were averaged. As suggested by Quandt (2018) and Erenstien, Hellin, & Chanda, (2007), indicators were given equal weight to make the results easier to understand. Additionally, the sustainable livelihoods framework and supporting literature do not indicate factors that might merit more weight than others. The process of combining the various indicators resulted in a human, natural, social, financial, and physical capital score within the 0 to 1 range for each household. A composite household asset score was then created by averaging the five capital scores. Each of the capital scores was given equal weight. The composite index score represents an estimation of

the overall potential livelihood resiliency of each household (Quandt, 2018). Figure 4.2 provides a schematic of process for creating the index.

Summary statistics, radar charts, and Wilcoxon rank sum tests were then used to estimate and describe the level of livelihood resilience in the parish of Guangaje and the extent of any variability between communities and across livelihood capital types. It was necessary to use the Wilcoxon rank sum test as data for the capital variables was not normally distributed and comparisons needed to be made between more than two groups (Field, Miles, & Zoe, 2012).

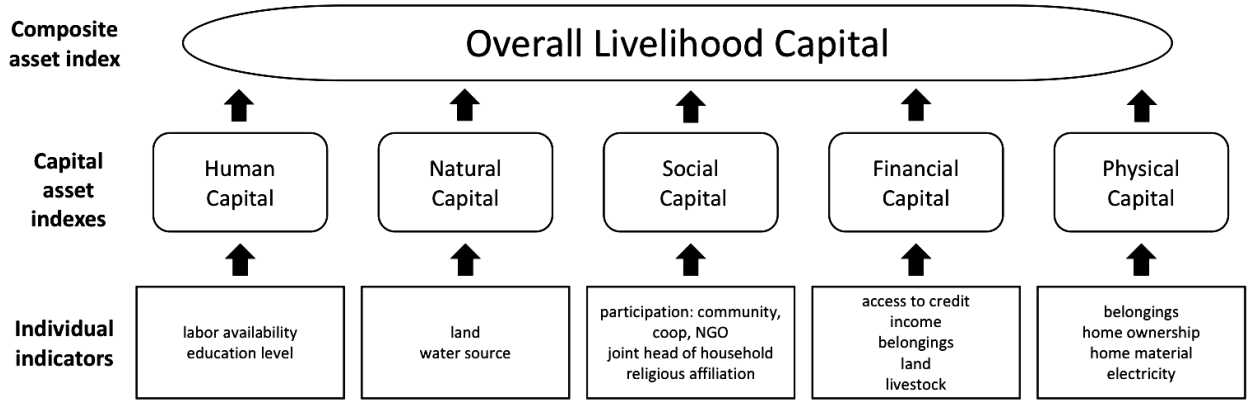


Figure 4.2. Schematic of index creation process. Adapted from Quandt (2018, p. 258)

## 4.4 Results

The first steps taken to estimate and describe the level of livelihood resilience in the parish of Guangaje was to create a radar chart of the average index scores of the five livelihood capitals across all three communities (Figure 4.3). Radar charts provide a way to visualize multivariate data (Quandt, 2018). Differences between average scores of variables are represented by the shape and size of the polygon that is formed. As shown in Figure 4.3, overall livelihood resilience in the parish of Guangaje appears to be relatively low on the 0 to 1 scale, especially in

the categories of human, physical, and financial capital. This is likely reflective of the high levels of poverty in the area and generally low educational attainment. Social capital appears to be slightly higher potentially due to the high percentage (89 %) of religious affiliation (primarily Catholic and Adventist) and participation in community groups (98 %).

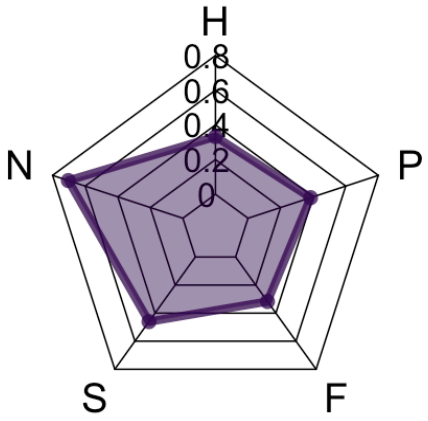


Figure 4.3 Radar chart of average index scores of the five livelihood capitals

The community group activities are usually associated with *mingas*, communal work parties to fix roads, improve water infrastructure, and/or other community related work (Weismantel, 1988). Natural capital ranks quite high on the 0 to 1 scale indicating that households have potentially more livelihood resiliency in this area. The high natural capital ranking is linked to high land and pasture ownership (97 % and 92 %) and the fact the primary water source for the majority (74 %) of households is piped water from a community maintained and managed water source (spring and/or river). However, it is important to note that the natural capital index does not take the quality and size of land into account. Poor soil quality was a

major theme of chapter 2 so more comprehensive data in this area would likely allow for a more complete and accurate estimation of natural capital.

A radar chart of the average index scores of the five livelihood capitals by community shows a similar pattern (Figure 4.4). Human, physical, and financial capital are all low on the 0 to 1 scale, social capital is slightly higher, and natural capital is the highest. There does appear to be some variability by community. The Curinge polygon is smaller, meaning households in Curinge scored the lowest across the entire sample in all five capital types. These results suggest that households in Curinge have relatively less potential livelihood resiliency than households in Tingo Pucará and Guangaje Centro and greater vulnerability to shocks and stressors. Another observable difference is that social capital appears to be higher in Tingo Pucará than in either Guangaje Centro or Curinge. The potential reasons for these differences are discussed in the following paragraphs.

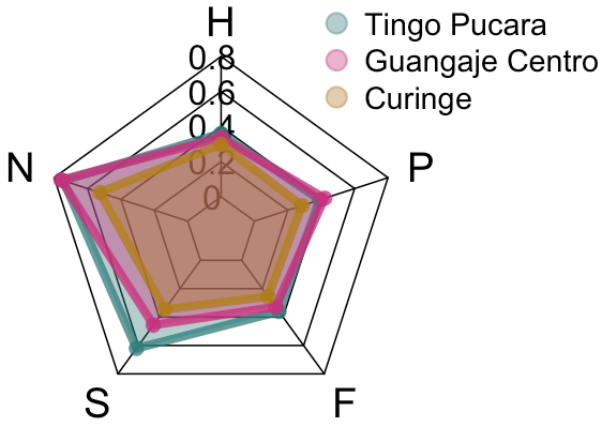


Figure 4.4. Radar chart of average index scores of the five livelihood capitals by community

To examine whether the observable difference is statistically significant we conducted pairwise comparisons using a Wilcoxon rank sum test. The results, shown in Table 4.2, indicate that the average livelihood resilience in Curinge is significantly lower than Tingo Pucará and Guangaje Centro across all five livelihood capitals and the composite asset index. The largest percentage differences in assets levels are in natural and social capital. Tingo Pucará natural capital is 34% higher than Curinge while social capital is 57% higher. In Guangaje Centro, natural capital is 36% higher and social capital is 27% higher than Curinge.

Table 4.2

*Comparison of mean composite and capital scores by community*

| **Community/Index** | **Obs.** | **Mean** | **SD** | **P-vales** | | |
|---|---|---|---|---|---|---|
| | | | | **Guangaje** | **Curinge** | **Tingo Pucará** |
| **Tingo Pucará** | | | | | | |
| Composite | 83 | .605 | .086 | .001 | .000 | |
| Human | 83 | .452 | .176 | .079 | .001 | |
| Natural | 83 | .932 | .135 | .051 | .000 | |
| Social | 83 | .776 | .161 | .000 | .000 | |
| Financial | 83 | .451 | .107 | .001 | .000 | |
| Physical | 83 | .489 | .100 | .086 | .000 | |
| **Guangaje Centro** | | | | | | |
| Composite | 273 | .576 | .083 | | .000 | .001 |
| Human | 273 | .423 | .188 | | .004 | .079 |
| Natural | 273 | .949 | .156 | | .000 | .051 |
| Social | 273 | .571 | .111 | | .000 | .000 |
| Financial | 273 | .410 | .109 | | .000 | .001 |
| Physical | 273 | .526 | .106 | | .000 | .086 |
| **Curinge** | | | | | | |
| Composite | 107 | .429 | .068 | .000 | | .000 |
| Human | 107 | .374 | .185 | .004 | | .001 |
| Natural | 107 | .660 | .064 | .000 | | .000 |
| Social | 107 | .434 | .099 | .000 | | .000 |
| Financial | 107 | .320 | .089 | .000 | | .000 |
| Physical | 107 | .356 | .100 | .000 | | .000 |

As can be seen in Table 4.3 examining the variability of indicator variables for social and natural capital provides insight into what may be contributing to these differences. For social capital, there is the most divergence in participation in cooperative/collectives. There is a

cooperative in Tingo Pucará and involvement by household members is nearly 86%. In comparison, there is no participation in cooperatives in Guangaje Centro and Curinge. The author is not aware of any cooperatives or collectives in these two communities. It is unknown if membership in the Tingo Pucará cooperative is exclusively for Tingo Pucará households as this question was not asked.

The cooperative in Tingo Pucará has several important functions. Through observation and informal conversations with Tingo Pucará community members we learned that the cooperative provides households with access to credit. Additionally, the cooperative has been used by the community to establish revenue generating projects such as a communally managed tilapia venture and a mechanized plowing service.

Table 4.3

*Social and natural capital indicator variables by community*

| Indicator variable (% of HH members) | Tingo Pucará | Guangaje Centro | Curinge |
|---|---|---|---|
| **Social** | | | |
| Participation in community groups | 96.3 | 99.2 | 99.0 |
| Participation in cooperatives/collectives | 85.5 | 0.0 | 0.0 |
| Participation in NGO programs/activities | 85.5 | 63.7 | 0.0 |
| Jointly headed household | 33.7 | 31.5 | 33.6 |
| Religious affiliation | 86.7 | 90.8 | 84.1 |
| **Natural** | | | |
| Land for cultivation | 100.0 | 96.3 | 99.0 |
| Land for pasture | 85.5 | 91.2 | 99.0 |
| Water source - piped | 93.9 | 97.1 | 0.0 |

The plowing service involves farmers paying a fee to have their fields plowed by tractor instead of having to do it by hand. In addition to having access to these agricultural services, revenue from the cooperative's income generating ventures is likely reinvested back into the cooperative for the benefit of participating households, although details about this process were not collected during the study. The other main difference in the social capital indicators is the

lack of participation in NGO programs by households in Curinge. As discussed in chapter 2, many Curinge interview participants expressed that the community did not receive support from outside organizations or the government. The fact that no households in Curinge have participated in NGO programs in the past year is likely a reflection of the lack of involvement of these types of organizations in this community.

Compared to Tingo Pucará and Guangaje Centro, households in Curinge have less access to a clean reliable water source. There is no infrastructure to bring clean water to homes in Curinge. Households meet their water needs by making an average four hour round trip to a river in the valley below the community and/or using collected rain water. Only 28% of the households in Curinge reported that they regularly boiled the water before use. This means that the majority of household members may be consistently exposed to contaminants, including human and animal feces, that drain off the surrounding mountainsides into the river. The exposure to contaminated water could negatively impact their overall health (human capital) and ability to work to generate financial capital.

As noted previously, while the majority of households in the three communities own land for cultivation and pasture (Table 4.3), the quality, in terms of soil fertility, and size of the land was not included in the creation of the index as the data was not collected. During the semi-structured interviews discussed in chapters 2 and 3 many study participants mentioned declining agricultural production and poor soil quality as a major challenge to their livelihood. The inclusion of this type of data could alter the natural capital scores and allow for a more nuanced assessment of potential variability between communities.

Households in Guangaje Centro had, on average, the highest level of physical capital (.526). While differences between Guangaje Centro and Tingo Pucará (.489) were not significant, the Curinge score (.356) was significantly less than Guangaje Centro and Tingo Pucará. The low level of physical capital in Curinge appears to be linked to a lack of productive assets compared to the other two communities.

Table 4.4

*Physical capital indicator variables by community*

| Indicator variable | | Tingo Pucará | Guangaje Centro | Curinge |
|---|---|---|---|---|
| Avg. value of owned farm equipment (USD) | | 66.6 | 69.5 | 52.2 |
| Own home (% of HHs) | | 100.0 | 94.5 | 97.2 |
| Avg. house size ($m^2$) | | 24.9 | 28.3 | 26.9 |
| Avg. number of rooms | | 1.6 | 1.5 | 1.5 |
| Home roof material (% of HHs) | zinc | 6.0 | 24.1 | 48.6 |
| | grass | 8.4 | 2.6 | 0.0 |
| | Eurolit (fiber cement) | 77.1 | 63.7 | 51.4 |
| | other | 8.4 | 8.8 | 0.0 |
| Home wall material (% of HHs) | mud | 2.4 | 3.6 | 1.9 |
| | cement/brick | 97.6 | 92.3 | 96.3 |
| | wood | 0.0 | 3.6 | 1.9 |
| | other | 0.0 | 0.4 | 0.0 |
| Home floor material (% of HHs) | cement | 80.7 | 62.3 | 65.4 |
| | wood | 4.8 | 4.8 | 0.0 |
| | earth | 14.5 | 30.8 | 34.6 |
| | ceramic tile | 0.0 | 2.2 | 0.0 |
| Electricity (% of HHs) | | 95.2 | 98.5 | 87.9 |
| Toilet type (% of HHs) | latrine | 55.4 | 17.2 | 0.0 |
| | bathroom with septic tank | 0.0 | 74.7 | 11.3 |
| | shared latrine/bathroom with septic tank | 9.6 | 0.0 | 0.0 |
| | field/yard | 34.9 | 4.3 | 88.7 |
| | other | 0.0 | 3.7 | 0.0 |
| Stove type (% of HHs) | gas | 27.7 | 43.6 | 15.0 |
| | gas/wood | 25.3 | 19.8 | 18.7 |
| | wood | 47.0 | 30.8 | 66.4 |
| | electricity | 0.0 | 1.5 | 0.0 |
| | gas/kerosene | 0.0 | 1.8 | 0.0 |
| | kerosene/wood | 0.0 | 2.6 | 0.0 |
| Television (% of HHs) | | 50.6 | 52.3 | 45.8 |
| Refrigerator (% of HHs) | | 0.0 | 12.4 | 6.5 |
| Bike/motorbike (% of HHs) | | 20.5 | 22.7 | 9.3 |
| Animal sheds (% of HHs) | | 72.3 | 61.9 | 15.0 |
| Crop storage infrastructure (% of HHs) | | 61.4 | 65.6 | 10.3 |

On average, the amount of farm equipment owned by households in Curinge is 15 USD less than Tingo Pucará and Guangaje Centro (Table 4.4). The percentage of households with infrastructure for storing crops, sheds to house animals, and motorized transportation is also a lot less than in the other two communities. This is not to imply that the amount of productive assets in Tingo Pucará and Guangaje are adequate but, comparatively, the households in Curinge are worse off.

The small percentage of homes in Curinge with animal sheds and crop storage capabilities is particularly striking. The inability to store crops could, as discussed in chapter 3, diminish a household's food security during periods of seasonal hunger. They are also limited in their ability to store any surplus crops and sell when prices increase, which negatively impacts their capability to generate financial capital from agriculture. Not having sheds to protect livestock also decreases the household's ability to accumulate and properly maintain assets that could be sold when cash is needed to cover medical or educational expenses. The higher percentage of households in Curinge that use wood as a fuel source (66.4%) and fields and/or yard as the toilet (88.7%) are additional indicators of their relative poverty.

The average financial capital in Tingo Pucará (.451), while low on the 0 to 1 scale, is significantly higher than Guangaje Centro (.410) and Curinge (.320) (Table 4.2). The Guangaje Centro score is also significantly higher than Curinge. As with physical capital, the low Curinge score appears to be linked to a low percentage of households with assets that can be used to facilitate income generation (Table 4.5). These include crop storage infrastructure, animal sheds, and motorized transportation. Households in both Guangaje Centro and Curinge have, on

average, less large livestock. This suggests that they have fewer assets available that could be sold if they experience a stress or a shock, which increases their livelihood vulnerability. Guangaje Centro and Curinge households also have less access to credit. This finding may be linked to the fact that there is a community managed cooperative in Tingo Pucará that provides credit and no similar type of organization in Guangaje Centro and Curinge. Without access to credit it can be harder to make investments in physical infrastructure like crop storage and animal shelters that could then lead to increased financial capital and greater long terms resilience. The comparatively low average annual per capita income from agriculture in Guangaje Centro and Curinge may reflect the lack of options for making investments in productive assets and infrastructure.

Table 4.5

*Financial capital indicator variables by community*

| **Indicator variable** | **Tingo Pucará** | **Guangaje Centro** | **Curinge** |
|---|---|---|---|
| Access to loans/financing (% of HHs) | 72.3 | 47.3 | 42.1 |
| Avg. annual per capita agriculture income (USD) | 52.2 | 20.9 | 13.9 |
| Avg. annual per capita nonagricultural income (USD) | 147.0 | 256.2 | 201.7 |
| Avg. large livestock (# of livestock) | 17.6 | 6.0 | 9.0 |
| Avg. small livestock (# of livestock) | 16.7 | 12.0 | 15.7 |
| Avg. value of owned farm tools (USD) | 66.6 | 69.5 | 52.2 |
| Land for cultivation (% of HHs) | 100.0 | 96.3 | 99.0 |
| Land for pasture (% of HHs) | 85.5 | 91.2 | 99.0 |
| Crop storage infrastructure (% of HHs) | 61.4 | 65.6 | 10.3 |
| Animal sheds (% of HHs) | 72.3 | 61.9 | 15.0 |
| Television (% of HHs) | 50.6 | 52.3 | 45.8 |
| Refrigerator (% of HHs) | 0.0 | 12.4 | 6.5 |
| Bike/motorbike (% of HHs) | 20.5 | 22.7 | 9.3 |

As with financial capital, human capital is low in all three communities. The Tingo Pucará and Guangaje Centro scores are not significantly different. However, both communities scores are significantly higher, by 19% and 12%, than the Curinge. Households in all three communities appear to be primarily constrained by the limited educational attainment. In Tingo

Pucará, 30% of household members have no education, 41% have an elementary level education, and only 29% have at least some education at the secondary level. There is a similar pattern in Guangaje Centro (27% none, 49% elementary, 24% secondary) and Curinge (32% none, 49% elementary, 19% secondary), though the percentage of household members with no education is slightly higher in Curinge than in the other two communities. It should be noted that children were included in the human capital measure and so the educational attainment percentages should be viewed as a cross section of the current situation. If children are able to stay in school, the household educational attainment dynamic and overall human capital may improve in the future.

Low education levels limit the ability of households to diversify sources of potential income as household members do not have the skills and/or knowledge necessary to be employed in anything other than agriculture and/or other forms of manual labor like construction. On average, households do have at least two members who are of prime working age (18 to 55). This means they may have some capability to send one working age adult to do construction work while the other stays to manage agricultural production, which allows for some minimal income diversification if necessary

Figure 4.5 provides a visualization of how study findings discussed in this section fit into the framework of the five capital types. A point this figure helps emphasize is the degree to which capital types are interconnected and feed off one another. For example, participation in an organization that enables access to credit could allow a household to have the resources to buy the physical materials they need to improve their crop storage. By storing crops, they are able to

sell them at a better price, which means they have money to repay their loan and invest in their children's education.

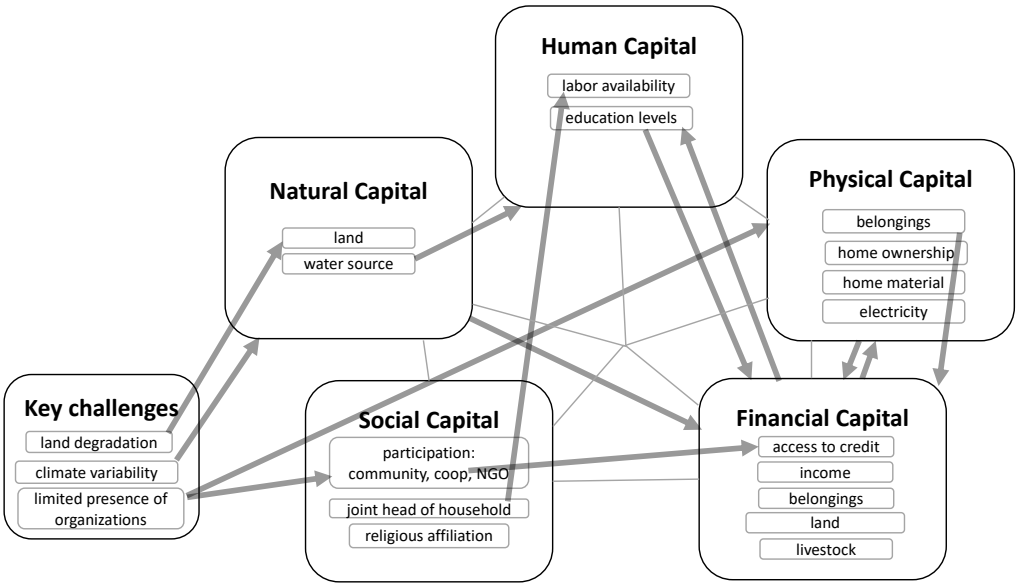


Figure 4.5. Summary of relationships between capital types

This dynamic can be disrupted if, due to a climate shock, such as drought, the crop harvest is poor and there is not enough surplus to sell at a later date. Then the family is in debt and may decide to sell a productive asset like livestock or if they don't have livestock they may have to pull their children from school to help support the household while an adult family member works in the city to try to earn enough to repay what is owed. To truly be resilient in times of shock or stress households need to be able to strengthen and maintain the resources and relationships that comprises each capital.

# 4.5 Conclusion

Overall livelihood resilience in the parish of Guangaje appears to be relatively low on the 0 to 1 scale, especially in the community of Curinge. Given that the methodology used to create the

assets index was published within the last year there is not a lot of literature that can be used to compare results. The Quandt (2018) paper did share composite index scores from a case study in Kenya. Communities with agroforestry were found to have an average livelihood composite index of 0.440 which was significantly more than communities without agroforestry (0.400) (Quandt, 2018). These results suggest that the communities of Tingo Pucará (0.605) and Guangaje (0.576) have, on average, higher livelihood resiliency than both Kenyan communities while Curinge's livelihood resiliency (0.429) is only higher than the Kenyan community without agroforestry.

The categories of human, physical, and financial capital are low in all three study communities. Minimal educational attainment across the communities limits the development of human capital and ability of households to diversify and expand income generation. The acquisition of physical capital and generation of financial capital appears constrained by a lack of productive assets, particularly physical infrastructure like crop storage and animal shelters and farm equipment. The inability to generate much income from agriculture is likely associated with the issues of declining soil fertility and climate variability discussed in chapters 2 and 3. The high percentage of land and pasture ownership in all three communities is a strength but if that land is of poor-quality households are likely going to be stuck in a cycle of subsistence, poverty, and vulnerability.

Study results indicate that capital/asset accumulations varies by community. The average composite asset index and scores for all five livelihood capitals are significantly lower in Curinge than in Tingo Pucará and Guangaje Centro. This suggest that households in Curinge have less potential livelihood resiliency and greater vulnerability to shocks and stressors

compared to households in the other two communities. The significant differences between communities appears to be linked to Curinge's lack of a clean reliable water source, limited presence of governmental and non-governmental organizations (NGOs), poor access to credit, and a lack of productive assets compared to the other two communities. The high average social capital score for households in Tingo Pucará is striking. Households in Tingo Pucará also had the highest composite asset score and the elevated level of social capital, compared to the other two communities, appears to be playing a significant role. Improving social capital in Guangaje Centro and Curinge, especially access to credit, could prove to be an effective approach to increasing livelihood resiliency in these two communities.

The analysis and discussion of community level differences underscores the important role formative research can play in identifying contextual variability that could significantly impact the success of resiliency focused interventions. Our findings highlight how interventions need to be tailored to the community context even when working with geographically and demographically similar populations that experience comparable climatic events. Without the knowledge generated by a formative assessment it would be easy to make misplaced assumptions about community needs and what the potential barriers to helping them meet those needs might be.

Another important consideration for interventions focused in improving livelihood resiliency and sustainability is that resilience is a process that happens over time and the path towards resiliency is often nonlinear and uncertain (Christopher B Barrett & Constas, 2014). A household or individual may achieve a degree of resiliency but can still be vulnerable to yet unknown future shocks (Christopher B Barrett & Constas, 2014; Quandt, 2018). The time

dependent and nonlinear nature of resiliency needs to be taken into consideration when designing and implementing evaluations of resiliency focused interventions. A limitation of the data used for this paper is that it is cross-sectional and therefore cannot provide insight into changes in livelihood resiliency over time. However, by documenting and analyzing the current household livelihood asset dynamic our research serves as a starting point for a more prolonged longitudinal assessment of vulnerability and resiliency in the three study communities.

# Chapter 5: Recommendations

This chapter uses the knowledge gained about the vulnerability context in the parish of Guangaje to develop recommendations for a livelihood focused intervention and/or program that addresses the major challenges that have been identified, would be acceptable and appropriate for the study populations, and feasible to implement. The hope is that these recommendations can be used by researchers and development practitioners as a starting point for the design of an intervention that helps rural indigenous communities of Guangaje sustainably improve their livelihood security. The follow sections provide an overview of the frameworks and concepts used to develop the recommendations and then details the specific recommendations.

## 5.1 Frameworks

The development of recommendations has been structured around Chen's (2005) conceptual framework for program rationale (Figure 5.1). Creating a program rationale represents the first step in the process of designing, implementing and evaluating an intervention program (Chen, 2005). The focus is on determining which problem/s need to be alleviated/resolved and which intervention should be used to address the problems that have been identified. Program rationales provide the "foundation for planning, for efficient communication, and for a basis of outcome evaluation" (Chen, 2005, p. 75). Formative research provides the empirical information about community needs, target group characteristics, and clients' and implementers' perspectives required to develop the program rationale (Chen, 2005). Figure 5.1 illustrates the core components and questions that should make up the program rationale's systematic argument for why a specific intervention has the potential to achieve a set of stated goals. The top boxes

display the problem and target population that have been identified. The information necessary for problem identification comes from the findings of chapter 2, 3, and 4.

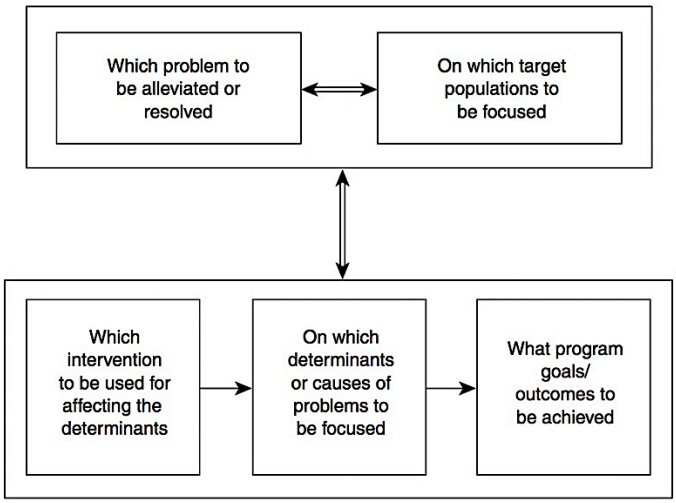


Figure 5.1. Conceptual framework of program rationale (Chen, 2005, p. 74)

The bottom boxes contain the components that Chen (2005) categorizes as the change model, which consists of identifying the intervention that would address the problem/s, specifying the determinants or leverage mechanisms that will be activated by the intervention to solve the problem, and indicating the outcomes the intervention/program will achieve. The two-way arrows that link the problem/target group boxes to the change model are meant "to demonstrate the importance of the "fit" between change model and target group…it is vital that goals, determinants, and interventions (the three change model components) are appropriate to the target population and the problem it faces" (Chen, 2005, p. 75). The determination of intervention "fit" is one of the main goals of this dissertation.

The change model is part of Chen's more comprehensive conceptual framework for program theory seen in Figure 5.2.

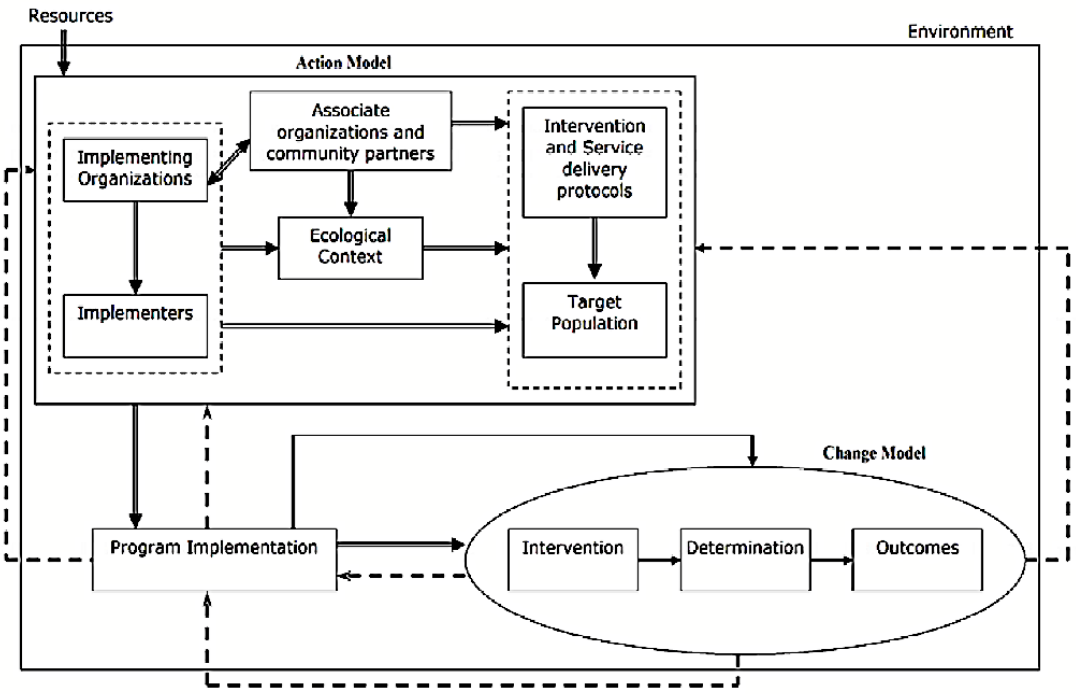


Figure 5.2. Conceptual framework of program theory (Chen, 2005, p. 31)

This framework presents "a systematic configuration of prescriptive and descriptive assumptions underlying a program" (Chen, 2005, p. 34). The action model within the framework represents the various interactions that need to take place for a program intervention to be implemented successfully. The double-banded arrows signify the sequential order of the implementation process, which highlights the fact that some components provide the structural base for the completion of others (Chen, 2005). The dotted arrows represent the feedback loops of information and knowledge that can be taken from one step in the process and used to improve a previous step. When the action model is implemented appropriately, the causal process represented in the change model should be activated and some type of outcome achieved (Chen, 2005). This dissertation focuses on understanding the ecological context and the target population components of the action model.

## 5.2 Concepts

The conceptualization of the acceptability, appropriateness, and feasibility of the recommended intervention strategy is guided by the work of Proctor et al. (2009, 2011) in the field of dissemination and implementation (D&I) science. D&I science has emerged in the past ten years as an important research approach focused on measuring and understanding context with the goal of improving the implementation of interventions and the dissemination of evidence-based knowledge (Brownson, Colditz, & Proctor, 2018). D&I has made significant contributions to better understanding how the measurement of specific concepts prior to implementation, during the formative research stage, can improve service and target population outcomes.

The idea represented in the heuristic model of implementation research proposed by Proctor et al. (2009, 2011) ( Figure 5.3), is that improved understanding of the acceptability, appropriateness, and feasibility of the problem and potential intervention is necessary prior to implementation to achieve more efficacious, effective, and timely service outcomes.

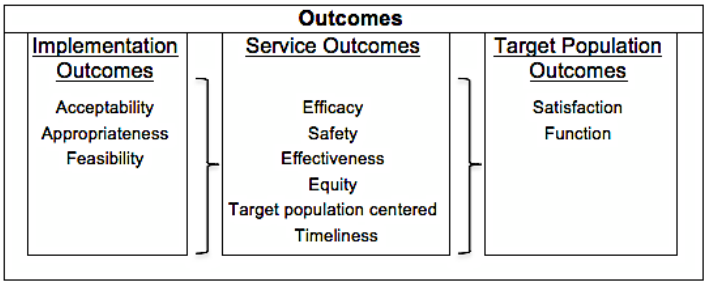


Figure 5.3. Types of outcomes in implementation research (Proctor et al., 2009, p. 29)

Ultimately, this will increase the likelihood that the intervention meets the needs of the target population. Figure 5.4 is part of the Taxonomy of Implementation Outcomes table found in Proctor et al. (2011) and includes definitions for acceptability, appropriateness, and feasibility.

| Implementation outcome | Level of analysis | Theoretical basis | Other terms in literature | Salience by implementation stage | Available measurement |
|---|---|---|---|---|---|
| Acceptability | -Individual provider<br>-Individual consumer | Rogers (1995): "complexity" and to a certain extent "relative advantage" | Satisfaction with various other aspects of the intervention (e.g. content, complexity, comfort, delivery, and credibility) | -Early for adoption<br>-Ongoing for penetration<br>-Late for sustainability | -Survey<br>-Qualitative or semi-structured interviews<br>-Administrative data |
| Appropriateness | -Individual provider<br>-Individual consumer<br>-Organization or setting | Rogers (1995): "compatibility" | Perceived fit; relevance; compatibility; suitability; usefulness; practicability | Early (prior to adoption) | -Survey<br>-Qualitative or semi-structured interviews<br>-Focus groups |
| Feasibility | -Individual provider<br>-Organization or setting | Rogers (1995): "compatibility" and "trialability" | Actual fit or utility; sustainability for everyday use; practicability | Early to mid | - Survey<br>-Administrative data |

Figure 5.4. Taxonomy of the implementation outcomes acceptability, appropriateness, and feasibility (Proctor et al., 2011, p. 68)

Based on the work of Proctor et al. (2011), acceptability is the "perception among implementation stakeholders that a given treatment, service, practice or innovation is agreeable, palatable, or satisfactory" (p. 67). For acceptability to be assessed stakeholders should have knowledge of the different dimensions of the intervention including content and complexity (NIH, 2017; Proctor et al., 2011). If/when an intervention is implemented, acceptability should be gauged throughout implementation, particularly during the early stages of adoption (NIH, 2017; Proctor et al., 2011). Because the focus of the dissertation is on better understanding context to be able to recommend an agreeable and satisfactory intervention that address key problems, and not on the implementation of an intervention, acceptability will be assessed based on whether the problem is a top concern raised by the community members involved in the study.

Appropriateness is concerned with relevance and/or compatibility given the setting, provider, target population, and resources (NIH, 2017; Proctor et al., 2011). Appropriateness does not guarantee acceptability for the target population or the implementer so continual

assessment during implementation is recommended (Galeazzi, Elkins, Pingani, & Rigatelli, 2006; Proctor et al., 2011). The assessment of whether it would be appropriate to address a specific problem will be based on the problem's relevance to the study population, usefulness of addressing the problem, and whether or not it can be addressed with available resources.

Feasibility is the "extent to which a new treatment, or an innovation, can be successfully used or carried out within a given agency or setting" (Proctor et al., 2011, p. 69). Though it may encompass appropriateness, it includes practical matters such as infrastructure, organizational capacity, and needs for different types of capital (NIH, 2017; Proctor et al., 2011). As with acceptability and appropriateness, feasibility should be considered during the early stages of implementation (Proctor et al., 2011). As detailed in Figure 5.4, a mix of qualitative interviews, focus groups, and quantitative surveys is necessary to gather the level of rich data required to comprehensively document the acceptability, appropriateness, and feasibility of an intervention (Ayala & Elder, 2011; Proctor et al., 2009, 2011).

# 5.3 Logic Model of Problems

A logic model has been developed to illustrate the range of problems identified in chapter 2, 3, and 4 and assist with prioritization (Bartholomew et al., 2016). Logic models are a tool long used in the international development community to depict a " reasonable, defensible, and sequential order from inputs through activities to outputs, outcomes, and impacts" (Chen, 2016; Patton, 2014, p. 163). Logic models have been used heavily in the evaluation of government programs because they provide a systematic way of capturing the complexity of program planning and development (Chen, 2016). Creating a logic model of the problem is the first step in the intervention mapping process outlined by Bartholomew et al. (2016). The problem focused logic

model shown in Figure 5.5 illustrates the range of contextual factors impacting livelihood security in the parish of Guangaje and the key relationships between those factors.

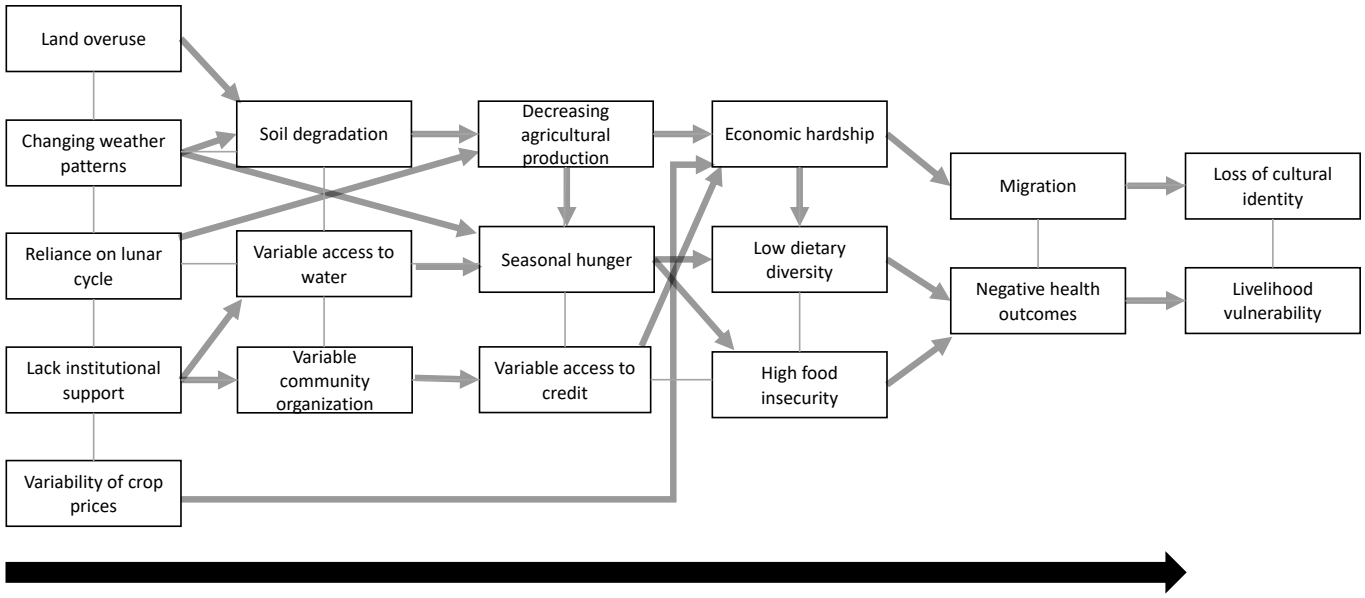


Figure 5.5. Determinants of increased livelihood vulnerability in the communities of Guangaje

Figure 5.5 depicts the range of social, economic, physical, and environmental determinants, trends, and challenges that, based on the study findings, are believed to be contributing to the high level of livelihood vulnerability in the three study communities as well as the observed behaviors and/or beliefs expressed during the qualitative data collection process that may be playing a role in the populations ability to achieve livelihood security and well-being. Though there are likely feedbacks and multidirectional impacts between determinants, the general direction of hypothesized impact, represented by the large black arrow, is from left to right. Directional relationships and/or associations between specific determinants are denoted by the smaller grey arrows.

The main theme captured by Figure 5.5 is that land overuse, changing weather patterns, cultural beliefs, such as a reliance on lunar cycles, limited support from outside institutions (governmental and nongovernmental), and crop price variability appear to be the primary determinants of livelihood security in Guangaje. The other factors that were found to be contributing to the level of livelihood vulnerability in Guangaje stem from these five determinants. Some of the primary relationships include land overuse and climate variability feeding into soil degradation, declining agriculture production, and economic hardship. Economic hardship has led to increased levels of migration and a loss of cultural identity as well as low dietary diversity and negative health outcomes.

Cultural beliefs, like the reliance on the lunar cycle for crop cultivation, combined with climate change, likely play a role in the declining agricultural production, seasonal hunger, and high food insecurity. The lack of institutional support, especially in Guangaje Centro and Curinge, is believed to be contributing to the low levels of community organization and access to credit in these communities as well as the lack of water infrastructure in Curinge. Limited access to water means households are vulnerable to extended periods without rain which in turn can increase seasonal hunger, food insecurity, and the prevalence of a range of negative health outcomes. Variability of crop prices, though related to crop supply and therefore production, is believed to be primary determinant because agricultural product prices are often related to outside economic forces that can be challenging for rural subsistence farmers to predict or have any control over. If families are forced to sell their products when prices are low, due to an emergency or other immediate household need, they are likely to face future economic hardship and vulnerability due to the inability to accumulate and save resources.

## 5.4 Problem Classification and Ranking

The next step in the recommendation development process, according to Chen's (2005) program rational, is deciding which of the primary determinants/problems should be alleviated. As described previously in this chapter, this determination will be made by estimating and grading the acceptability, appropriateness, and feasibility of addressing the problems that have been identified in Figure 5.5. Specifics about how the problems will be graded are shown in Table 5.1. The definition of different grades of acceptability, appropriateness and feasibility in Table 5.1 are grounded in the work of Proctor et al. (2009, 2011) but have been repurposed by the author and applied to a problem assessment instead of implementation outcomes.

Table 5.1

*Problem classification criteria*

| Grade | Acceptability | Appropriateness | Feasibility |
|---|---|---|---|
| High | A top concern raised by community members | Highly relevant to the target population<br>Very useful to address<br>Can be addressed with available resources and assets | Target population has the human capital to sustainably address<br>Practical to address given relevant stakeholders and environments |
| Moderate | A low-level concern raised by community members | Relevant to the target population<br>Useful to address<br>Can be addressed with available resources and assets | Target population has some of the human capital to sustainably address<br>Practical to address given relevant stakeholders and environments |
| Low | Not a concern raised by community members | Little relevance for the target population<br>Not useful to address<br>Cannot be addressed with available resources and assets | Target population lacks human capital to sustainably address<br>Not practical to address given relevant stakeholders and environments |

The goal of the grading process is to clarify and decide on the most pressing problem/s facing the population of Guangaje. The problem with the most 'high' grades or combination of 'high' and 'moderate' grades will be the basis for the recommended intervention/s. Table 5.2 provides a summary of the five key problems that were identified through the creation of the logic model and the grade those problems received.

Table 5.2

*Problems ranked according to the classification criteria*

| **Problem** | **Acceptability** | **Appropriateness** | **Feasibility** |
|---|---|---|---|
| Land overuse-soil fertility | High | High | High |
| Changing weather patterns | High | High | Moderate |
| Cultural beliefs-lunar cycles | Low | High | Low |
| Limited support from outside institutions | High | Moderate | Low |
| Crop price variability | High | Moderate | Low |

Based on the research findings presented in this dissertation, the problems linked to land overuse, soil fertility, soil degradation, and declining agricultural production, received the highest grade for all three categories. This issue was a top concern raised by study participants in all three communities. It is a problem that is very relevant to the target population because of their reliance on agriculture for their livelihood. There is also a high concentration of human capital with agricultural knowledge because households have been farming in the Guangaje area for several generations. The majority of households reported owning land for crops and pasture, which indicates that land, the main resource associated with problem, is available. Where the target population is limited is in the area of physical and financial assets to invest in improving the productivity of their land. This will likely be the area of focus for a land use/land regeneration intervention.

Changing weather patterns, specifically changes in the amount and timing of rainfall, was another top concern raised by community members. Again, because of the reliance on agriculture, this issue is highly relevant to the target population and trying to mitigate the impacts of climate variability is likely to decrease the high level of food vulnerability and seasonal hunger in the parish. The primary challenge with trying to address this problem is that climate change is not something that can be significantly altered at a local level. For this reason, it received a 'moderate' feasibility grade. The intervention approach for this problem is going to have to focus on limiting the negative impact of future climate change on livelihoods by increasing household resiliency and capability to adapt.

The reliance on the lunar cycles for crop cultivation, limited support from outside institutions, and crop price variability have been deemed to be problems of less priority primarily due to their feasibility challenges. Without more prolonged engagement with local officials, an intervention is unlikely to be able to impact and/or encourage governmental investment priorities, at least initially. However, building relationships with local stakeholders should be a component of any future intervention. Crop price variability would be relevant and useful to address but the problem was given a low feasibility grade because crop prices are often tied to economic forces outside of the communities and so it might not be practical to address given the stakeholders that would need to be involved. However, there are steps that households and communities can take, like improving crop storage, to protect themselves against price variability. Improved crop storage can also help increase household resiliency to climate change so it possible that by addressing climate change vulnerability the issue of crop price variability could be mitigated. Addressing cultural beliefs regarding the importance of lunar cycles was

given a ‘low’ grade for acceptability and feasibility because it was not a concern raised by study participants. Additionally, it can be challenging and potentially irresponsible to try to influence or change cultural beliefs without more thorough knowledge and understanding of their significance.

## 5.5 Recommendation

Based on the problem classification and grading detailed in the previous section the author recommends that a future livelihood intervention in the parish of Guangaje focus on the challenges of land overuse/soil fertility and changing climate patterns. An ecologically sustainable approach for addressing low crop productivity and soil degradation involves building up the soil’s organic matter through agroecology (Duru et al., 2015; Teixeira et al., 2018; Wezel et al., 2014; Willett et al., 2019). Agroecology focuses on “enhancing diversity and complexity of farming systems via polycultures, rotations, agroforestry, use of native seeds and local breeds of livestock, encouraging natural enemies of pests, and using composts and green manure to enhance soil organic matter thus improving soil biological activity and water retention capacity”(Altieri & Toledo, 2011, p. 588).

Other common practices within agroecology include reduced tillage and expanding the use of intercropping, a multiple cropping practice involving growing two or more crops in proximity (Duru et al., 2015). Erosion control, planting appropriate nitrogen-fixing cover crops, and the introduction of more drought-tolerant varieties of potato, barley, and fava beans could also positively impact soil quality and production. However, the introduction of new varieties of crops and agricultural practices would need to be done in close consultation with community members to ensure that the approach is acceptable and appropriate. The exact design and

implementation of the agroecological intervention should be done using a participatory methodology that takes into account community level variability across the five livelihood capitals (Duru et al., 2015).

As described in chapter 3, an approach that could be used to address the unpredictability of precipitation and shifting rainy seasons is the creation of a communal water retention pond and canal network that would fill during the rainy season and could be used to water crops through drip irrigation and/or maintain the moisture of pastures during periods of low precipitation (The Mountain Institute, 2016). Similar water retention systems, dating back to 1,000 AD, have been found and restored in the highlands of Peru, suggesting that they could be applicable to similar areas of the Andean region including the highlands of Ecuador (The Mountain Institute, 2016). The project sites in Peru have experienced an increase in the availability of local water during the dry season and improved livestock productivity (The Mountain Institute, 2016). Though likely to involve a significant initial investment, improved water storage and irrigation infrastructure could have long term benefits for food and livelihood security in Guangaje. Rehabilitation and conservation of the *páramo* grasslands, which has a natural water absorption and retention function, would also aid efforts to capture precipitation (Hess, 1997; Ulloa Ulloa, n.d.).

Better crop storage would minimize the impact of seasonal hunger linked to increasing climate variability. Collaboration with the *Centro Internacional de la Papa* (CIP) [International Potato Center] in Ecuador could help facilitate the implementation of solutions to address the postharvest storage of tubers. CIP also was a wealth of information and expertise regarding the various physical, physiological and pathological factors that reduce the quantity and quality of

harvested tubers. Interventions that aim to address the documented issues with postharvest storage would benefit from this expertise. A majority of households likely do not have the resources to build proper crop storage facilities so any training workshops on proper storage approaches and techniques should be paired with the provision of materials and equipment for this type of infrastructure.

By addressing the issues of land overuse and degradation and improving resiliency to climate change, specifically rainfall variability, it is hoped that households in Guangaje can begin to regenerate and preserve the ecosystem that they rely on for their livelihoods. Better soil quality and water retention and redistribution infrastructure should lead to an increase in the quantity and quality of crops that can be produced and the amount of livestock that can be sustainably maintained. The agricultural surplus generated from this increase will help households improve their income generation, minimizing the need to migrate to cities in search of work, and hopefully allow families to begin to address the documented issues of undernutrition and low dietary diversity. A focus on sustainably increasing the amount of agricultural production that can occur on already cultivated land should also reduce the need for families to expand into previously uncultivated virgin *páramo*. This will benefit not only households in Guangaje through increased water retention and decreased erosion but will also positively impact downstream communities due to the integral role that mountain ecosystems play in supporting the provision of water and nutrients (Messerli & Ives, 1997; Rhoades, 2006).

One of the primary limitations of the proposed recommendations is that the introduction of new agricultural approaches and regeneration of ecosystems takes time. Funding agencies need to be ready and willing to make a long-term investment and be committed to conducting a

longitudinal assessment to better understand impact and how the intervention can be improved and amplified. The benefit of the proposed approach is that by addressing the underlying food production issues, not just outcomes like undernutrition and low income, households in the parish of Guangaje are much more likely to have sustainable and resilient livelihoods. Better understanding and addressing the underlying issues facing rural subsistence farmers is critically important given the key role they play in the global food system and the increased challenges they are likely to experience as the climate continues to change.

The study findings discussed in this dissertation reinforce the importance of conducting formative research prior to developing an intervention. This importance is highlighted by several discoveries made by the author during the process of conducting the research. The initial research proposal written by the author focused solely on trying to determine if it would be acceptable, appropriate, and feasible to implement a poultry intervention in the three study communities. The premise was that because the proposed study population was believed to suffer from a high level of undernutrition, specifically stunting, an intervention that increased the availability of eggs, the consumption of which had been found to decrease the prevalence of stunting, could have very positive nutritional impacts (Iannotti et al., 2017). As described in this dissertation, the study population does have severe undernutrition issues. However, during the course of the qualitative interviews the author discovered that while the population likes to consume poultry and poultry products and would like to have more poultry they felt that they did not have the resources to properly maintain them. As stated by study participants, this is primarily because they rely on barley to feed their poultry and due to declining barley production linked to land degradation there was not enough of the grain being produced to support

increasing the number of poultry. They also did not have the economic resources to purchase feed. This finding led the author to conclude that while a poultry intervention would be acceptable and feasible it would not be appropriate until the underlying food production issues were addressed. If the author had proceeded with implementing a poultry intervention without this contextual information the intervention would very likely have been unsustainable.

The lack of success in addressing persistent poverty in rural areas of the world highlights the need for more high-quality formative assessments focused on understanding what type of intervention/s could help rural communities sustainably improve their livelihood security. As underlined by the authors own research process and discovery, too often assumptions are made about the needs and priorities of underserved and disenfranchised populations. This leads to the development and implementation of interventions that end up being unsuccessful and/or unsustainable because they do not take community voices and concerns and the local context into account. Collecting and utilizing baseline information on the beneficiary population and context should enable the design of acceptable, appropriate and feasible interventions and more effective and efficient delivery and implementation.

# 6. References


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