

PERCEPTIONS OF LOCAL  
VULNERABILITY AND  
THE RELATIVE  
IMPORTANCE OF  
CLIMATE CHANGE  
A CASE STUDY OF THREE RURAL  
COMMUNITIES ON THE NORTHERN  
ECUADORIAN COAST

Author: Helen Gutierrez  
Thesis advisors: Dr. Gwenyth O. Lee and Dr. Rebecca Hardin

To my family for making me who I am and encouraging me when I was feeling discouraged. Thank you!

## *1. Abstract*

Populations that are natural resource dependent are especially sensitive to accelerating climatic change. Therefore, it is important to understand how multi-dimensional vulnerabilities that affect community well-being also impact the capacity of these populations to cope with and adapt to climate change. Coastal communities, in particular, exist in a state of flux and are continually exposed to a variety of environmental and social changes. Yet, as the effects of climate change become more pronounced, these communities are expected to face greater rates of change than ever before (Bennett & Dearden, 2013; Bunce et al., 2010; McDowell & Hess, 2012). The aim of this study is to document and conceptualize factors that shape vulnerability among three coastal, rural communities in northeastern Ecuador and explore the perceived relative importance of climate change, compared to other factors, among community members. The study draws upon participatory risk assessment methodologies and theories of vulnerability, adaptive capacity, and political ecology to better understand the relative importance of climate change within a broader context. Data was collected at the household level through surveys and free-list interviews and at the community level through focus group discussions. Findings suggest that factors such as economic instability, lack of access to basic services, and environmental degradation are perceived as greater threats to overall community well-being than climate-related factors such as seasonal variability or increased rains. Our results indicate that different stressors interact with each other synergistically to create greater local vulnerability to climate change. Thus, policies directed at climate change adaptation need to take a holistic assessment approach that integrates analyses of climate and non-climate related stressors.

## *2. Anecdote*

Esmeraldas, the northernmost coastal province of Ecuador, is an incredibly lush area, where varying shades of green dominate the landscape. My first trip upriver is captivating, and I want to take everything in. All is beautiful – tropical plants and trees abound, a sparkling river flows out towards the sea, and houses dot the countryside.

Following many conversations with residents and local experts, a patchwork picture began to form. A living etched out from an ever-changing landscape by a people working ancestral lands, creating patterns of adjustment, learning, and adaptation over time. Yet, over the years, another, parallel story had emerged, one shaped by shifting global economic forces and changing political interests. Miles of African Palm tree plantations, artisanal gold mining pits, and logging operations litter the Emerald province – new stakeholders, forcefully tearing their way across ancestral lands. Community members spoke of dwindling fish stocks and of a river so heavily polluted that they forbid their young children from swimming in it; of a changing relationship with the river, once a source of bounty and health, now a dumping ground – toxic to the touch and a burden to those who live off it.

News headlines tell us about the latest floods and heavy rains (see Masoero, 02/02/2016; Schumer, 12/18/2015) while science warns us of climate change – another threat added to a growing list. What's one more flood in a land intimately familiar with the water's touch? Communities have adjusted thus far, but amidst so many changes, how will the story play out? The story of life along the Cayapas River in Esmeraldas, Ecuador is complex and layered. My aim through this study is to disentangle some of these layers to get to the heart of how individuals and communities are dealing with change and how to best move forward.

### ***3. Introduction***

Populations that are highly dependent on the availability of natural resources and engage in climate-sensitive activities, are especially sensitive to accelerated changes (Bennett & Dearden, 2013; Bunce, Rosendo, & Brown, 2010; McDowell & Hess, 2012). Individuals living in coastal areas are continually exposed to a variety of environmental and social changes and live in a constant state of flux (Bennett & Dearden, 2013). Yet, as the effects of climate change become more pronounced, coastal communities are expected to deal with greater rates of change than ever before (Bennett & Dearden, 2013). Changes in precipitation patterns have had observable effects on natural hydrological systems, impacting fresh water availability, river flow, and crop yields (IPCC, 2014). Yet, these impacts are felt with greater intensity and are made more devastating to those who depend upon the land and local ecologies to live – in effect those who contribute the least to global change but face the greatest risk.

In Latin America extreme weather events from 2000 to 2013 affected more than 53 million people and generated losses of up to \$52.3 billion (IPCC, 2014). In Ecuador alone, economic losses resulting from climate change are expected to reach approximately \$5.6 billion by the year 2025 (Ecuador, 2012). Trends linking increased precipitation to linked to El Niño Southern Oscillation (ENSO) are especially prevalent in coastal Ecuador where intense rainy seasons are already being felt (IPCC, 2014; Morán-Tejeda et al., 2015). Furthermore, Fernandez, Bucaram, & Renteria (2015) found that cantons located within Esmeraldas are some of the most vulnerable to the impacts of climate change in the country. Studies have been done on vulnerability to climate-specific stressors and risk in Ecuador (see Eguiguren-Velepucha et al., 2016; Fernandez, Bucaram, & Renteria, 2015), yet there is limited information documenting vulnerability relative to climate change on the Ecuadorian Coast within a broader political, social-economical, and historical context.

Climate change is just another form of ‘slow violence’ that is making its way into people’s daily lives. ‘Slow violence’ is defined by Watts (2011) as “a violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space, an attritional violence that is typically not viewed as violence at all”. Esmeraldas is a region that has been subject to immense change. Incredibly violent processes stemming from colonialism and slavery shaped its history and continues to impact the day-to-day life of residents there. Residual effects of these processes continue to impact local well-being through high poverty and illiteracy rates, unemployment, environmental degradation, deforestation, and the depletion of their resource base, among other factors (Antón Sánchez, 2015; Whitten, 1986; Whitten, 1998). By acknowledging the ‘slow violence’ of the development processes shaping the region’s political economy, we can better understand the forces that weave together to create community vulnerability.

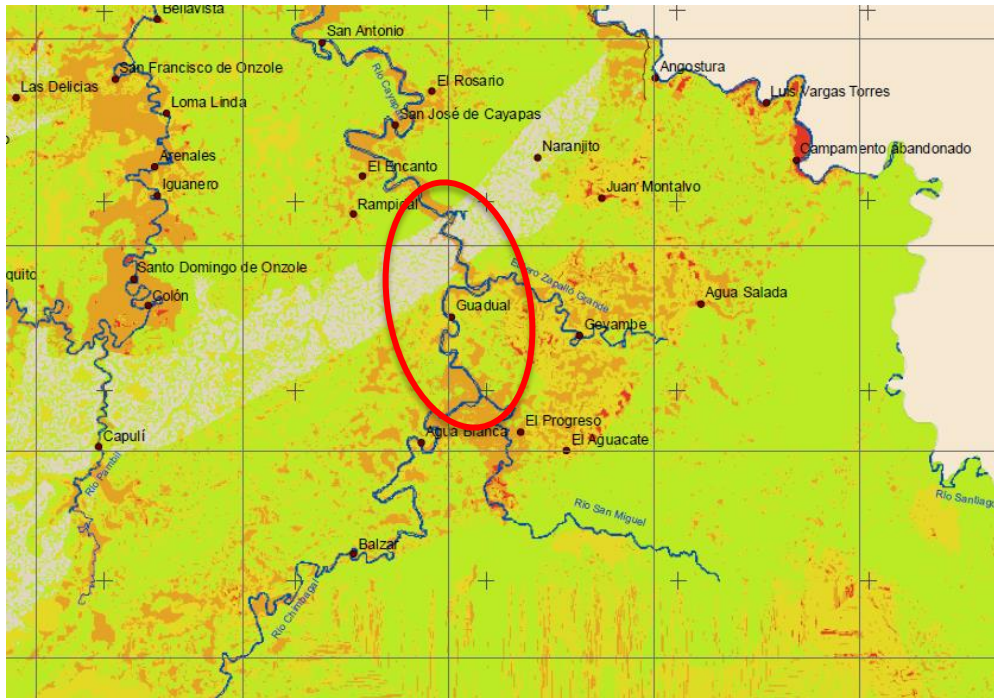
Therefore, the aim of this study is to document and conceptualize vulnerability as experienced in three coastal, rural communities in northwestern Ecuador. We draw upon theories of vulnerability, well-being, and political ecology to better understand how vulnerability is shaped through multiple factors and what the relative importance of climate change is within a broader context. To address this overall aim, we answer the following research questions: How do community members from three riverine communities in the Esmeraldas province in northern coastal Ecuador perceive local well-being and vulnerability? How do identified threats to well-being interact within the local context? How do community members perceive climate change? What is the relative importance of climate change in relation to the other stressors identified by community members? This paper is part of the larger study “Impacts of El Niño-Related Climate Hazards on Individual and Household Behavior and Health” conducted through the School of Public Health at the University of Michigan.

#### **4. Study site:**

Our study site is situated in the Pacific lowlands along the Ecuadorian coast in the province of Esmeraldas. Esmeraldas lies within the Chocó-Darién Biogeographical region, a ‘biodiversity hotspot’ that spans the Pacific Coast from northern Colombia to northwestern Ecuador, an area of about 200,000 km<sup>2</sup> (Conservation International, n.d.; Sierra, 1999; Sierra & Stallings, 1998). The area is composed largely of tropical wet forests that are home to many endemic species (Myers et al., 2000; Sierra & Stallings, 1998). In addition to being ecologically diverse, the area is also rich in minerals and other natural resources, such as timber and oil, which make it of strategic national interest (Whitten, 1974).

Climate in the region is influenced by primarily by the Humboldt and Equatorial counter ocean currents, and they determine humidity, temperatures, rainfall patterns (de Guenni et al., 2017). From May to October, the region experiences higher humidity, while December to April are characterized as hotter months. 75% – 95% of annual rainfall occurs from December to May, while remainder of the year is experiences less rainfall (de Guenni et al., 2017). The Esmeraldas province experiences regular flooding every year, but the past few years have been reported as especially bad flood years, with resulting in extensive economic losses (Masoero, 02/02/2016; Schumer, 12/18/2015). Figure 1 is from a map of the area where the study communities are located (area circled in red) signaling areas that are at risk of floods, where the darker orange color indicates high risk.

**Figure 1.** Preliminary Map of the Flood Prone Areas in Eloy Alfaro, Esmeraldas, Ecuador



**Source:** Unidad Provincial de Gestion de Riesgos de Manabi, 2011

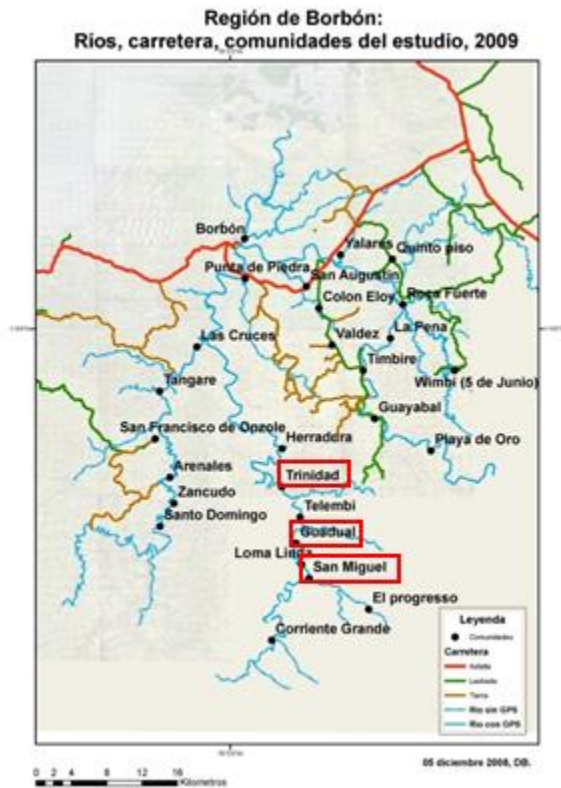
There are approximately 125 villages (See Figure 2) that line the Cayapas, Santiago, and Onzole Rivers, three of the main riverways in the region (Carlton et al., 2014; Rao et al., 2015). The rich natural resource base of the region has made it attractive to global economic forces throughout its history, beginning with gold mining from colonial times in the mid-1500s (Antón Sánchez, 2015; Whitten, 1986; Whitten, 1998). Legal and illegal logging, oil extraction, and cash crops, including oil palm, banana, and cacao, have been present since the 1940s (Whitten, 1986). However, recent years have seen an upsurge in cacao production due to push from government. Construction of the road and greater connectivity have led to intensified logging and industrial farming, leading to higher rates of deforestation (Eisenberg et al., 2006; Vieira et al., 2007).

The three communities (Trinidad, Guadual, and San Miguel, see Figure 2) in this study lie along the Cayapas River, within the buffer zone of the Cotacachi-Cayapas Ecological Reserve (Ministerio del Ambiente, 2015). San Miguel and Guadual belong in the Parrish Atahualpa and Trinidad belongs in the Parrish Telembí. All three villages are only accessible via river



transportation, but road access is slowly opening up the region (Carlton et al., 2014). For communities in this region, fish, shrimp, bushmeat, green plantain, and coconut are traditional foods for people living along the Cayapas River (Norman Whitten, 1986); plantains, leafy greens, cacao, cassava, beans, and fruit are commonly cultivated for personal consumption as well as for sale at regional markets (Whitten, 1986).

**Figure 2.** Map of villages in the confluence area of the Cayapas, Santiago, and Onzole Rivers



**Source:** EcoDess, 2004

*a. Brief history of the region*

The Pacific lowlands in Esmeraldas has been valued for its' gold since colonial times, considered as "El Dorado" by the Spaniards (Whitten, 1986; Whitten, 1998). Gold mining expansion nearly led to the collapse of local indigenous populations, and as a result, fueled the slave trade in the area for 350 years (Antón, 2015; Whitten, 1986). Esmeraldas was founded by

escaped slaves and given its history, is a region of historic importance for Afro-Ecuadorian culture (Antón, 2015; Whitten, 1986). According to the 2010 census, 43.9% of all residents in Esmeraldas identified as “Afro-Ecuadorian” and 2.8% identified as Indigenous; however, in the more rural areas of the province, these figures increase. In Atahualpa, 51.6% of all residents identify as “Afro-Ecuadorian” and 44.9% identify as “Indigenous” (National Institute of Statistics and Census, 2010). In Telembí, 27.2% of the population identifies as “Afro-Ecuadorian” and 70.7% identify as “Indigenous” (National Institute of Statistics and Census, 2010).

Yet, national identity is tied to ideals of whiteness or “mestizaje” stemming from colonial times, and this has given rise over the years to exclusionary politics through structural racism (Antón Sánchez, 2015; Rappoport Delegation on Afro-Ecuadorian Land Rights, 2009). Afro-Ecuadorians and Indigenous peoples generally experience greater rates of poverty and inequality than whites or “mestizos”. Through the years, afro-descendent history has been obscured within national narratives and many policies reflect this. For example, land tenure rights Afro-Ecuadorian and Indigenous peoples have long contested their right to ancestral lands in Esmeraldas. Lands are collectively owned and are an important basis for their way of life, yet collective land titles went unrecognized, and for many years were considered “unproductive” lands (Anton Sanchez, 2015; Rappoport Delegation on Afro-Ecuadorian Land Rights, 2009). Rural Afro Esmeraldeños and the local Indigenous groups, fight against displacement from their land by commercial agriculture, extractive industries continuing pressures from migration, and increasing violence around the Colombian border (Whitten, 1998; Anton Sanchez 2011 & 2015).

## ***5. Research Methods***

### *a. Theoretical Framework - Multiple Stressor Approach to Vulnerability*

Vulnerability is commonly defined as “the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change” (IPCC, 2007). Within this framework, vulnerability is described as a function of three parameters: exposure, sensitivity, and adaptive capacity. Exposure refers to how a shock is experienced, sensitivity is how susceptible a system is to the impact of exposure, and adaptive capacity refers to the system’s ability to respond to and bounce back from disturbances (Adger, 2006; IPCC, 2014). Seen as the susceptibility to harm, this risk-hazard perspective frames vulnerability as an outcome of a shock (Adger, 2006; Bennett, Blythe, Tyler, & Ban, 2016; Eakin & Luers, 2006; Räsänen et al., 2016) and is often used for hazard management through technical solutions in order to prevent future losses (Adger, 2006; Eakin & Luers, 2006).

Nevertheless, vulnerability to environmental change doesn’t happen in isolation, but rather it is part of a process in which climate change is one of many factors that produce and reproduce hazards and risk. There is a tendency within scholarship on climate change to attribute individual climate-related factors to vulnerability without acknowledging the different social and historical processes that have local contexts. Thus, in an attempt to avoid a narrow conceptualization of vulnerability, linked the concept to that of well-being, specifically “Buen Vivir” (see: Secretaría Nacional de Planificación y Desarrollo, 2013). In 2008, Ecuador implemented a policy of “Buen Vivir” or “good living”, and we thought that in using this concept, it would ground the study within the national context and make it more relevant to the participants. “Buen Vivir” comes from the Quechua word “Sumak Kawsay” which is rooted in Quechua cosmology that describes a more harmonious way of life “community-centric, ecologically balanced, and culturally sensitive” (Balch, 2013).

Therefore, we organize our analysis around a ‘multiple stressors’ approach, where vulnerability is conceptualized as a condition resulting from the interaction between ecological, physical and social processes within a specific context (Adger, 2006; Antwi-Agyei et al., 2016; Räsänen et al., 2016; Tschakert, 2007; Wisner, Blaikie, Cannon, Davis, 2003). This approach has been identified as useful to understanding both how vulnerability is produced and how it affects a population’s capacity to respond to change (Adger, 2006; Bunce et al., 2010).

*b. Data collection*

*Household survey on flood impacts*

Up to 25 households per community were selected to participate in the household survey (If there were fewer than 25 households in the community, all households were invited to participate). All households with a child under two years of age were invited to participate, while the remaining households were randomly selected. The survey included questions about household demographic factors (e.g. number of individuals in the household), household socio-economic status (e.g. household building materials, livelihood strategies, assets), and flood damages in the past year. These included questions about damages to property and damages to crops and to livestock. Surveys and free listing was conducted from March to June of 2017.

*Free listing activities*

All households that participated in the survey were also invited to complete a free-listing activity. The free list prompt was chosen to draw out information related to change and risk (framed as problems or worries) and were piloted among study fieldworkers (themselves members of the local community) prior to implementation.

The free listing activity was based on non-specific prompting where the respondents were asked to list whatever came to mind after hearing a specific question. Due to the low literacy rate

of the population, free listing was conducted orally (participants were asked to verbally name items as they occurred to them, and any observing neighbors or family were asked not to participate). After initial responses were recorded by the interviewer, participants were then prompted, both non-specifically and by reading back previously listed items, until they couldn't think of anything else. If climate change (or climate-related concepts) were not mentioned by the respondent in the initial free list, they were then prompted to think of any climate-related problems affecting their community – this was noted on the with responses.

### Focus group discussions

A total of six focus group discussion were held for this study, two in each community. Separate focus group discussions were held by gender to overcome potential gendered biases and ensure equal participation of both groups. Focus group participants were selected based on community leadership, age, and gender. Additionally, the participants invited to the focus groups were selected to ensure an even participation of younger and older generations. Within each focus group, specific tasks (participatory risk mapping and vulnerability matrices) were conducted in separate breakout sessions for older (>40 year old) and younger (<=40 year old) participants. All focus group discussions were recorded with the consent of the participants, in addition, detailed notes were taken by the focus group facilitators. Focus groups were completed in June 2017.

The focus group discussion guide was developed through a review of the literature, then contextualized and reviewed together with local collaborators before the data collection. Given that the objective of the study was to identify and better understand interactions between perceived risks and stressors (specifically climatic and non-climatic) and how they affect local vulnerabilities, questions in both the focus group and free list interview guide were intentionally worded broadly to avoid prompting for specific responses. Additionally, to ensure that the

questions were universally understood, vulnerability was framed as an impact to community “Buen Vivir” or well-being, while stressors and risk were framed as problems, worries, or threats to well-being.

In the focus groups, we used two participatory activities to gather information on experienced and perceived problems within the community. The first activity was a map drawing session where the younger group was asked to draw the community as it looks like today and the older group was asked to draw the community 20 or more years ago. The goal of this activity was to encourage participants to visualize their community and to think about latent risks or problems that impact local well-being. The second activity was a vulnerability matrix exercise where community members (once again divided into two age groups) were asked to identify and rank problems and resources within the community that affect their well-being. Each group was given a set of blank index cards and was asked to write down first, all the problems in the community, then all community resources, and then rank each problem or resource identified as high, medium, or low importance. As with the free listing activity, if climate change was not mentioned, the respondents were then prompted to also identify climate-related problems that affect their well-being.

### *c. Data Analysis*

#### Survey Data

Survey data was tabulated and summary statistics (mean and standard deviation of continuous, normally-distributed variables, percentages of binary and continuous variables) were calculated. Chi-squared tests and ANOVA were used to compare differences in the proportion of key variables (respondent age, respondent sex, percentage of households that had experienced flood damages in the past year) between communities. [\*Mention % of male vs female surveyed]

### Free Listing Data

Data from free list prompts were tabulated, cleaned (replicates were recoded into broader category), and translated. The data was analyzed for salience and community network structure to give a broader picture of community trends. To calculate item salience, responses that were generated after promptING for information related to weather were excluded, and the Smith Salience Statistic, which accounts for the frequency that an item is mentioned across all lists and the order in which the item is mentioned in lists, was calculated (Smith, 1993).

Free listing responses were then analyzed for community network structure using a Stochastic Block Model to find hierarchical groups or blocks that best represent the network of problems listed by participants (Hric, Kaski, & Kivelä, 2017), and simultaneously, groups or blocks that best classified study participants according to their responses. A community detection, non-degree corrected algorithm was applied directly to the bipartite network linking respondents to the items they mention generating a graphic network. Salience analysis was completed using the ‘AnthroStat’ package in R version 3.4.1, and community network structure analysis was conducted in Python.

### Qualitative coding

All recordings except two were transcribed by a local collaborator in Quito. The transcripts were analyzed with NVivo, a qualitative data analysis computer software intended for researchers who need to organize and analyze large amounts of qualitative data. A codebook was developed based on the original research questions for this study and was subject to iterative improvement throughout the coding process (see Appendix 1). The data was also coded for emergent themes of relevance to the research questions. Both the interview data and the field notes were coded and analyzed through content analysis for recurrent themes. Queries were run to identify salient and

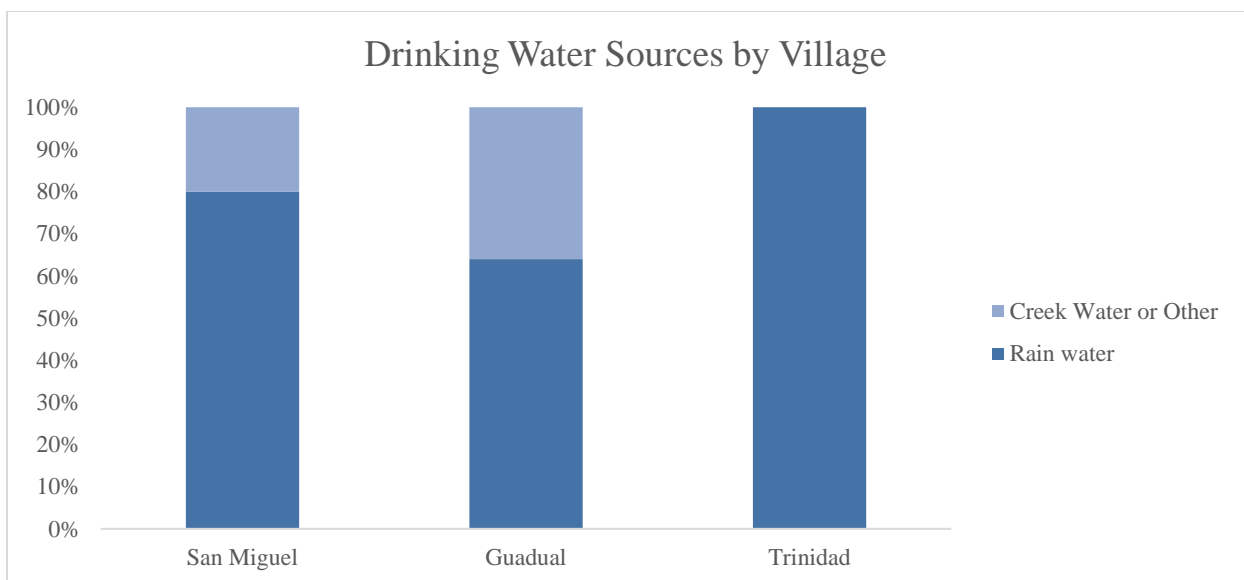
representative quotes on broad themes, as well as to identify stressor interaction through node overlap.

## 6. Results

### a. Survey Responses

San Miguel and Trinidad are predominantly Afro-Ecuadorian communities, while Guadual is a predominantly indigenous community of Chachi nationality. There are 23 – 44 households in each village and each has access to intermittent electric services, a communal telephone line, and rudimentary sanitation through latrines. All three communities have an elementary school; however, students wanting to complete high school must travel by boat to another community. Piped water is not available in any of the communities (see figure 3) and there are no trash management services available. Access to medical services is limited, as community members must travel to a different town to get to a clinic. Additionally, none of the villages are connected by a road and are only accessible via the river.

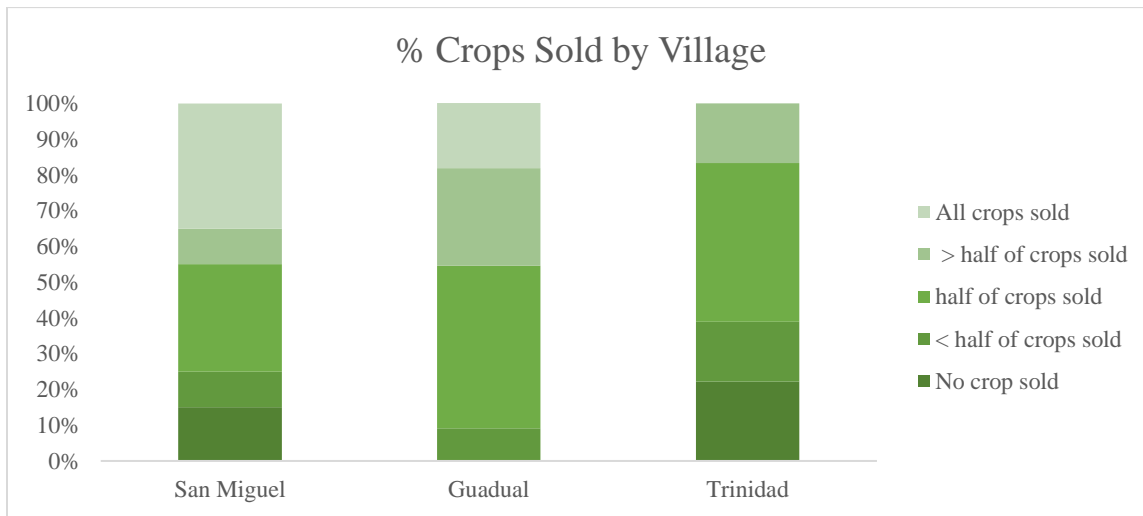
**Figure 3.** Distribution of drinking water sources by village



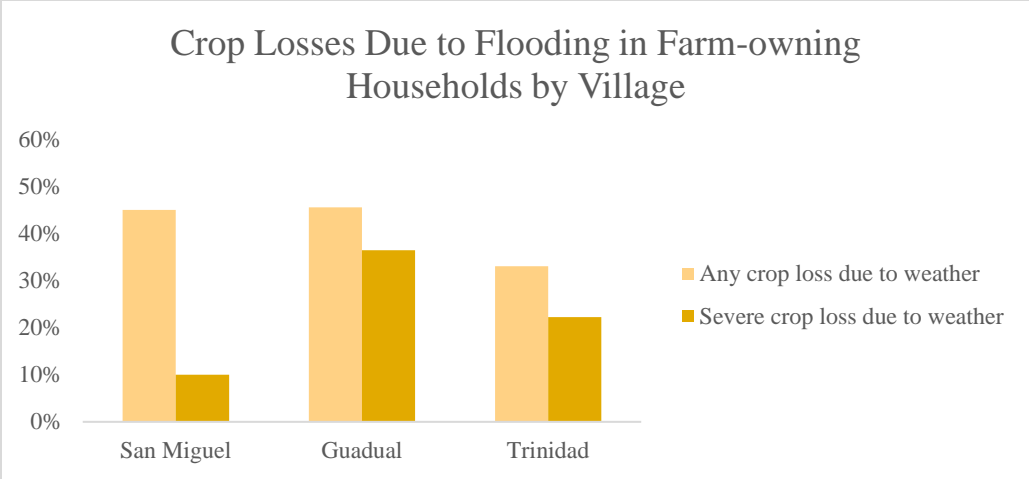


Local economic activities are mainly small-scale agriculture for subsistence and cash as well as small business entrepreneurship. Residents in all three communities rely on a combination of subsistence farming and small-scale commodity crop production for personal consumption as well as income. However, the amount of crops (e.g. all of production versus half of production) sold varied by household (see Figure 4). 52.0% of respondents in San Miguel, 77.3% in Trinidad, and 84.0% in Guadual reported receiving income from agriculture, and the differences between communities is significant for  $p < 0.05$ . Additionally, 16.0% of respondents in San Miguel, 0.0% in Trinidad, and 4.0% in Guadual reported income generated from small businesses. The government stipend is also an important source of income, where 60.0% of respondents in San Miguel, 69.2% in Trinidad, and 72.0% in Guadual reported receiving it. When asked about flood impacts on crops, more respondents from Guadual reported severe crop loss (see Figure 5).

**Figure 4.** Percentage of crops sold by village

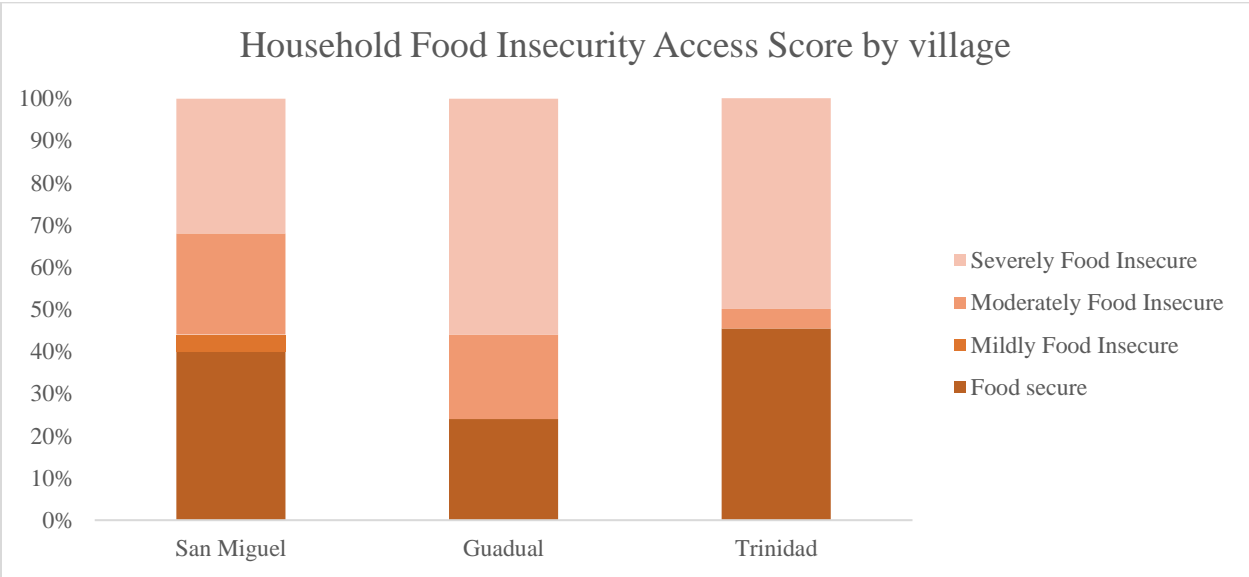


**Figure 5.** Crop losses reported from farming by village



Lastly, Household food insecurity, measured through the Household Food Insecurity Access Score (HFIAS), varied among communities, with greater severe food insecurity in Guadual followed by Trinidad (see Figure 6). However, it is important to note that in Trinidad, households tend to be either food secure or severely insecure (very few household are reported as moderately or mildly food insecure).

**Figure 6.** Household food insecurity access score by village



*b. Freelisting Responses*

Using the ‘Smith’s Salience’ statistic (S) as a measure of importance in the free-listing exercise, results indicate that flooding was the most important problem across all three communities (S = 0.25), followed by potable water (S = 0.23), contamination (S = 0.14), latrines (S = 0.13), and energy (S = 0.10). However, when disaggregated into different groups, priorities shift and differences between groups emerge; problems were analyzed by community, gender, age group, and wealth (measure by assets owned).

### Salience by community

Table 1 displays the top five problems listed in each community in order of salience. Floods were listed as the problem with the greatest salience value in Guadual, but in San Miguel and Trinidad the lack of potable water was the most salient problem. Contamination was of similar importance to individuals in Guadual and Trinidad, while floods were of similar importance to individuals in Guadual and San Miguel. However, results indicate that priorities vary greatly across towns. Figures 7-10 display some of the top problems mentioned in the free listing exercise overall and the importance attributed to each by community. The greatest differences (more than twice the lowest S) in salience across communities are with potable water, contamination, latrines, and water system (see Figure 7).

**Table 1.** Problem Salience by Community

<b>Guadual</b>		<b>San Miguel</b>		<b>Trinidad</b>	
<b>Problems</b>	<b>Smith’s Salience</b>	<b>Problems</b>	<b>Smith’s Salience</b>	<b>Problems</b>	<b>Smith’s Salience</b>
Floods	0.29	Potable Water	0.32	Potable water	0.31
Latrines	0.26	Floods	0.30	Water system	0.30
Contamination	0.21	Energy	0.13	Contamination	0.24
Trash	0.18	Rains	0.10	Transportation	0.16
Violence	0.10	Medical Services	0.10	Energy	0.15

### Saliency by gender

Table 2 displays the top five problems listed in by women and men in order of saliency. The lack of potable water was the most salient problem for women, while floods were most important for the men. Both groups shared similar concerns, but prioritized them differently; for instance, the women placed more importance (3 times more) on potable water than the men did. Additionally, problems related to household needs (potable water and energy) were more salient for the women, while problems related to infrastructure (latrines and trash) were more salient for the men. The greatest difference (more than twice the lowest S) in saliency across gendered groups is in potable water, while both groups consider floods, livelihoods and transportation to be of similar importance (see Figure 8).

**Table 2.** Problem Saliency by Gender

Female		Male	
Problems	Smith's Saliency	Problems	Smith's Saliency
Potable water	0.32	Floods	0.27
Floods	0.23	Latrines*	0.21
Energy	0.16	Contamination	0.17
Water system	0.12	Trash	0.11
Contamination	0.12	Potable water	0.10

### Saliency by age group (40 years or younger/older than 40)

Table 3 displays the top five problems listed by both age groups in order of saliency. Flooding was the most salient problem for both groups, but the older group placed slightly more importance in flooding than the younger group. Findings indicate that there are greater similarities between age groups than differences. Figure 9 indicates that between age groups there are no marked differences (greater than two times the lowest S) in saliency for a particular problem.

**Table 3.** Problem Salience by Age

<b>&gt; 40 years</b>		<b>=/&lt; 40 years</b>	
<b>Problems</b>	<b>Smith's Salience</b>	<b>Problems</b>	<b>Smith's Salience</b>
Floods	0.21	Floods	0.27
Potable water	0.20	Potable water	0.25
Contamination	0.15	Energy	0.15
Water system	0.15	Latrines	0.14
Latrines	0.12	Contamination	0.13

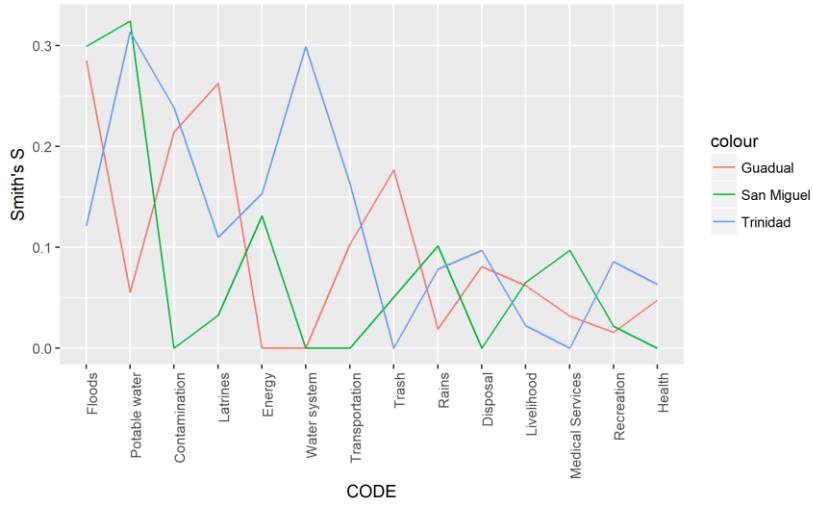
*Salience by assets (assets owned less than median, assets owned greater than median)*

Table 4 displays the top five problems listed by the group that owns less than half the median assets and the group that owns more than half in order of salience. Lack of transportation was the most salient problem for individuals with less assets and floods were of greater concerns to those with more assets. Results indicate that priorities vary across group, e.g. the lack of potable water was important to both, but it had a slightly higher S-value in the group with greater assets. Figure 10 indicates that between groups there are marked differences (greater than two times the lowest S) in saliency with problems related to transportation.

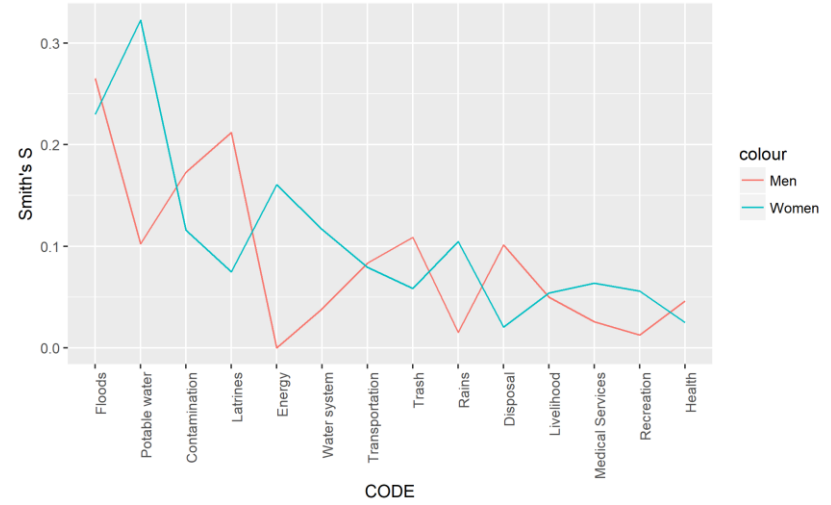
**Table 4.** Problem Salience by Assets Owned

<b>&gt; median</b>		<b>=/&lt; median</b>	
<b>Problems</b>	<b>Smith's Salience</b>	<b>Problems</b>	<b>Smith's Salience</b>
Transportation	0.21	Floods	0.29
Potable water	0.18	Potable water	0.26
Floods	0.17	Contamination	0.19
Water system	0.15	Latrines	0.16
Rains	0.13	Trash	0.11

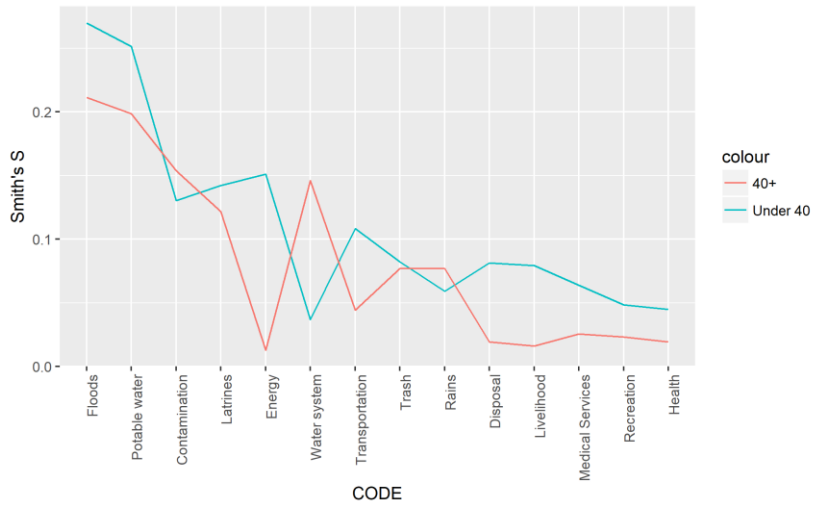
**Figure 7: Saliency by Community**



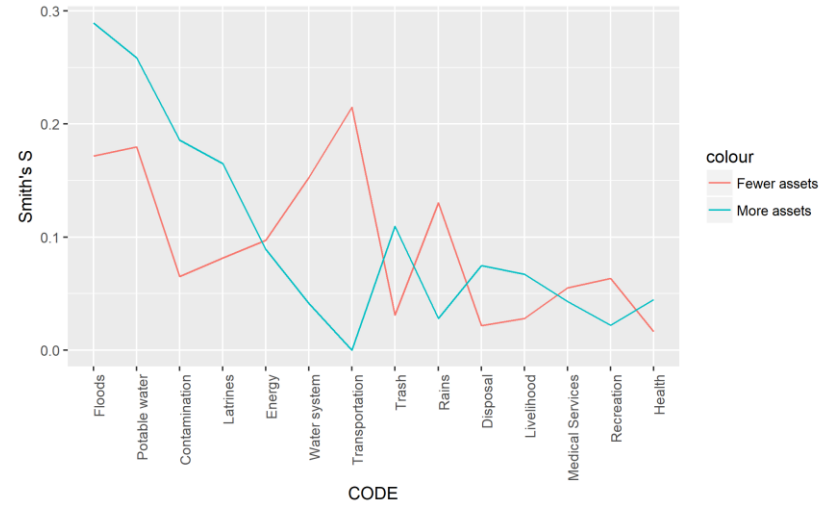
**Figure 8: Saliency by Gender**



**Figure 9: Saliency by Age**



**Figure 10: Saliency by Assets Owned**



### Community Network Structure:

Results from the network analysis are displayed in Figure V, where: node size corresponds to the degree, or the number of times the node appears in the edge list; colors indicate categories; and the light blue squares and arrows illustrate hierarchical relationships among the partitions. Respondents were divided into two groups (red and pale blue nodes), a larger group (1) comprised of 47 individuals mostly from San Miguel and Guadual, and a smaller group (2) of 17 individuals almost all from Guadual or Trinidad. The problems listed by respondents were clustered into four groups, shown as yellow (flooding), lilac (loosely related to infrastructure), light pink (loosely related to environment and sanitation), and orange nodes (loosely related to social issues).

Responses from group two are clustered primarily in the lilac and light pink nodes, while responses from group two are clustered primarily in the yellow, lilac, and orange nodes. Note that the problem “floods” was placed into its own group and is linked mainly to respondents from group 1, while the “environmental/sanitation” node cluster is populated mainly by responses from group 2. Concerns about the problems clustered in the lilac node are shared by respondents in both groups.

63.8% of respondents from group 1 reported flood-related losses (both agricultural and non) in the survey, while only 15.8% of respondents from group two reported this. Findings indicate that there are significant differences ( $p < 0.05$ ) between respondent groups 1 and 2 for the variables community and flood loss (agricultural and non). Thus, the network suggests that flooding was mentioned more in the free list by those who have experienced it more recently.





(both in sufficient quantity and quality) and clean water, as well as living in harmony and tranquility both within the familial unit and among neighbors. A “dignified” home is considered to have the following characteristics: it must be sturdy and well built, provide adequate and safe shelter from outside elements, and have all the appliances and furnishings, like a stove-top or toilet, necessary to live comfortably. Some respondents also expanded the term “dignified home” to “living with dignity”, incorporating other essential components to living well, ranging from access to clean, safe water to more immaterial needs such as friendship. However, it is important to note that most respondents talked about “living with dignity” as something unachievable because they lack basic necessities like potable water, that are precarious and often outside of individual or community control.

“Buen Vivir” was also defined as *“having ‘lushi’ [money]. And I don’t mean, having money just to have it, no. I have to have farms and I have to have crops, so that I can have money. If I have my farm, then I don’t have to worry more about my family, right?”* Having money was considered as important for having a good life, but only to the extent that having money enabled respondents to provide for and sustain a family. Another respondent described “Buen Vivir” as more of an emotional state where *“having respect for one another, living in unity, being understanding, and (living) in solidarity with one another”* was important for a good life. Solidarity was perceived by many community members as an important component to overall cohesion. Respondents indicated that if the community works as one and is organized, it can better fight for what it wants and needs. Organization was perceived as a way of providing a platform to voice community concerns at a political level and as an important component for community development. *“(Community organization) is a key element for (social) guarantees, right? That*

*they give us that on a social level, and then we should also have something on a political level (...) to have an impact” (San Miguel, Woman)*

### Change

When asked to talk about changes that they’ve witnessed in their communities, most respondents agreed about the benefits of material infrastructure improvements to their towns, such as: the construction of paved walkways, the recent availability of services like electricity, and improved homes and building construction with concrete and zinc. Respondents from all three towns identified community expansion and population growth as the greatest change to have occurred over the last 20 to 40 years (see community maps in Appendix 2). Community expansion was regarded as a positive change because it opened opportunities to residents previously inaccessible.

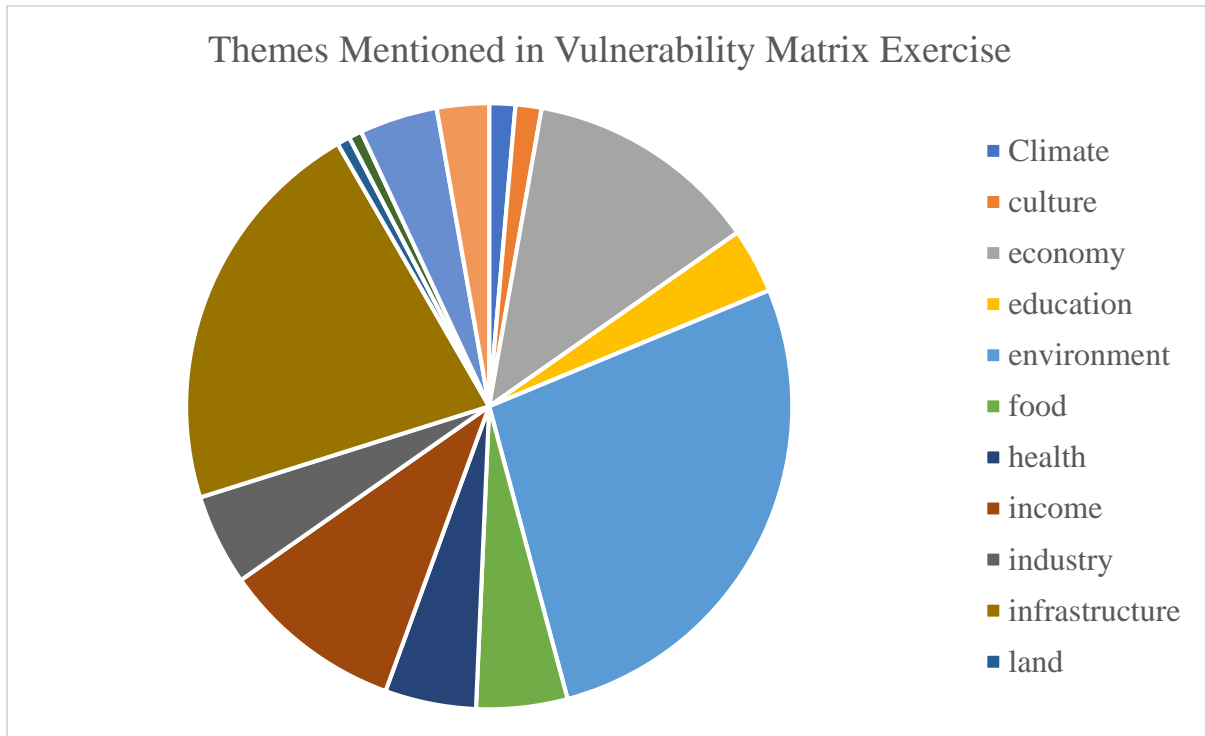
Furthermore, other observed changes ranged from seasonal shifts and greater rainfall to changes in water quality and river health to changes in economic activities. Respondents identified negative impacts to their surrounding environment and local ecosystems largely as a result of natural resource extraction and commodity agriculture. Most of the residents of the area have relied historically on their land and the river to maintain their way of life, yet many of the changes to land use and the local economy are shifting local traditions. The river is an especially important component of the local landscape, yet communities can no longer rely on it in its’ degraded state, adjusting historical patterns of adaptation in response. Furthermore, many of the changes described by communities go together with other issues that are problematic for residents.

### Factors that negatively impact “Buen Vivir”

In the vulnerability matrix exercise, negative impacts identified ranged from social conflicts, lack of higher education options, environmental degradation, changes in local economies, to even changes in seasons and increased flooding (see Figure 11). But of all the

problems listed, those that were prioritized the most are related to water quality and scarcity and food security.

**Figure 11.** Themes from the problems mentioned in the vulnerability matrix exercise



### Water Quality and Scarcity

Although the study communities described relied upon the Cayapas River for consumption and farming for years, clean, *safe* drinking water was now regarded as a scarce resource. Water taken from the river in past years was perceived as safe to consume, in fact one respondent considered that, “*you would drink the water, and you wouldn’t get sick, the water was good!*” (San Miguel, female, 2017). During Focus Group Discussions, individuals expressed hesitation about the quality of the river water, and most community members reported that drinking it will make you sick. Some respondents observed having stomach cramps and diarrhea after drinking the water, while others observed rashes and skin blemishes after bathing in the river. In spite of universal perception that the water from the Cayapas River is unfit for human consumption,

community members still reported drinking water from the river during the dry season or times of drought.

One of our respondents never imagined that the river would deteriorate so much, “*we helped ourselves to the water from the river believing that it would never leave us, that in the end, the number of problems we have now would never reach us*” (Trinidad, male; personal translation). This statement is striking because it captures the surprise and dismay of an individual whose life was largely dependent on the river, yet now must adjust to great changes in a short time. Throughout our discussions about change, community members identified a positive correlation between the decline in river water quality and extractive industries in the area. The women in Guadual recall how clean the water was before the arrival of the logging companies, but once operations began up-river, the river water became undrinkable. Individuals from all three communities agreed that both logging and mining operations are the river’s biggest polluters and are primarily responsible for the decline in water quality. To illustrate how badly industry is polluting the river, one man from Guadual talked about irresponsible mining practices he had witnessed, saying: “*they said that’s where they wash the gold, the pond had spilled already, and then the river (water) became turbid*” (Guadual, male; personal translation).

Community members also acknowledged their role in contributing to current pollution problems. The lack of waste management is considered the most significant source of pollution coming from communities. One woman from Trinidad indicated that, in the absence of waste disposal services, everything from sanitary pads and diapers to dead animals gets thrown in the river. Respondents also noted changes in consumption patterns that have led to changes in waste production, for instance, widespread use of disposable products and single-use plastic have created a new waste stream – one that isn’t as easily disposed of as organic products. Because individuals

and communities alike don't know what else to do with it, most end up throwing their discarded items into the river, ensuring that the current will move the waste downstream. In addition to solid waste, individuals must also find a way to dispose of their waste water. Some communities appear to have a more established sanitary system, but individuals from all three communities noted a need to build latrines in households up and down the river.

Respondents also identified other sources of pollution coming from excessive pesticide use, fuel leaks, and motor boat traffic on the river. In fact, of concern is the use of agrochemicals as an alternative way to catch fish – fishers will throw the chemicals in the water to kill the fish, then skim off those that died. When asked how the chemicals are used to fish with, one respondent described it as:

*“the veterinarians themselves sell the chemical so that the Chachi can throw it into the estuaries – it kills the... if, if, we don't have fish it's because it (pesticide) kills even the eggs (seeds), so then we don't catch the shrimp. Before they would say that you could find the shrimp at the head of the river, but not anymore, there is no more fish because it kills everything, even the seed”* (San Miguel, woman; personal translation).

This practice has many residents disturbed, not only because of its' impact on water quality, but also because of its' toxic effects on human health.

However, most prevalent throughout discussions is the overwhelming amount of concern from community members about a water source that for them had always been accessible. Utility aside, the river plays an important role in community identity and thus to residents, degradation of their river is more than just a loss of resources – but a very important part of their culture and way of life. For some, the situation is bleak: *“we never, I don't know if I feel that I can ever live well.*

*From now on, I think that my life will get worse, because I go through the communities, and that is what I see, there are no more fish, there are no more shrimp, and I don't know how we will recover from this – it's very difficult”* (San Miguel, woman; personal translation).

Changes in water quality have resulted in more than the elimination of water for human consumption; it has prompted the depletion of fish and shrimp stocks (staple foods for many residents) as well as cultural shifts dictating interactions between people and the river. Some blame the gold mines for the depletion of fish stocks, *“look, the worst that we have now, is from when the heavy machinery was brought in (for) the gold mines. (Since then), you don't get any fish from the river, you don't catch anything now because the water is contaminated”* (Trinidad, male, 2017; personal translation). As a result, traditional fishing practices, such as hook and line fishing and submerged basket traps, are no longer as successful or efficient. In response, non-conventional fishing practices including the use of dynamite in sections of the river, as well as the application of specific agrochemicals to small estuaries and pools that form at the river's edge, have resurged in some villages. These practices in turn, aggravate the pollution of the river, while also considerably impacting both ecosystem and human health. As community responses indicate, human-nature relationships are changing, and individuals are finding different uses of the river within this shifting landscape.

### Food Security

Many community members live in conditions of food insecurity stemming from a variety of factors. Loss of traditional foods, like fish, shrimp, and bush meat caused by overhunting and contamination contribute to food insecurity. Traditional diets are based on a few staple foods that are locally found, including: river fish, shrimp, bush meat, plantain, yuca, and coconut, among

others. However, traditional food sources are declining, and respondents attribute this mostly to contamination. On the loss of bushmeat, one respondent mentioned that *“[the animals] have completely gone far away, and I (think) in part it’s the contamination from the buzz saw, and also in part from the poison we use to fumigate the forests”* (San Miguel, woman). Others link declining fish and shrimp populations to the river pollution problems. Traditional fishing methods with baskets, line and hook, and nets, are no longer as effective as they used to be because fish are scarcer: *“everyone grabbed fish with a wire, with baskets and fish hooks, and now, nothing – not even the nets trap any. Nothing, nothing comes”* (Trinidad, Man). In addition, individuals are concerned that those who eat fish caught with pesticides are harming their health by eating “poison”; one respondent framed it as ignorance: *“they don’t understand, they think that the only way they can feed themselves is to throw poison in the estuary and collect the fish”*.

The loss of traditional foods is also attributed to the health of the remaining river fish populations, as community members perceive unhealthy fish to be “contaminated” (meaning fish with unusual growths) and not for consumption. Community members have observed lumps and growths on the fish: *“and right there (in the river) the fish is contaminated, and now, the fish come covered in small balls (growths), small, white balls”* (Guadual, man). Losses in traditional food sources means that individuals must buy their food more frequently than in the past and their diets are changing as a result.

However, changing economies also limit access to nutrition. Communities in the region have always struck a balance between cash and subsistence economies, but respondents indicate that they rely more on cash crops, like cacao, for income which has resulted in land use changes. One respondent described the moment he realized that his family’s ancestral lands had been planted with cacao:

*“people used to say that cacao damaged the earth, that if you planted cacao, the green plantain trees wouldn’t produce anything (...) They planted everything (else) because cacao killed the plantains. So when I came (later) and I went to our field and I saw that cacao had been planted, tears came to my eyes, I cried.”* (San Miguel, Men)

Because other traditional food sources are limited, participants say they are forced to buy more food than before. Yet, ability to buy food also depends upon how much individuals can earn, either from employment or their crops.

Of great concern for most community members was the question of how to feed themselves. Purchasing food requires an income or source of money, that many respondents said they didn’t have: *“if it (income) doesn’t come, we can’t eat anything, it’s a little difficult here”* (Guadual, woman). Community members report that they rely on income from their crops, primarily cacao, because paid jobs in the region are scarce. Respondents were concerned that if they didn’t produce enough cacao, they wouldn’t have the money they needed to buy food. Community members grow other produce (like yuca, cane, and plantain), but demand and prices are so low, they worry that it would not be worth the time or investment to even try to sell.

Additionally, many respondents indicated that in Borbón, the closet town where they can sell their products, there is a lack of market demand for cacao and intermediary buyers ask for very low prices. *“We plant chocolate and when it’s (time) for the harvest, they pay us 25 cents per pound of chocolate, and I think there is a lack of market because we can’t take out the product if we can’t sell it”* (Trinidad, man). Many respondents indicated that prices are so low, they don’t cover production costs. Yet, access to larger buyers in Esmeraldas is limited by road access. Some community members indicated that the government had been advocating for increased cacao production in the region but didn’t provide the assistance farmers needed. Referring to government



policy, one respondent mentioned that they believe that growing cacao will help ease financial difficulties, but only if the government fixes cacao prices at a fair rate. However, because cacao prices are low and fluctuate frequently, this process becomes a burden to individuals that are trying to provide for and feed their families.

Related to access to food, concern over child health was discussed more among the women. Some women say that they worry about money because, if they can't buy food, their kids go hungry. Respondents indicated that sometimes they must choose what to pay for, for example, if they pay for gasoline so that their child can go to school, they won't have money to send with the kids to buy snacks or lunch. Others said that their children sometimes go to school sick and hungry because they can't afford medicine or food. Many of the women indicated that their household income was supplemented with a government bonus that helped greatly in times of need, but even that was sometimes not enough to adequately meet family needs.

In addition to the lack of food, respondents also discussed changes in diet and eating habits. Loss of traditional knowledge regarding plant lore means that individuals don't grow as much of their own herbs like their ancestors used to. Many indicated that they now buy more ingredients like condiments or seasonings, than they used to before, which has led to changes in how people they prepare their food. Individuals mentioned repeatedly that the food they eat now isn't "natural" like how their ancestors ate. Some of the respondents perceive that modern or pre-prepared food is full of chemicals and preservatives.

## ***7. Discussion & Conclusion***

Revisiting our goal to document and conceptualize vulnerability from the community perspective, our findings suggest that factors such as unfulfilled fundamental necessities, economic instability, and changes in the local ecosystem through environmental degradation are perceived as greater threats to overall community "Buen Vivir" than climate-related factors. Central to our

approach was framing “Buen Vivir” as a proxy to vulnerability to ground the study within the national context and make it more relevant to the participants. We had respondents set their own definition for “Buen Vivir”, to avoid imposing our own perspectives and biases into the analysis, and let people create their own narrative relative to their values and needs. Overall, participants agreed on a few key elements that they need to have “Buen Vivir”, including: the fulfillment of basic fundamental necessities, sharing a common culture and values to maintain traditional ways of life, and living in harmony with the environment. However, given the development processes playing out through the region, a stable state of “Buen Vivir” seems to be precarious and often outside of individual or community control.

Respondents indicated that to live well they needed a dignified home equipped with basic facilities, access to food (both in sufficient quantity and quality) and clean water, as well as living in harmony and tranquility both within the familial unit and among neighbors. Yet, as previously discussed, fulfillment of these needs is limited or hindered by other factors like the practices of extractive industries that contaminate the local environment, or reliance on a specific crop for income. Perceptions of contamination are corroborated by studies done by local researchers on extractive industries in the area and their impact on local environments (see: CID PUCESE-PRAS, 2012; Hazlewood, 2012; Rebolledo Monsalve, 2017). Community observations and concerns about the health and degradation of local ecosystems related to water quality and fish health match findings from a broader study conducting environmental impact assessments of mining practices in nearby rivers (CID PUCESE-PRAS, 2012).

Contamination from extractive industries was perceived as the main reason behind dying fish populations and diminished water quality, which in turn has a significant impact on basic survival needs. To fulfill these basic needs, residents turn more frequently to alternative coping

strategies like buy food or using non-conventional fishing or hunting techniques, yet this also endangers traditional lifestyles and human-environment dynamics. Recent changes have disrupted the fragile equilibrium that residents had created to live well yet must now find new ways to achieve local “Buen Vivir”. As the landscape changes, residents also must adapt and adjust.

The development processes described here are not new and have been documented in many studies all over the world (for examples, see: Bates, 2005 or Raffles, 2002). As globalization weaves through the region through the construction of new roads, increased extraction from miners and loggers, and shifts to cash economies, traditions and culture will also shift. However, the advent of climate change has brought a new dimension to the discussion on development and how it will affect local well-being. Studies indicate increased precipitation and flooding in the coming years (greater than historical patterns that local residents have adapted to) and warn that this area is especially vulnerable to extreme weather events (Fernandez et al., 2015; Morán-Tejeda et al., 2016). Yet, vulnerability to climate change exists within a constellation of other stressors that interact with each other synergistically to create greater overall local vulnerability. Our findings suggest that while community members recognize climate, and climate related factors (e.g. increased flooding or seasonal changes) as stressors, they are of little consequence when compared to more basic, or immediate concerns (such as having enough food or having access to basic services). However, this is not to say that climate change is not important to community members, their livelihoods and food access *are* indirectly and directly impacted by it, but there other more urgent needs that take precedence.

## ***8. Conclusions***

Despite violent histories of forced labor, displacement, and extraction, residents found ways to adjust, live, and thrive under difficult circumstances (Whitten, 1986; Anton, 2015). Life

in Esmeraldas has always been challenging: poverty and illiteracy is high in the region, enteric diseases continue to affect local health, land tenure is precarious, heavy rains and floods happen every year, and the area is generally overlooked by politicians. Despite these challenges, residents came up with strategies to cope with and adapt to these circumstances. However, changes in local ecosystems, dietary patterns, and economies in more recent history are endangering traditional ways of life and making it difficult for residents to achieve “Buen Vivir”.

Existing vulnerabilities can make it difficult for people to adapt to a rapidly changing landscape. Concern about climate, and climate-related stressors, is outweighed by concern for other, more fundamental needs like potable water and adequate nutrition. Yet, climate change is a real threat to daily life in the region. Coping and adaptation mechanisms for survival are already shifting in response to changes, yet some responses also have the potential to further exacerbate vulnerabilities in the face of climate change. Thus, the question is how to address existing community needs without further creating or exacerbating vulnerability, while also strengthening adaptive capacities. The National Climate Adaptation Strategy and the Policy for “Buen Vivir” recognize that climate change needs to be addressed, yet specific strategies or actions aiming to reduce overall vulnerability in the study area are not mentioned or acknowledged; this indicates a disconnect between policy and demonstrated need. Policies directed at climate change adaptation need to take a holistic assessment approach that integrates analyses of climate and non-climate related stressors.

Limitations:

- During its application, the free listing activity was occasionally applied after respondents filled out the survey (which focused on flooding). Some of the responses, especially those related to weather or climate, may have primed the respondents to talk about flooding.

Also, part of the free listing method entailed prompting respondents that didn't mention or talk about climate and flooding to see if they could think of anything else climate-related.

- One of our field workers, a community promoter (from a neighboring community in the study area), who assisted the focus group discussions was given instructions to not participate in the discussions or provide new information to the respondents. However, line separating community member from outsider (and government employee) was blurred during the discussions. This individual frequently participated in the discussions, which in some cases may have primed participants to respond in a certain way or to focus on specific ideas.
- Due to constrained time and resources, the focus group discussion guide was not piloted before it was applied in the field. It was discussed and revised among team members, in consultation with local collaborators, but some aspects of the discussion guide would have benefited from a pilot run. For instance, the focus group discussions lasted up to four hours long which may have caused fatigue and influenced participants' answers towards the end activities.
- Two of the recordings from the FGD were missing from the final transcript and we had to rely on notes to supplement the information. Therefore, some of the information provided by respondents may have been missed.
- The survey and free listing activity was applied to one person in the household, but there were no specific instructions to ensure even participation of men and women. Thus, the results from Trinidad and San Miguel were more skewed towards women, while the results from Guadual were more skewed towards men because of deep-rooted gender dynamics.

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## 10. Appendices

### a. Appendix 1: Codebook



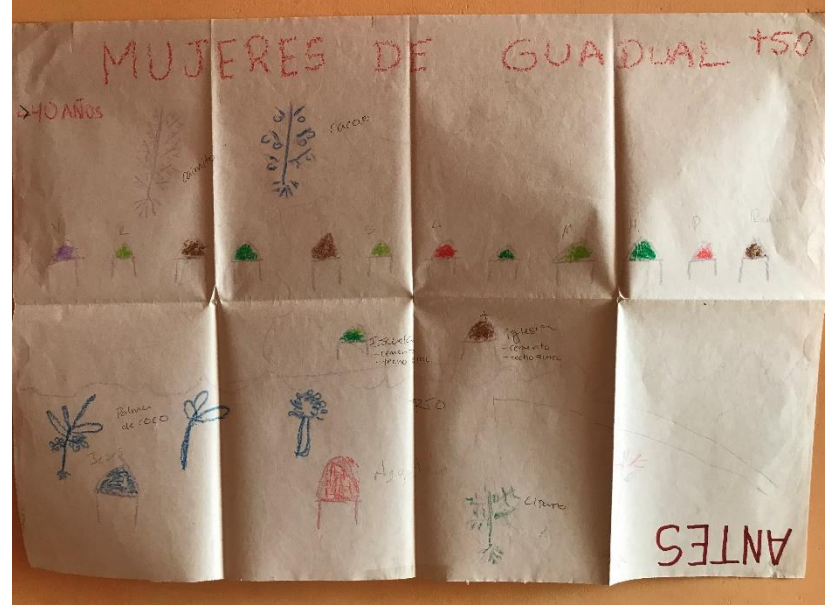
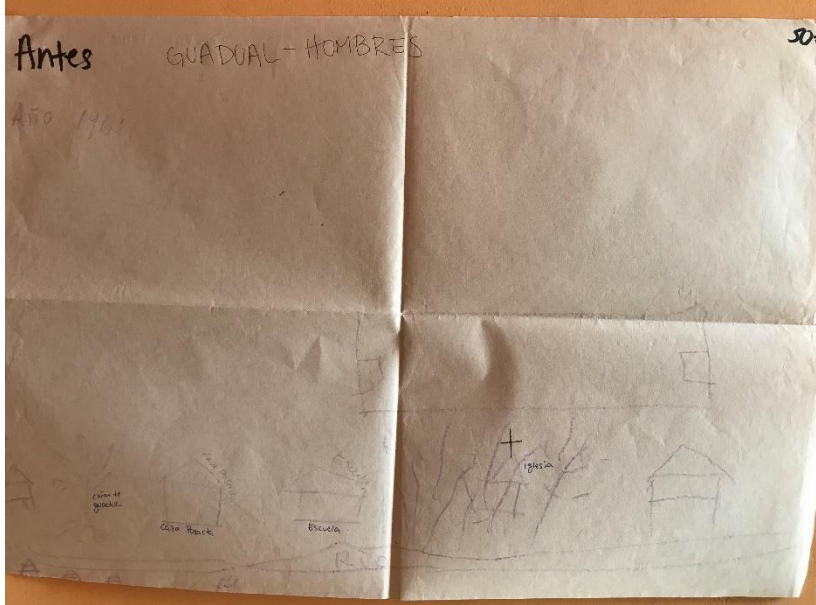
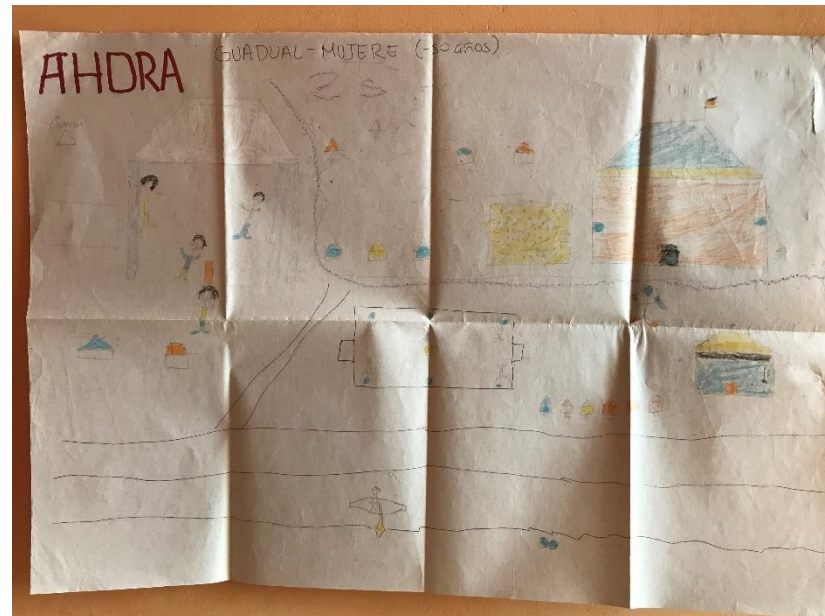
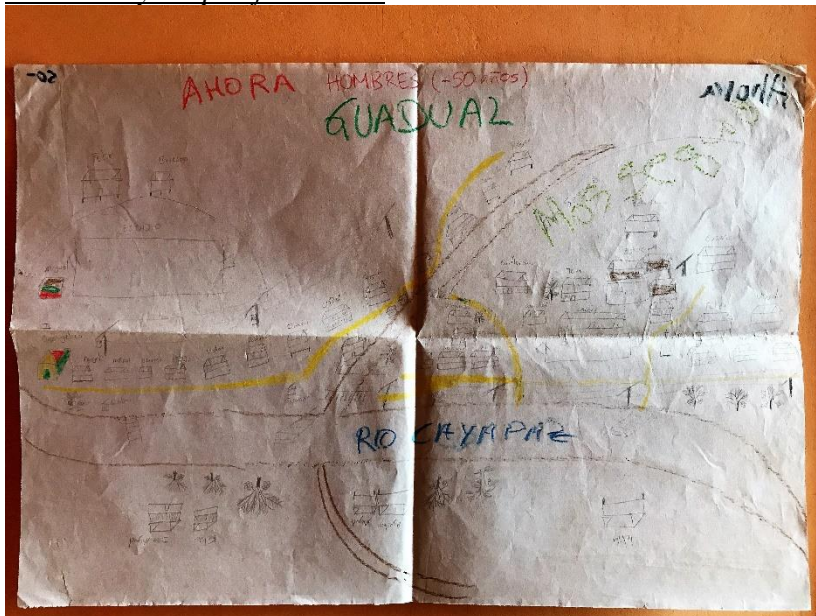
Name	Description
<b>Community characteristics</b>	Description of the community/environment where the respondents live and interact in (characteristics that the community currently possesses, NOT needs or desires)
cohesion	communal unity, relationships between community members,
gender	Anything that relates to gender relations in the community (e.g. some women state that they work harder than the men)
Infrastructure and services	structures present in the community, e.g. paved walkways, water filtration, etc.
organization	leadership, community organizations, community-led initiatives
sense of belonging	Strong sense of place, sentiments related to place/community
<b>Drivers</b>	pressures on the system
ecological	factors related to the local ecology (anthropomorphic or natural)
Climate	factors specifically related to climate and climate change
economic	Factors related to local economy...
Political	political factors (like government support) that are needed to cope with change
Social	social factors (like basic services) that are needed to cope with change (anything “social” not considered economic or political)
<b>Experiences</b>	lived and perceived experiences by community members
change	new events that occur; an event that disrupts the status quo
daily life	daily living conditions or events that people experience that aren't necessarily change
Impacts	the resulting effects felt by individuals
<b>Food</b>	anything food related

Name	Description
<b>Individual characteristics</b>	Description of the respondents (characteristics that individuals currently possess or something they already feel, NOT needs or desires)
Beliefs	Religious beliefs, personal beliefs about why something is the way that it is, opinions
education	Related to schooling, importance of, level of education attained, etc.
livelihood	employment, subsistence, way or earning an income
Personal satisfaction	mental health, anything related to satisfaction with current life situation (e.g. someone says they're happy living where they are)
personal security	Anything related to personal safety (includes health and well-being)
values	what the respondents value, e.g. respect to individuals and nature, concern about the environment, awareness, unity, solidarity, etc.
ecological awareness	Concern and appreciation of nature, awareness of the importance of natural resources, etc.
looking ahead	Future, anything related to concerns for future generations
Traditional knowledge	memory keepers, traditional ways of knowing, e.g. teachings or practices of brujos or curanderos, knowledge passed down through generations, etc.
<b>Land</b>	Anything related to land tenancy or land rights
<b>memorable quotes</b>	Representative quotes or quotes that are unique or particular
<b>Needs</b>	community needs or desires that are related to improving community quality of life
<b>Problems</b>	<b>THIS CODE IS ONLY USED TO VERIFY CONTENT CREATED DURING RISK IDENTIFICATION EXERCISE – NOT FOR ANALYTICAL USE</b> issues that take away from well being; worries or concerns;
<b>Resources</b>	Capital that can be contribute to community well-being, resist or deal with change, etc.

Name	Description
<b>Response</b>	responses to changes in the landscape
Proactive	Initiatives or response to potential (perceived) change or risk (anticipating risk)
Reactive	Initiatives or response to change or risk (reaction to existing risk/event that already happened)
<b>Risk</b>	the danger or hazard related to change; sense of security
external	Origin of the risk comes from outside of the community, e.g. mining companies dump their waste into the river pollutes the river.
Internal	origin of risk created within the community from practices or behaviors replicated, e.g. dumping household waste into the river pollutes the river

*b. Appendix 2: Community Maps*

Community Maps of Guadual



Community Maps of San Miguel:

