PROJECTED AND CONSTRUCTED SCARCITY:

CLIMATE CHANGE, GLACIAL LOSS, AND WATER AVAILABILITY

IN THE PERUVIAN ANDES

by

KATHERINE WILSON DUNBAR

(Under the Direction of J. PETER BROSIUS)

ABSTRACT

Climate change is currently a much debated topic across the globe, and this is no less the case in the Peruvian highlands, where it manifests largely as conflicts over water. Water resources for eastern Peru originate in the highlands from rainfall and seasonal glacial melt. Both of these sources are affected by increasing temperatures and other global climatic changes. The Cordillera Blanca, a segment of the Andes mountain range in north central Peru, is home to the largest contiguous area of tropical glaciation in the world, but its glacial peaks are rapidly receding and are in critical condition. The loss of glaciated peaks will cause dramatic changes in the amount of water in the hydrological cycle as seasonal runoff into river networks declines. Concurrently, rainfall, the region's other key water source, is becoming increasingly erratic and unpredictable in both frequency and intensity. Increasing water scarcity is projected to be the consequence of climatic changes in the arid highland landscapes of Peru.

Water scarcity is due to supply and demand changes in the hydrological cycle coupled with the consequences of human activities guided by the various valuations of water involved. In the Peruvian highlands, a critical obstacle for development has historically been and continues to be the irregular distribution of water. The difficulty with water distribution reflects physical and climatic circumstances (e.g., topographical complexity, glacial loss, and ENSO events) as well as political dimensions of conflicting valuations of water and tendencies toward privatization or centralized control that construct scarcity. The ability to respond effectively to water scarcity, whether projected or constructed, is complicated by the contradictions between agendas and actions that value water as an essential and profitable commodity. Though there are serious concerns about future decreases in river flow due to projected glacial loss, current water scarcity is more of an outcome of social and political dynamics, a constructed scarcity of increased diversions and demand for regional water supplies. This dissertation is organized around how the various scales of knowledge and political power interact through the highly engineered waterways of the Andes to aid or hinder responses to climate change.

INDEX WORDS: climate change, glacial loss, water availability, vulnerability, adaptive capacity, Peruvian Andes

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DEDICATION

This work is dedicated to my parents,

Nancy Wilson and Peter Dunbar,

who taught me how to do it for myself.

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INTRODUCTION

If climate change is indeed global, its consequences are profoundly local.

Julie Cruickshank

Introduction

Climate change is currently a much debated topic across the globe, and this is no less the case in the Peruvian highlands, where it manifests largely as conflicts over water. Water resources for most of Peru originate in the highlands from rainfall and seasonal glacial melt. Both of these sources are affected by increasing temperatures and other global climatic changes (Beniston 2003). The Cordillera Blanca, a segment of the Andes mountain range in north central Peru, is home to the largest contiguous area of tropical glaciation in the world, but its glacial peaks are rapidly receding and are in critical condition (Georges 2004, UGRH 2010).[1] The loss of glaciated peaks will cause dramatic changes in the amount of water in the hydrological cycle as seasonal runoff into river networks declines. Concurrently, rainfall, the region's other key water source, is becoming increasingly erratic and unpredictable in both frequency and intensity (Magrin et al. 2007). The combined effect of these hydrological changes is increasing water scarcity. Glacial loss and climate-induced modifications to the hydrological cycle have already caused increased water stress for over 60% of Peruvians (Vasquez 2004).

[1] *Tropical glaciers* refer to glaciers that have formed in tropical climates at an altitude where the temperature remains at or below freezing for most of the year. Due to their tropical locations these glaciers exist only at fractions of degrees above freezing.

For affected populations, the capacity to adapt to the projected consequences of climatic changes depends on many factors, chief among them environmental knowledge, awareness of change, and institutional structures that may aid or hinder adaptive responses. There is a significant degree of scientific knowledge on climate-related environmental changes in highland Peru and the projections of decreasing water availability for the region. However, depending on scientific knowledge alone to address climate change, with myriad consequences and affected populations, is insufficient for planning purposes. Data gaps and scientific uncertainties can be minimized to some extent by local observations of change, particularly in mountain regions like the Andes where many microclimates exist across the landscape due to the complex orography. Including local populations in the collection of knowledge will not only enrich the overall understanding of climatic consequences, but it will also help in overcoming historical prejudices and barriers between highland citizens and their government. These tensions perpetuate perspectives on the part of both highland communities and government agencies that hinder the flow of resources and knowledge.

Knowledge of climate change and the potential responses to its consequences reside in multiple scales. The particular scale at which glacial loss and other climatic changes are experienced play a role in how individuals, communities, regional development agencies, and larger governmental institutions address such changes. Fundamentally, my dissertation is organized around how the various objective and subjective scales of knowledge interact through the highly engineered waterways of the Andes to aid or hinder responses to climate change. Perspectives of change and potential responses are informed by various circulations of knowledge that reflect specific valuations and power relationships. Hydrological scales both create and are a function of knowledge employed by those social actors involved in water management. Political and social landscapes in which knowledge claims circulate determine the success, or even initiation of adaptation processes for individuals, social groups, and government initiatives.

I examine the sources and circulations of knowledge about the changing climate and how knowledge sources influence responses to ongoing environmental changes and projected climate consequences for the region within various social and geographical scales. Most Peruvians are highly knowledgeable about glacial change and subsequent fluctuations in water availability and flow. This knowledge comes from a wide range of sources. Information comes in part from the many scientific studies conducted in the region, which have become part of a global dialog on climate change. Research has also informed a national discourse on changing weather patterns based on serious El Niño events. There is high confidence in the physical evidence for climatic changes throughout the country; however, there is as yet little action with regards to national or regional governmental responses. Additionally, local populations possess knowledge about glacial changes and the consequences for water availability stemming from generations of close personal observations of the glaciers that frame their lives; however, changes to daily activities or community-wide priorities are few. None of these knowledge systems are static; they are constantly shifting, are produced and reproduced, sometimes erode, and are even lost completely (Cruikshank 2005, Ellen et al. 2005). All of them, however, are “situated” within the larger historical, political, and environmental scenarios in which they exist (Nazarea 1999: vii). This dissertation will consider how these situated contexts influence current water management considering the knowledge about projected environmental changes.

In order to explore the various knowledge systems and influences at play in the Cordillera Blanca, the following questions guided my fieldwork and subsequent analysis of environmental change in an Andean community:

1) How are climate changes perceived to affect water availability in the Cordillera Blanca?

2) In which scales are changing water availability actively negotiated?

3) What are the adaptive implications of these negotiated changes for the study community?

These questions are of importance both theoretically and programmatically given the significant environmental changes being experienced globally and the urgency with which entities are attempting to respond to the shifting needs of affected populations. Theoretically, this research shows how explorations of ecological knowledge must take into account the political and social contexts in which knowledge is accumulated, circulated, and acted upon. The various knowledge systems involved in observing or measuring climatic changes and the potential consequences for available water are influenced by the historical and contemporary contexts in which these systems operate. This is as true for those designing national water management legislation or adaptation initiatives as it is among communities responding to their changing environment. Each of these groups are operating based on the knowledge systems they value, but also on the ever-shifting political dynamics that influence the valuations associated with various elements of the knowledge systems on which they depend.

Programatically, capturing the perceptions and responses of a specific community to their changing environment and sharing this high level of local environmental knowledge with decision-makers could prove useful as adaptation planning initiatives commence throughout the study region. Currently, rural communities are largely left out of decision-making or planning regarding resource management. This is due in part to the perception of some government officials that these communities are unaware of changes or unwilling to cooperate with external agencies, a view informed by historical confrontations. Conversely, communities in the study region are weary of government officials and iniatives and so are hesitant to approach or embrace these entities as potential resources. From an applied perspective, this research makes transparent some of the cultural barriers on the part of both affected communities and government agencies tasked with adaptation planning. Acknowledging and understanding these barriers is a critical step toward the participatory planning and governance that will be necessary to successfully adapt to the consequences of ongoing environmental change. By exploring the knowledge of highland populations surrounding changes in water availability and the nested scales of governance in which the resource is managed, this dissertation provides an assessment of the adaptive capacity of a highland community to the consequences of climatic changes predicted for the Cordillera Blanca.

To provide the necessary context for this dissertation, I outline below an overview of the scientific basis for climate change, its consequences, and related terminology. This introduction concludes with a presentation of the research site and a description of how the research was carried out. Following the introduction, the subsequent chapters further outline the theoretical frameworks that shape this dissertation (Chapter 2), provide the historical context for the current Andean condition (Chapter 3), and present the contemporary land and water distribution systems within the study community (Chapter 4). The first research question on the connection between climate change and water availability is addressed across Chapter 4 and Chapter 5 through an exploration of community perceptions of environmental and social change. Chapter 6 presents the scalar negotiations of water management and how they influence local concerns for water availability. The third research question about the implications of adapation for the study community is addressed in Chapter 7 though an assessment of vulnerability and adaptive capacity alongside local perceptions of risk and concerns for the future of their livelihoods.

Climate Change: Mitigation, Adaptation, and Uncertainty

The increasing attention to global warming in the 1980s saw the establishment of an international body to address the science of climate change. The Intergovernmental Panel on Climate Change (IPCC), formed in 1988, is a collaboration between the World Meteorological Association and the United Nations Environment Programme whose mission is “to provide an authoritative international statement of scientific understanding of climate change” (IPCC 2007). This scientific understanding is not limited to the physical evidence of climatic change, but also aims to systematically explore the range of potential responses to climate change, identified by the IPCC as mitigation and adaptation. The IPCC defines mitigation as policy or action that reduces or stabilizes greenhouse gas emissions and defines adaptation as “the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC 2007: WGII). Early debates on responses to climate change dealt almost exclusively with mitigation. Those countries considered responsible for rising emissions continue to debate the need for and effectiveness of various mitigation efforts. However, debates on climate change in the past decade have also begun to explore the potential for adaptation of vulnerable countries and populations to the predicted effects of climatic changes (Adger et al. 2009). This turn toward an interest in adaptation is important because simultaneous to mitigating future emissions, countries like Peru who are already experiencing affects from climatic changes must also facilitate adaptation processes.

However, political will to mitigate or adapt to climate change is affected by perceptions of uncertainty. As such, uncertainty is fundamental to the physical and social dimensions of climate change research. Like the myriad causes of climate change, social and physical uncertainty surrounding climate change is also difficult to disentangle. The various forms of uncertainty shift from scientific uncertainty inherent in models to the social uncertainty of policy makers and individuals living in affected areas juggling multiple knowledge claims. Scientific uncertainties influence social uncertainties, and social uncertainty can influence the politics surrounding scientific research into climatic changes.

From a scientific standpoint, there are three major factors of uncertainty: the natural internal variability of the climate, the trajectories of greenhouse gas emissions, and the response of the global climate system to future emission scenarios (Cox and Stephenson 2007, Giorgi and Mearns 2010).[2] Models and forecasts designed to understand and project climatic changes carry a significant degree of uncertainty due to data gaps. Particularly for mountain regions, the General Circulation Models (GCMs) are simply not accurate due to the "steep environmental gradient where diverse climatic zones are compressed into single valleys, and hill-sides may span several thousand meters of altitude" (Brush 1976: 149, Price and Barry 1997, Beniston 2003). Beniston et al. state that:

> Precise understanding of the climatic characteristics of mountain regions is complicated on the one hand by a lack of observational data at the spatial and temporal resolution adequate for climate research in regions of complex topography, and on the other by the considerable difficulty in representing complex terrain in current general circulation climate models. (1997: 234)

[2] The IPCC study includes over 29,000 observational data sets from 75 studies that show changes in physical and biological systems; these changes are 89% consistent with the predicted direction of change (IPCC 2007:WGII).

While there have been improvements since this statement, mountain regions like the Andes with topographical extremes and a multitude of microclimates continue to complicate modeling (Keller et al. 2008). Trade-offs exist between course spatial scales of GCMs and the lack of temporal depth in the regional climate model (RCM) simulations, both necessary for the complex orographic detail in order to obtain accurate predictions (Beniston 2003). Predictions made on the basis of these models need to carefully discuss the known scalar limitations of data.

Though the lack of data and insufficient observational equipment undermines the reliability of forecasts and consequently their value in the eyes of the public (Broad 2000, Nelson and Finan 2000, Roncoli et at. 2002, Roncoli 2006, Magrin et al. 2007), Dessai et al. (2009) argue that this scientific uncertainty need not limit societal responses. Adaptation plans could and should be explored without waiting for precise predictions of climatic changes and their consequences. While a great deal of uncertainty exists, Adger et al. (2009) claim that predictability surrounding the climate system is higher than it is for other elements of adaptation (e.g., economics, technology, demography). However, social uncertainty is not only a response to data gaps, it stems from several factors. For individuals, uncertainty can be triggered by environmental changes surpassing individual and social knowledge of a once-familiar environment, not knowing how to react to observed changes, or a disbelief in the claims about climate change altogether. For decision-makers, the range of unknown variables and possible effects of change often causes extreme uncertainty on which actions to pursue, the magnitude of which can sometimes lead to inertia.

The large continuum of prominence and legitimacy of the multiple knowledge claims about climatic changes exacerbates social uncertainty (e.g., Lahsen 2008, Smithson 2007, Procter and Schiebinger 2008, Goddard and Dilley 2010). Broad and Orlove (2007) show that scientific predictions and discussions related to climate change in Peru are often handpicked to serve certain political interests to the point that local residents or vulnerable populations distrust the authority of information. Further, the communication of predicted changes and their potential effects is sporadic, which exacerbates existing issues of distrust or fear.[3] Before further exploring the political and social landscape in which knowledge claims are circulated, I discuss below the state of scientific consensus on climate change and its consequences for the Peruvian Andes.

Scientific Evidence for Climate Change

Climate change is defined by the IPCC as:

> A change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. (IPCC 2007, Synthesis Report: 30)

Beyond the evidence aggregated in the IPCC reports, many scholars have independently supported the scientific consensus of climate change (e.g., Oreskes 2004, Doran and Zimmerman 2009, Anderegg et al. 2010). Below I discuss the major natural and anthropogenic climate change causes.

Natural Forces[4]

The major natural forces controlling the variability and fluctuation of Earth's climate are solar radiation, tectonic activity, volcanic activity, continental drift and the tilt of the earth (Dessler and Parson 2006). When discussing the natural forces of climate change, the IPCC only cites

[3] For example, in the Callejón de Huaylas, many of the devastating avalanches and outburst floods that have occurred in the valley were predicted by various agencies. However, due to complex social and political variables, messages of warning and calls for evacuation were ignored, leading to severe casualties (Carey 2010, Mark 2008).
[4] The IPCC uses the terms *forces* and *forcing* to refer to variables that influence climate variation and change, either natural or anthropogenic.

solar irradiance as a significant natural factor in warming. The other forces mentioned above contribute negligibly to warming or, in the case of volcanic activity, provide an overall cooling effect. The influence of shifts in solar radiation on the Earth's atmosphere and temperature is a popular subject within climate change studies. Though few scientists claim that warming trends can be attributed solely to shifts in solar radiation, solar radiance studies dating back to the 1920s including reconstructions dating back to the 1600s cannot conclude that solar radiance alone has forced atmospheric changes in temperature (e.g., Lean et al. 1995, Cubasch et al. 1997, Frohlich and Lean 1998, Waple 1999).

Of the radiation reaching the Earth, 30% is reflected back into space by the atmosphere and by the Earth's surface (Karl and Trenberth 2003, Dow and Downing 2006). Radiation that reaches the Earth is converted from shortwave radiation to heat energy, or longwave radiation, which warms the Earth's surface. This heat energy is highest at the equator, where the sun is directly overhead nearly year-round, and is lowest at the poles due to the Earth's tilt. Aatmospheric and oceanic circulation systems move this heat energy from the equator toward the poles. This movement of heat energy across the Earth creates regional climates which is why significant disruptions or differences in temperature trigger changing climatic conditions across the globe.

Ocean circulation, also known as teleconnection, is an important mechanism for the distribution of solar energy and the connection of weather phenomena in different parts of the world. Ocean currents are driven by factors such as wind, tides, salinity and temperature gradients. The coupled ocean-atmosphere system is a feedback mechanism responsible for weather regimes (Bjerknes 1969, Namias 1969). These weather regimes are influenced by changes in sea surface temperature, precipitation, and atmospheric circulation (Diaz et al 2001).

One of the more globally important currents—and of particular importance to the climate variability in the Peruvian Andes—is the El Niño-Southern Oscillation (ENSO). Typically ENSO behavior operates on a decadal regime; however, shifts in this behavior have been correlated with rising sea surface temperatures that are a result of global warming (Allan 2000, Mann et al. 2000). El Niño is a warm phase of the ENSO cycle that occurs about every ten years in the austral summer, bringing about warmer sea and air temperatures as well as increases in precipitation along the Peruvian coast. Precipitation in the highlands during El Niño diminishes, causing problems for farmers, since the austral summer is when the majority of annual precipitation falls. La Niña is the cold phase of ENSO and has the opposite effects.

Anthropogenic Forcing

These natural causes and mechanisms of climate variability are aggravated by anthropogenic actions resulting in the emission of green house gasses (GHGs), known as the greenhouse effect, specifically four long-lived GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and halocarbons (groups of gases including fluorine, chlorine or bromine). Global CO_2 and CH_4 concentrations are cited in IPCC 2007 as exceeding the natural range from the last 650,000 years, with growth of 70% since 1970 (IPCC 2007: WGIII). By far the most significant GHG is CO_2, whose increases are due largely to fossil fuel use, although land-use changes also contribute. Methane increases are also due to fossil fuel use as well as agricultural practices (IPCC 2007: WGI). Aerosol use contributes to increased scatter and absorption of radiation through its effect on cloud formation (Spracklen et al. 2008, Koehler et al. 2010). Aerosols are also implicated in the decrease of ozone; however, there is a large degree of uncertainty surrounding ozone change due to the altitude-specific complexity of GHG and aerosol effects on ozone layers (Shine 2000).

It is difficult to disentangle natural and human-related forces, as they both create many complex feedback loops. Increasing concentrations of GHGs and aerosols alter their absorption and change the patterns of global absorption of solar radiation within the atmosphere, altering the overall balance of incoming and outgoing energy. The increase in GHG concentrations combined with the natural factors influencing radiative forcing described above are the major drivers of climate change, raising the global-average annual-mean surface-air temperature, or simply, global temperature (Dow and Downing 2006, IPCC 2007: Summary). The measurements of radiative forcing relative to preindustrial conditions have shown widespread warming of the atmosphere and ocean.[5] These data, along with significant loss of ice cover, led the IPCC to conclude that it is *very likely* these changes are not due solely to natural forces. The pattern of warming in the troposphere and cooling in the stratosphere is *very likely* a combination of GHG increases and stratospheric ozone depletion (IPCC 2007: WGI). Only models that have included anthropogenic forcing (e.g., GHGs and land cover change) have reproduced the warming trends to date; no models using only natural forcing (e.g., solar radiation and volcanic inputs) have been able to predict the warming patterns observed over the 20th century (IPCC 2007: WGI).

Given the current policies and practices related to climate change mitigation and sustainable development, there is *high agreement* and *much evidence* that GHG emissions will increase over the next decades (IPCC 2007: WGIII). Sustained emissions will result in continued warming and provoke additional changes in the global climate systems that are *very likely* to be larger than those observed to date (IPCC 2007: WGI). Even if GHG concentrations were

[5] Distinguishing between preindustrial and industrial conditions is accepted by IPCC scientists and modelers as occurring in the year 1750.

stabilized at today's levels, consequences of previous emissions would continue forcing change for centuries given the time scales associated with the climate system and feedback mechanisms (IPCC 2007: WGI).

Consequences of Climate Change: Glacial Loss and Water Availability

Together these natural and anthropogenic causes are responsible for global temperature rises and shifts in the ozone. Globally, it is now *very likely* to have fewer cold days and nights, more hot days and nights, with more frequent extreme events such as heat waves and frosts. These trends have consequences for weather pattern disruptions, glacial loss, the frequency of major storms, droughts and floods. Resulting changes in precipitation patterns and glacial loss are predicted to critically effect water systems across the globe, affecting water availability for domestic uses, agriculture, and energy generation (IPCC 2007: WGII and SPM). Areas in the dry tropics dependent on snow melt—like the Peruvian Andes—are *likely* to be especially affected by climate change. These areas are particularly affected by worldwide decreases in snow and ice coverage, which is the main effect of global warming and is predicted to accelerate in the coming century (IPCC 2007: WGI and WGII).

Glaciers are the most visible indications of climate change, particularly tropical glaciers. The health of a glacier is measured by its mass balance, which in the case of tropical glaciers is determined by the ratio of accumulation to ablation. Snow accrues in the higher accumulation zone and turns into ice under pressure. Meltwater originates in the lower ablation zone as the ice in that zone melts. When accumulation exceeds loss through melting or fracture, the glacier grows in mass; when ablation zones grow and snow and ice losses exceed accumulation, the glacier loses mass. For most glaciers in the Cordillera Blanca the ablation zones are growing while the accumulation areas are decreasing causing overall glacier surface area to shrink (Chevallier et al. 2005). Loss is generally experienced by thinning or retreat, but progress in modeling on-land glacial hydrology will be important to understand the velocity of glacial loss and how subterranean water sources interact with glacial drainage.[6] Changes in mass balance are determined by temperature and weather patterns. In high and mid-latitudes, mass balance cycles are linked with annual cycles of air temperature (accumulation in winter, ablation in summer), but in the tropics this cycle is determined by seasonal precipitation patterns; shifts in these patterns will change the length of the periods of accumulation and loss (Kaser and Osmaston 2002). Seasonal shifts cause surface meltwater to combine with the basal drainage, raising basal water pressure, which results in higher basal flow rates. If enough surface meltwater intrudes on the basal drainage system, conduits develop which relieve the pressure and increase glacial discharge. Glacial mass balance changes lag behind climatic shifts, but the steep shallow glaciers found in the tropics are sensitive to small changes and only lag by a few years (Kaser et al. 2003).

Glacial Loss in the Cordillera Blanca

The Cordillera Blanca is the largest contiguous area of tropical glaciation in the world. Tropical glaciers like those found in the Central Peruvian Andes are widely considered to be the first line of science in climate change studies because they are sensitive to small temperature changes, and also because they are such an important element of water cycles throughout the highlands and desertified coastal areas downstream. The small rise in temperature predicted for future decades

[6] Until recently, glacier hydrology focused on the basal drainage system and did not adequately address channelized drainage. A new model has been introduced that combines the two drainage systems for a more accurate explanation of shifts in ice-flow velocities. The new model of sub-glacial hydrology combines "an interacting sheet (‘slow’ or ‘distributed’ system) and ice-walled conduits (‘fast’ or ‘channelized’ system)" (Flowers 2011).

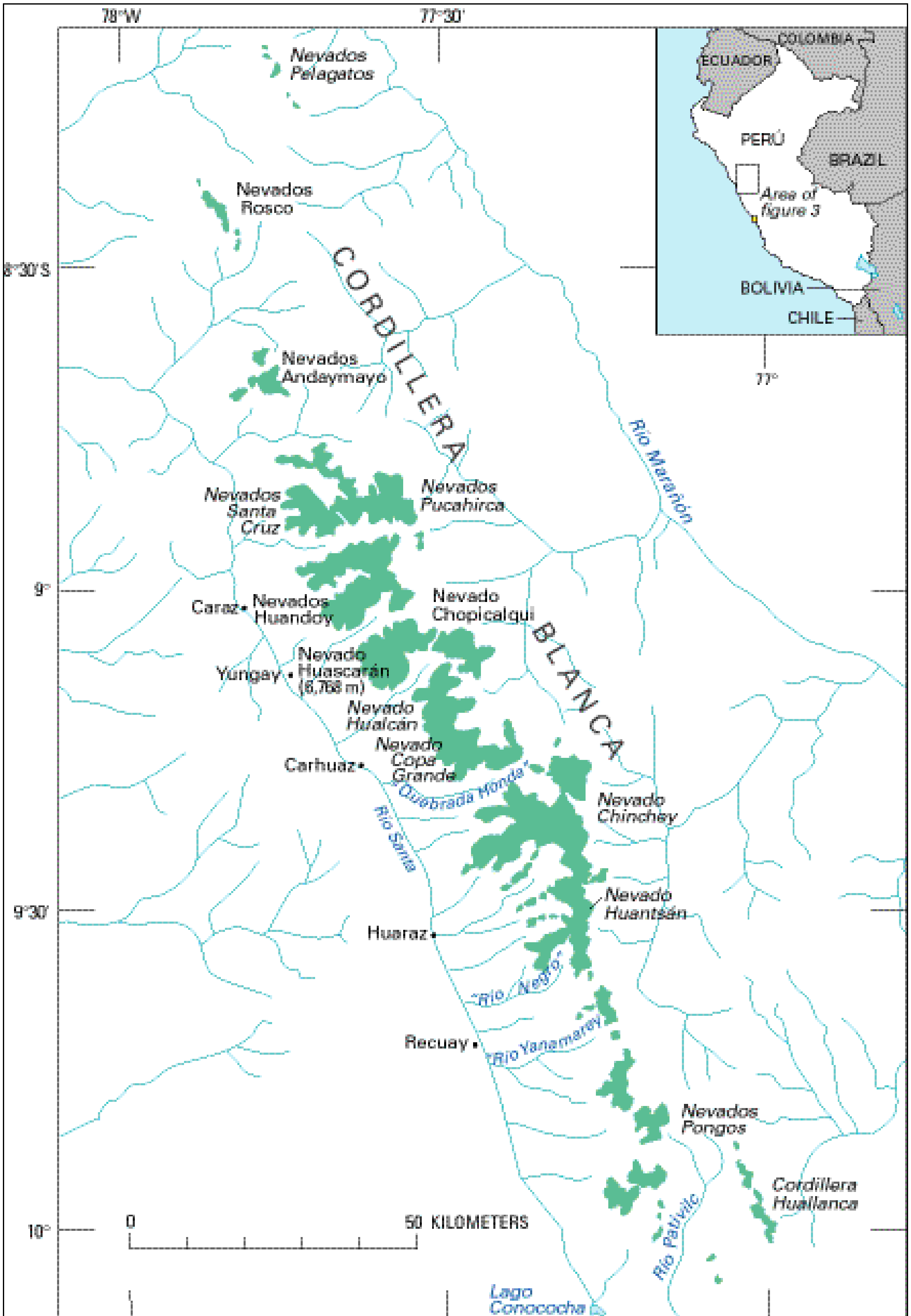

Figure 1 Glaciers in the Cordillera Blanca[7]

[7] http://pubs.usgs.gov/prof/p1386i/peru/intro.html

will have dramatic effects on the survival of these glaciers. Indeed, recent studies have shown that as temperatures rise, the freezing-level heights surpass the altitudes at which some glaciers exist in the Andes (Bradley et al. 2009). In these zones, the glaciers experience daily maximum temperatures above freezing, which exacerbates the loss of mass.

Natural climate variability and local forcing due to GHGs and changing land use shift significantly at smaller scales. This variability results in a larger degree of uncertainty for local and regional climate change predictions. While the IPCC correctly notes major data gaps in their work at the regional and local scales, within the Callejón de Huaylas, there is a significant collection of glacial history and paleoclimate data for the Cordillera Blanca (Ames and Francou 1995, Portocarrero 1995, Thompson et al. 1995, Thompson 2000, Zapata Luyo 2002, Diez et al. 2003, Georges 2004, Vuille et al. 2008). Scientific glacial research began in the area in 1935 (Kinzl 1935). Since the end of the Little Ice Age (late 19th century) the glaciers in the Cordillera Blanca have been receding. Although there was a brief resurgence in the 1920s, there has been significant acceleration of retreat since the 1980s (Kaser et al. 1990, Thompson et al. 1995, Kaser and Georges 1997, Ames 1998, Morales Arnao 1998, Kaser and Osmaston 2002). Glacial recession leaves the remaining rock and ice fields highly unstable. This instability led to 22 glacial lake outburst floods and six avalanches that killed over 25,000 people in the 20th century (Ames and Francou 1995, Portocarrero 1995, Zapata Luyo 2002, Carey 2010). After a devastating outburst flood in 1941 the Peruvian government began systematically carrying out surveys and aerial photography, culminating in the first Cordillera Blanca glacial lake inventory of 1953 (Broggi 1942, Torres Vargas 1942, Spann and Concha 1950, Fernández Concha and Hoempler 1953). Subsequent outburst floods saw the initiation of the Control Commission for Cordillera Blanca Lakes. This organization has been sporadically funded and often renamed, though its mission remains to monitor glaciers and to control glacial lakes (Carey 2005). Known as the National Institute of Natural Resources (INRENA) until recently, this unit is now the Glaciology and Hydrological Resources Unit (UGRH) under the National Association of Water (ANA) within the Ministry of Agriculture.

There are 722 glacierized peaks in the Cordillera Blanca, spanning 507 square km. Glacier meltwater from these peaks drain into the Rio Santa watershed, which covers 11,600 square km and provides water for domestic needs, agricultural irrigation, generation of hydroelectric power, maintaining such industries as large and small-scale mining operations and many growing cities along the desertified coast. From a 1970 baseline developed using aerial photographs (Ames et al. 1989), the national inventory of Peruvian glaciers shows that glaciers in the Cordillera Blanca have shrunk by 27% in the last 30 years (Beniston and Fox 1996, Ramirez et al. 2001, Kaser and Osmaston 2002, Georges 2004, UGRH 2010). According to the "First National Communication of Peru on Climate Change," co-published by the Andean Institute of Glaciology and Geology and the National Advisory on the Environment, the amount of water lost due to this recession is equivalent to the total amount of water used in Lima for 10 years. It is predicted by the most recent government estimates that "within 10 years, all the ice below 5,000 meters (16,400 feet) is likely to be gone" (Black 2011: 31).

Predicted Effects on Water Availability

The IPCC reports that there are critical effects predicted for the water systems across the globe and throughout economic sectors. The principal effect expected from climatic changes (specifically changing rainfall patterns and glacial retreat) in the arid highland landscapes of Peru is increasingly irregular water availability (Price and Barry 1997, Coudrain et al. 2005, Bradley et al. 2006). While glacial melt only makes up one piece of the hydrological budget for the Rio Santa, it serves as a critical buffer during the dry season months (Barry and Seimon 2000, Kaser et al. 2003, Mark & Seltzer 2003, Chevallier et al. 2005). Although glacial melt initially increases stream flow, as glaciers retreat this input will decrease and not be supplemented by rainfall (Chevallier et al. 2005). To date, glacial discharge contributions to stream flow have been measured with select single-glacier situations. Modeling using several of these single-glacier sites over multiple years shows that 40% of the Rio Santa flow is glacial meltwater (Mark 2008). Scaling up water budget losses from single-glacier estimates to the regional or watershed scale, where human usage is typically calculated, is a challenge to current researchers.

Evaluating how hydrological transformations are affecting human and social dynamics is critically important for understanding the nature of adaptation strategies and how future changes can be anticipated and managed. Tracing the hydrological effect involves cross-scale considerations and higher levels of uncertainty (Mark 2008). Figure 2 shows modeling of glacial runoff in five different catchments of the Cordillera Blanca based on two IPCC climate change scenarios (B1 and A2).[8] This runoff results in the enlargement of existing glacial lakes and the formation of new lakes. The increasing geological instability due to melting permafrost regions and enlarged glacial lakes leads to more rock avalanches and increased potential for glacial lake outburst floods. While increased runoff leads to more available water, the timing of this availability is shifting. As mentioned above, seasonal meltwater from glaciers, snow pack, or permafrost are critical buffers for freshwater availability during dry seasons. Glacier recession causes earlier spring peak discharge in glacier- and snow-fed rivers. The temporal and

[8] These are IPCC temperature change scenarios based on various potential levels of emissions. B1 reflects average increases in global mean temperature over the next century (0.2º C per decade) and A2 assumes Business-as-Usual which predicts global mean temperature will rise at 0.3º C per decade. These catchments all exhibit decreasing degrees of glaciation (compared to 1990 values): Paron 40.9%; Llanganuco 31.0%; Chancos 24.1%; Quillcay 17.4%; Pachacoto 9.7%.

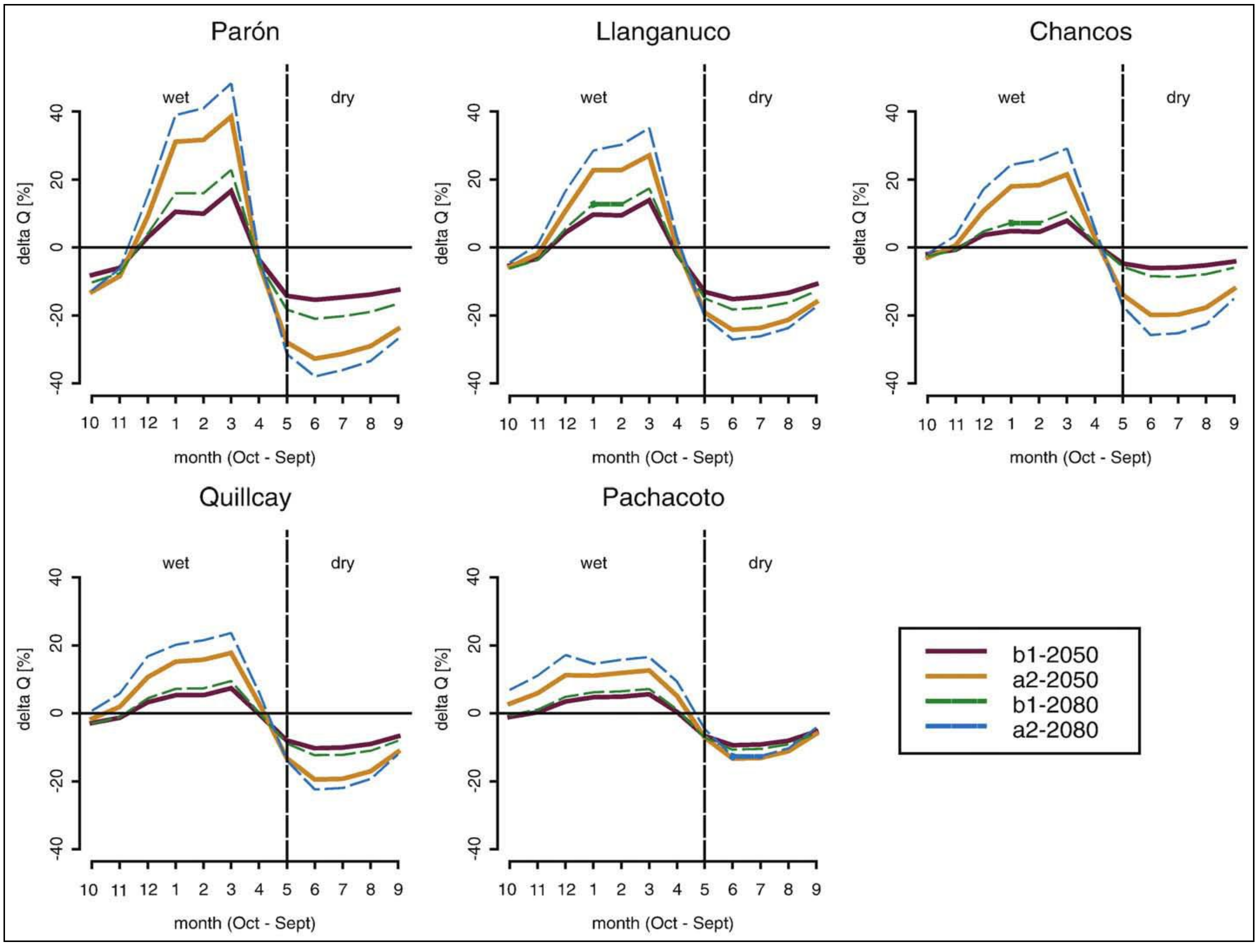

Figure 2 Simulated Change in Monthly Runoff in 2050 and 2080. Vuille et al. 2008.

temperature shifts alter terrestrial biological systems as well as the timing of spring events like migration and egg laying (*very high confidence*).

Though runoff is predicted to increase in some areas, this will be tempered by increased variability in precipitation and seasonality of runoff, shifts in water quality and demand, as well as flood risks (IPCC 2007: WGII). Rainfall is becoming increasingly erratic in both time and space; for example, rainfall usually occurring in November will fall in late December, and this rain will fall in one valley and not in the next due, in part, to the extreme topography of the Andes (Magrin et al. 2007). Temperature changes and ENSO influences are altering the frequency and intensity of extreme weather events. Heavy precipitation events are now more frequent with a large proportion of total rainfall for an area falling in a few, intense events. While heavy precipitation events may increase, the overall mean rainfall is predicted to decrease (Magrin et al. 2007). These extreme weather events and flooding will negatively affect water quality by overflowing existing treatment systems, while the warming of lakes and rivers affects the thermal structure and therefore the quality of existing water systems.

Before exploring how these changes are perceived and observed locally, below I introduce the specific study community and the methodology employed to address the research questions posited above.

Site Description and Methodology

While the discourses of climate change, including adaptation and vulnerability, and water management are indeed global, the goal of this research is to understand the perspective of those living directly under these glacial masses that are changing so rapidly, and to explore responses to such direct observation. This section will introduce you to the research site and detail the methodology utilized to address the guiding research questions posed above.

The research site lies within the Callejón de Huaylas, a valley running north-south in the department of Ancash bordered by the heavily-glaciated Cordillera Blanca on the east and the significantly drier Cordillera Negra on the west. [9] Sitting at a latitude of 9º 32' 0" S, a longitude of 77º 32' 0" W and 3,052 meters above sea level, Huaráz is the regional capital of the administrative department of Ancash, which straddles highland and coastal environments north of Lima. The valley is further defined by the Rio Santa, which flows between the two ridges before cutting through the Cordillera Negra at the north end of the valley and flowing west

[9]Callejón de Huaylas is a Spanish-Quechua hybrid term that is translated as a valley abounding in meadows and pasture grounds (www.promperu.gob.pe, accessed February 8, 2010).

towards the Pacific Ocean. Many of the peaks along these ranges rise above 6,000 meters, sitting roughly 3,000 meters above the valley. The valley itself is relatively narrow, in some areas only as wide as the river itself, but in other sites small cities swell or citrus plantations thrive on the river banks. The valley gives way to impressively sloped hills where there is a mix of agriculture, eucalyptus and pine plantations, and small clusters of houses. Climbing higher, villages appear with plazas, fields, pastures and extensive canal networks. Above these villages, in the Cordillera Blanca, lie more pasture and native, high-altitude trees and shrubs, which fade away to bare rock walls and eventually to the glaciers themselves. Some of the glaciers are relatively smooth fields of ice, while others are steep peaks that seem to almost hang from the sky.

Table 1 Nested Demographics

Administrative District	Population	Meters asl	Land Area (km^2)
Ancash	1,063,500	0-6,000+	35,915
Huaráz	147,463	3,052	2,492
Carhuaz	43,902	2,630	804
Marcará	8634	2,757	157

Source: INEI 2007

Glacierized peaks in the Callejón de Huaylas provide water for domestic and agricultural activities in the highlands and several coastal cities downstream in addition to powering Peru's biggest hydroelectric plant (UNMSM 2004, UNGH 2010).[10] Three major coastal cities fall within the jurisdiction of Ancash and several other large cities lie outside of the Ancash departmental borders yet still depend on water from the Cordillera Blanca. Additionally, large water-dependent commercial projects use water from the Rio Santa. For example, Proyecto Chavimochic "is a vast expanse of irrigated green fields that until recently were naked sand. This project is almost entirely dependent on diversions from the Rio Santa, which draws nearly half of

[10]At the southern edge of the Callejón, the valley narrows and the Rio Santa passes through the Cañon de Pato, one of Peru's biggest hydroelectric plants. The plant was built in 1958 and is now run by Duke Energy from North Carolina (www.duke-energy.com.pe/es/canondelpato.htm, accessed January 29, 2011).

its volume from the now peaks of the Cordillera Blanca. Melting ice has transformed Peru into the biggest producer of asparagus in the world [sic]" (Black 2011: 35).

Siete Imperios, a *comunidad campesina* (campesino community), lies about 34 km from Huaráz in the province of Carhuaz, in the mostly rural district of Marcará, whose populations and land areas are shown in *Table 2* below.[11] Copa Grande, the administrative center of the Siete Imperios, lies at the highest point in the district before reaching the boundaries of Huascarán National Park. Tributaries to the Rio Santa form above Siete Imperios from glacial meltwater. These tributaries form the northern and southern borders of the community and are diverted into the canal systems or trapped by potable water reservoirs before joining the Rio Santa below. Siete Imperios is comprised of seven (hence the name) *centros poblados* (population centers), though the census documents only six. In contrast to the official census categorizations, community members divide Copa Grande into Centro I and Centro II and include Huecochec, Yanahuanca and Winac as sectors within Copa Grande. These five sectors are relatively close to each other and are nestled in a small valley between the glacier and several foothills. The other two sectors, Tuyo Alto and Tuyo (Bajo) are found on the lower foothills just above Marcará.

Table 2 Sectors, Households and Population in Siete Imperios

Sector	*Households*	*Population*
Copa Grande	78	295
Huecochec	53	196
Winac	58	206
Tuyo Alto	46	173
Yanahuanca	60	232
Tuyu Bajo	83	237
Total	378	1,339

Source: INEI 2007

[11] Indigenous communities were legally recognized in Peru in the 1920s, but were only recently granted the right to own land under the General Law of Campesino Communities in 1989. These communities are governed communally by elected administrations, the guarantor of the rights for registered families, and the first-level authorities for disputes.

These sector-specific areas correspond to hacienda ownership prior to the Agricultural Reform of 1969. The official name Siete Imperios stems from the administrative combination of these seven previously segregated *predios* (properties) into one *comunidad campesina*. The neighborhoods that make up Copa Grande were owned by siblings, and maintain a closer knit connection among them than with the lower sectors of Tuyo Alto and Tuyo Bajo. The name Copa comes from the Quechua word *Qopayaq*, meaning "to give." This designation is said to come from a time before the hacienda when the land that eventually came to be known as Siete Imperios was highly productive. As such, people from this area were known to be generous with their harvests, often sharing them with those who were less fortunate from surrounding areas.

Site Selection

After visiting over 20 communities throughout the Callejón, I chose Siete Imperios as the research site for this work. This selection was primarily based on two characteristics: 1) its proximity to glaciated areas (the Copa Glacier is visible from the community center and can be reached in a matter of hours by foot) and corresponding rivers, and 2) a lack of recent or intensive involvement on the part of programs addressing climate change specifically. These two characteristics would be pertinent to the comparison of local knowledge about glacial loss and climate change with scientifically documented environmental changes. The first criterion was crucial: living under a close and constantly visible glacier would almost guarantee regular observation and reflection. The second condition would minimize the amount of knowledge introduced by program-created dialogue about the global phenomena "climate change" instead of observational-based knowledge of local effects of climatic changes.


Figure 3 View of Copa Glacier from the plaza of Siete Imperios. Photograph by author.

Research Schedule

In order to address the research objectives outlined above, I worked with members of the study community to explore the political landscape within their watershed from November 2008 through March 2010. The Peruvian highlands experience two distinct seasons marked by the presence or absence of rain, and although global climatic changes are affecting the timing and intensity of precipitation events, this research was carried out during the traditional rainy and dry seasons. This way, it would capture variation in perspectives on environmental change given seasonal conditions and specific knowledge associated with each season. Research participants had a tendency to respond initially to questions about their environment that correlated with the season. For example, during the rainy season the river "*aumenta*" (increases) and there is "*bastante*" (a lot of) water in the rivers and canals. The dry seasons would initially evoke the opposite. By carrying out interviews during both seasons, I was able to capture the perceived abnormalities within seasonal cycles and compare seasonally induced responses with those responses that took into consideration a longer interval.

Research Methods

I implemented a toolkit of qualitative ethnographic methods, including semi-structured interviews, focus groups, and participant observation in order to understand the sources of knowledge on climatic changes in the region, focusing both on populations involved in water policy or use, and on those who interacted with the glaciers (see Appendix A for an example of the interview guide).

For the semi-structured interviews, I amassed a sample of community participants through a technique known as judgment sampling (Honigmann 1982, Bernard 2006), which allowed me to select informants opportunistically. Selection was based on the ability and availability of research participants to discuss current and historical issues related to water availability and climatic changes, and to share narratives about their interactions with the glacier throughout their lifetime. The 132 community interviews were split equally between men and women. Some participants did not know their exact age, in which case I assigned them an age-group that reflected how they were addressed by their peers: *joven* (young person), *tío/a* (uncle/aunt), or *abuelo/a* (grandfather/mother). Most interviews were with middle-aged, *tíos* or *tías,* followed closely by elder informants with only a few young men and women. For a full profile of the interview participants by sector, see Appendix C.

Navigating relationships among communities, district centers, and regional centers is critical for understanding how centralized management policies affect the ability of rural areas to adapt to changing environmental situations (Paulson and Gezon 2005). Thus, I also engaged with members of regional organizations, universities, and government agencies to explore these relationships; however, the main unit of analysis remains individual community members. Institutional interviewees (n=10) were selected based on salience to the community, involvement with glacier, water or vulnerability research or planning, the recommendations of community members or other institutional interviewees, and archival research. These interviews included the director of INRENA (now UGRH), the director of Huascaran National Park, former director of the NGO ITDG: Soluciones Practicas, director of a local NGO Urpichallay, the local representative for the Autoridad Nacional de Agua (ANA), local professor and historian of the Callejón de Haylas, Universidad Nacional Santiago Atúnez Mayolo (UNASAM) professor and arcaeologist for the region, UNASAM and Pontifica Católica Universidad de Peru (PUCP) professor of anthropology, researcher with the local branch of The Mountain Institute, and the doctors, nurses, and social workers with the Ministry of Health working in Marcará.

Traversing the hilly, high-altitude landscape of this region, with its hardened dirt roads and winding, muddy foot paths, is a time- and energy-consuming task. Requesting the presence of participants at a centralized location such as my house therefore felt like a serious imposition, and so, despite the uncertainty of any given interview taking place as scheduled, I decided early on that I would go to community members for interviews. This not only increased the number of interviews I was able to complete, but also allowed me to confirm that the Copa Glacier or another nearby peak was visible from almost every homestead and field.[12]

[12] Except, of course, in the rainy season, when thick mists roll over the glaciers.

Most of the interviews for this work were carried out in very informal settings, sitting on *llicllacs* (woven wool shawl) in a half-plowed field chewing coca or conversing among the post-breakfast pile of dishes at a hearth nibbling *cancha* (toasted corn kernals). And as with most activities in the community, they were conducted under the shadow of the Copa Glacier. Scheduling a specific time for an activity of this sort (or any sort) proved quite difficult. My research assistant, a local woman named Nelly who was very involved in community health initiatives and familiar with carrying out household visits, would ask a household if we might visit with them on a certain morning. This would never guarantee their presence upon our arrival, as other engagements often took precedence, a field that needed attention, an impromptu committee meeting in the lower section of the community, or an ailing child who required transport to the district capital of Marcará, several hours walk down the mountain. In some cases, giving advance notice of a visit by the "*Señorita*," as I was politely known, only guaranteed the family's absence.

In addition to the 132 interviews carried out in the hearths and fields of community members, I conducted six official focus groups. Each focus group had a minimum of four and maximum of eight participants though the average group was comprised of five participants. Unlike interviews, focus groups were carried out in a centralized location. My field assistants and I decided that holding these meetings around dusk, when work was generally winding down for the day, would be the best way to encourage participation. The declining light and dropping temperatures required that we hold these meetings indoors. Marco, my other research assistant, volunteered his home which was just off the plaza of Copa Grande. Voluntary focus groups were organized based on age, gender and migration status. In creating these focus groups, I was attempting to isolate what differences in knowledge existed between these groups. The first four focus groups were older men, older women, younger men, and younger women. The final two groups, while still segregated by gender, were for people who had migrated to Siete Imperios (usually through marriage) as an adult. In these groups, I asked how perspectives of environmental changes and the future of the community might be different from the places of origin for these participants. It was difficult to adequately publicize these groups in order to encourage local attendance and participation, as many community members do not read either Quechua or Spanish. The most effective technique was to orally circulate the time, place, and the theme of the group I planned to lead each week, then welcome those self-selected participants who attended voluntarily (Schensul and LeCompt 1999).

During my tenure in the community I lived in the house of the community president and his family. This provided me with an opportunity to participate daily in meals and localized pasturing or gardening activities. Through my friendships with other families in the community, I also observed during routine activities of planting, harvesting, and weeding of the major crops (corn and potatoes); harvesting and thrashing of wheat; rotating animals through near and far pastures; and the weekly market excursion. In addition to these routine activities, I was invited to attend a Catholic wedding, a secondary school graduation, the funeral of the president's mother-in-law, the community-wide inauguration of the potable water system, *Fiestas Patrias* (a week-long party to celebration the foundation of Siete Imperios, *Dia del Muerto* (Day of the Dead) celebrations where we baked bread and visited the cemetery in Marcará, and observed during a workshop for malnourished children.

Outside of the community observation, I had the opportunity to participate in several events by various entities involved in water or climate initiatives. The NGO ITDG: Soluciones Practicas holds a pilot climate change school in select communities within the valley and I was invited to join them in field visits to these communities where I met with some of the community authorities. Dr. Bryan Mark, who has been conducting hydrological studies on meltwater contributions to rivers in the valley, invited me to assist during a field trip where he and his team took rainy season measurements for glacial contribution to streamflow. I also attended a series of conferences in Lima surrounding World Water Week in March 2009, all of which were focused on climatic changes and their consequence for water availability. These conferences included the National Congress of Water meeting, an International Seminar at the offices of the National Service of Meterology and Hydrology for Peru (SENAMHI), and Cumbre LatinoAmerica which was a gathering of indigenous communities to discuss climate change. I was also asked to help organize Adapting to a World Without Glaciers: Realities, Challenges, Actions—an international workshop funded by the University of Georgia, USAID, and the Mountain Institute, among others that took place in Lima and Huaráz.

Whenever possible, I collected documents held at the various government agencies, locally-focused NGOs, and regional libraries. I was also granted access to a small portion of community records (*Libros de Actas*).[13] These documents include publications of legal frameworks for land and water tenure of highland communities as well as historical documents on land exchanges that have taken place since the Agrarian Reform of 1969. I also collected national and regional environmental management plans where possible, along with documents regarding ongoing climate change modeling and analysis and drafts of plans and timelines for adaptation policies.

[13] Communities keep detailed notes of all community and advisory committee meetings, collected in a series of hand-written notebooks called the Libros de Actas. I was only permitted access to a small timeframe of these records, during which the majority of the discussion was about the ongoing tree plantation activities.

Data Analysis

During both the semi-structured interviews and focus groups, participants discussed water sources, engagements with the glacier, seasonal changes in water availability and use, memories of past drought or excess, practices employed to offset water scarcity, and institutional or individual responses that affected vulnerability during these events. They also discussed permanent social, environmental or political changes in communities as it related to glacial change or water availability. The discussions in focus group interviews provided a sense of a collective view of the above-mentioned issues along differentiating variables such as age, gender, community sector, or migration status.

Transcripts from community interviews and focus groups were assigned a number to maintain confidentiality and are referred to by this number throughout my dissertation to assure anonymity. Community member interviews were recorded in either Spanish or Quechua, usually a mix of both. An assistant then transcribed these interviews in the recorded language, then translated from Quechua to Spanish if necessary. In the event an interview was translated from Quechua, the original Quechua was kept with the translated Spanish for future reference. I have translated the quotes from community members and institutional informants that appear in the following chapters from Spanish to English. Analysis of transcripts from focus groups and interviews, community records, and field notes from participant observation was conducted through manual coding in Excel. Each transcript was coded for demographic data (where applicable); whether and how glaciers were discussed and the degree and purpose of direct interaction with glaciers; general environmental changes, including rainfall, and whether or how these changes were related to glacial loss; the degree of concern for water, which sources were changing and how, fears of privatization and existing or future conflict; and finally actions that are or could be taken by the community or others to combat the consequences of glacial loss.

The vast majority of archival documents were not directly related to Siete Imperios, but provide a contextualization for historical or current political processes. These documents were important for addressing my second research question on the political negotiations within the water sector. The same is true for institutional interviews as the majority of these participants did not interact directly with the study community. Institutional interviews however, provided context for all three research questions, depending on the interviewee in question. Within Siete Imperios, interviews, focus groups, and participant observation were organized to capture knowledge of water systems, environmental changes and their connectivity. The comparison of focus groups and individual interviews helped to determine if significant differences existed between what was being reported by individuals and concepts under discussion more collectively. These data directly addressed the first research question on the perceived connectivity between climatic changes and water availability, and informed the analysis for the third research question on the implications for adaptive capacity within Siete Imperios.

Limitations and Challenges

Upon reflection, I feel the biggest limitation for this research was the large scope of the project. Attempting to navigate the local, regional and national levels of water governance in addition to how adaptation and vulnerability are conceptualized and institutionalized at these levels is a huge undertaking. And this only addresses one of my research questions. However, this was a lesson best learned as I did, through baptism by fire, or ice in this case.

Another limitation to my analysis was my inability to gain access to most community records and general information about water management in Siete Imperios. While this could be labeled as timorous behavior on the part of the researcher, I believe it due to a profound understanding of historical and continuing "legibility" methods and practices on the part of the state that aid in further extraction or exploitation of resources (Scott 1999, Gledhill 1998, Brosius 2006, Carey 2010). Despite my best attempts at assuring them this was not my intention (which was difficult since I myself agreed with their hesitation), community authorities recognized that my study could provide information to entities that could then use it against them in future regulatory planning. The hesitation of the community is at once an example of how historical exploitation has left communities extremely wary of outsiders (while simultaneously feeling incredibly dependent on their knowledge) and a limiting factor for my research. I was able to glean some information about current water management practices, but was intentionally kept from accessing the information that would provide me with a clearer picture of both current and historical trends.

A third factor that has hindered this study to some degree is a language barrier. Though I am fluent in Spanish, I underestimated the number of Quechua-speaking individuals in Siete Imperios. While there is a fair degree of bilingual speakers in the community, almost all women and older generations of men only spoke Quechua. I attempted to set up intensive Quechua classes with a professor living in Carhuaz, but making these appointments presented more of a hindrance to fieldwork than the likelihood that my language acquisition would happen quickly enough to be effective. My research assistants were helpful in translating between myself and research participants, but many opportunities to follow up in an interview on a nuanced comment here or there were lost. The language barrier was more obvious as a hindrance during participant observation. Even those who where bilingual would engage with their neighbors in Quechua and communities meetings were conducted in Quechua. Though I was able to understand a good deal by following body language during these meetings, again, details that could have been useful in my analysis fell through the cracks.

Chapter Organization

As described above, in the next chapter I will address the constellation of theoretical concepts that guide this dissertation. This work is fundamentally organized around how objective and subjective scales interact through the response to melting glaciers and the projected decrease in water availability. Scales both create and are a function of knowledge employed by those social actors involved in water management. Navigating within these social scales to identify specific vulnerabilities to the effects of climate change and the adaptive capacities of vulnerable populations is critical for creating adaptation policies and practices that resonate with affected populations. Chapter 3 presents a history of resource management in the Callejón de Huaylas beginning with the prehistoric habitation of the valley through the Inca expansion and colonial influences on the region, leading into the contemporary historical affects of the Agrarian Reform of 1969, the disastrous earthquake and glacial lake outburst in May 1970, and the establishment of the Huascarán National Park. This chapter will conclude with a discussion of how growing global attention to environmental issues, the influx of development aid, and decentralization efforts increased the degree of vulnerability among highland agro-pastoralist communities. Chapter 4 presents detail on the current land tenure, water systems and agricultural management within the community. This chapter also discusses concerns over changing water availability and projected scarcity of the resource. Chapter 5 outlines the various environmental changes observed within Siete Imperios and explores how community members engage with these changes. In Chapter 6 I explore how changing water availability is being negotiated throughout the valley by exploring changes in national water legislation, fears of privatization, and regional conflicts over control of the resource. Chapter 7 investigates vulnerability and adaptive capacity in the face of projected climate scenarios for Siete Imperios specifically. To conclude I summarize the findings of this research and the implications of studying local climate change knowledge for planning adaptation policies and programs in the Peruvian Andes.

CHAPTER 2

SCALING KNOWLEDGE AND POWER IN ANDEAN WATERWAYS

All things are subject to interpretation, whichever interpretation prevails at a given time is a function of power and not truth.

Friedrich Nietzsche

Introduction

This chapter introduces this constellation of theories and approaches that guide this dissertation: political ecology of scale, politics of knowledge, and vulnerability and adaptation approaches. First, I provide an overview of the political ecology of scale, and how shifting through scaled perspectives of water management change the values and knowledge through which the resource is viewed. This section briefly introduces political ecology and the evolution of scale concepts within political ecology approaches and then discusses why the politics of scale is important for research on water management and climate change.

The second section presents arguments in the politics of knowledge that demonstrate how certain knowledges are prioritized over others because of political and economic motivations. This section will briefly introduce the foundations of the politics of knowledge, discuss the debates surrounding traditional ecological knowledge as “opposed” to scientific knowledge systems, and conclude with arguments on how the transmission and circulation of knowledge is influenced by political agendas and sometimes manipulated to serve particular ends. The degree of power behind certain motivations can lead to some knowledge claims having a more significant circulation and therefore an assumed authority over others.

The final component of my theoretical framework is scholarship pertaining to social vulnerability. In this section I will explore the evolution of physical and social vulnerability studies and discuss how vulnerability and the related concepts of adaptation and adaptive capacity are critical elements for investigations into the human dimensions of climate change. These theories together provide a framework in which I locate the knowledge and vulnerability of Siete Imperios with regard to water management in the face of projected scarcity, and navigate the relationships between the scales in which decisions are made regarding the future of the resource.

Political Ecology of Scale

Scale has been a core focus of political ecology since its inception. Political ecology emerged from a dialogue between the cultural ecology studies pioneered by anthropologist Julian Steward (1955) that explored the role of human populations in ecological systems, and research that focused on larger economic and political systems in which these populations exist, such as dependency theory and world systems theory (Greenberg and Park 1994, Peet and Watts 1996, Zimmerer and Bassett 2003, Paulson and Gezon 2005). Blaikie and Brookfield, often heralded as the pioneers of political ecology, describe the approach as addressing "the concerns of ecology and a broadly defined political economy. Together this encompasses the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself" (1987: 17). Greenberg and Park lean on the political economy roots of political ecology, which they see as emerging from the "central questions asked by the social sciences about the relations between human society, viewed in its bio-cultural-political complexity, and a significantly humanized nature" (1994: 1). Broadly, the political ecology approach has an underlying assumption of a "politicized environment" (Bryant 1998: 82) and focuses on degradation and marginalization, environmental conflict, conservation and control, and environmental identity and social movements incorporating "political and ecological dimensions, as well as material and discursive elements" (Neumann 2005: 10, Paulson et al. 2003, Robbins 2004). Political ecology continues to focus on these intersecting processes that create and operate within diverse spatial and temporal scales, which are each subject to various political forces (Neumann 2005).

Traditionally, the natural sciences have viewed scalar concepts such as time and space as relatively rigid and hierarchical, while social scientists have often used the idea with greater variety and flexibility. Although the concept of scale remains a central theme throughout the natural and social sciences, a "fundamental conceptual problem" persists (Levin 1992: 1944). This confusion is due largely to the variety of definitions both within and across disciplines (see Gibson et al. 2000, Marceau 1999, O'Neill and King 1998, Peterson and Parker 1998, Delaney and Leitner 1997, Cash and Moser 2000, Murphree 2000, Howitt 1998, Johnston et al. 1986). Across disciplines, definitions of scale stress a variety of potential aspects: size, time, space, level, hierarchy, and social construction or relationship (Martson 2000, McCarthy 2005). For example, ecologists define scale as the spatial or temporal dimension of a process or an object, measured by grain and extent. Grain is the smallest spatial unit used for measurement, and extent is the total size of the spatial area or length of time in which the grain of the process or object is measured. In contrast, social scientists are more concerned with how these spatial and temporal units are defined and the relationships between them. These distinctions give rise to further confusion stemming from the mistakenly interchangeable uses of terms such as “level” and “scale” (Sayre 2005), and approaches which define scale by what it is not. For example, many scholars and researchers define scale as something not ontologically given, not an *a priori* definable territory (Swyngedouw 1997). The originating disciplines of biology and ecology continue to use “scale” to refer to variegated levels of organization, while social scientists have adopted a wider conceptual usage of spatial and temporal scales (O’Neill and King 1998, Sayre 2005).[14]

As the concept of scale was integrated into social science studies, Smith (1984) coined the term “politics of scale.”[15] With this term, he challenged the rigid, hierarchical and objective definitions of scale and established a significant literature arguing that scales are “socially constructed, historically contingent, and politically contested” (Neumann 2009: 399, Howitt 1993, Jones 1998, Herod 2003, Sayre 2005). The resulting work posits that the social construction of scales cannot be defined *a priori*; it reflects power relations, and it is critical to understanding socio-political processes (Swyngedouw 1997, Zimmerer and Bassett 2003, Cox 1997, Jones 1998, Gupta and Ferguson 1997). Strategic political processes create scalar relations that prioritize particular scales or perpetuate the marginalization of others (Cox 1997, Delaney and Leitner 1997, Swyngedouw 1997, Jones 1998, Herod and Wright 2002). Social actors attempt to scale their own activities in ways that allow them to exercise power or to deny power to others (Herod and Wright 2002). Scale literature as a whole has been critiqued for the reification of global and local scales, denying agency to localities while placing causal force exclusively with trans- or international entities (e.g., Brown and Purcell 2005, Marston et al.

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[14] Early discussions of scale in political ecology leaned heavily on the hierarchical view as adopted from ecology. For example, Blaikie and Brookfield’s “chain of explanation” idea of scale was a hierarchical conceptualization of a series of fixed sociospatial containers (i.e., rural-urban, local, regional) (1987:27).
[15] Smith draws on work by Lefebve (1991) and Harvey (1989, 1990) on the production of space as well as concepts of metaphor from geographical theory (Barnes 1996, Kelly 1997).

2005). However, the political ecology of scale explicitly recognizes that power relations and agency flow in multiple directions (Natter and Zeirhofer 2002, Leitner and Miller 2007, Nuemann 2007). In a key analysis of agency in scale, Swyngedouw and Heynen state that:

> The priority, both theoretically and politically, therefore, never resides in a particular social or ecological geographical scale; instead, it resides in the socioecological process through which particular social and environmental scales become constituted and subsequently reconstituted. In other words, socioecological processes give rise to scalar forms of organisation—such as states, local governments, interstate arrangements and the like—and to a nested set of related and interacting socioecological spatial scales. (2003: 912)

Scalar Politics of Water

Water management institutions are particularly well-suited for explorations of agency in scale production. Biophysical water properties—chiefly its fluidity above and belowground—appear differently as scale changes from a small spring to canal networks to entire watershed catchments. These various levels of properties are connected through surface flows, along with human manipulation via infrastructure that diverts, drains, stores, dykes, and pumps. While the politics of upstream-downstream relationships are fairly well documented, the relationships between surface water and groundwater are less well defined, both physically and politically (Wagnon et al. 1998, Molle 2006, Favier et al. 2008, Baraer et al. 2009). The ability to manipulate these connections illustrates the complexity of defining water rights and the hydrological connections of an area.

When using concepts of scale to assess water management institutions or climate change initiatives, there are several opportunities for scalar mismatch. Though the river basin, or watershed, offers a relatively bounded and conventionally accepted unit of analysis, often jurisdictional mismatch occurs when problems and potential solutions originate at scales outside of the watershed (Molle 2007, Pahl-Woslt 2007a, 2007b). Social interactions surrounding water management are influenced by various scales of action and effect: local conditions, state level policies, fluctuating markets, and climate change, for example (Snedden et al. 2002). Jurisdictional mismatch can also result in the levels of government not coinciding with beliefs, goals, concerns, and, perceptions of actors at various scales throughout a watershed. Governance of hydrological systems, or socio-ecological systems in general, does not rest easily with any particular scale of social organization and in some cases overthrows assumed properties of certain levels of government (Gibson et al. 2000, Young 2002, Robins 2004, Adger et al. 2005, Cash et al. 2006). For instance, Zimmerer (2000) critiques the assumed dichotomy of local, sustainable canal-based irrigation versus basin-scale (or valley-wide) irrigation as the icon of modernity and state control in the south-central Andes. He shows instead that these opposing scalar assumptions of local as “good” and sustainable and basin-scale as purely oppressive state-control hides factors of each that contribute to adaptive management, or constrain it. He concludes, contrary to the assumptions of smaller, local management scales are necessarily the best management regimes, that containing water management locally through the “indigenous” canal-based systems has reduced the cross-scale coordination among peasant populations necessary for adaptive management of water resources.

As individuals and governments attempt to address changing water availability that results from climatic, infrastructural, and social changes, the politics of scale and questions of governance clash over provision of rights and access to this resource.[16] And explicit manipulation of certain scalar categories for specific ends is evident in the evolution of watershed practices and politics. In Peru, the evolution of water management at the scale of the nation-state (be it Incan, colonial or national) has revolved around rapid economic development.

[16] The question of governance emerges from the literature on the commons dilemma, which asks what role institutions play in managing common resources to avoid environmental degradation (see Berkes 2002, Folke et al. 1998, Barrett et al. 2001).

This is not to say that smaller-scale actors are not able to act to shape water politics in the country. Social conflict and political struggles over rights and access to resources can play significant roles in rescaling power (Swyngedouw 2000, Swyngedouw and Heynen 2003). Rural highland residents in the Andes are renowned for their protests of environmental and economic abuses (e.g., Stern 1987, Bebbington et al. 2008, Schultz and Draper 2008). And due to the influx of international aid and interest, these residents are adept at what is referred to as "jumping scales," making connections with larger-scale environmental or social movements to bring attention to their cause (Sneddon 2002).

Scalar analysis also applies to the politics involved in addressing the effects of climate change. Effects of climate change and responses to them will vary significantly across geographical scales. For example, in the Callejón de Huaylas a principal effect of the changing climate is declining water availability, but east of the region, the lowlands are concerned with inundations resulting from rising temperatures. Because of the highly diverse effects of climate change on water availability, and because of the scalar differences between sources of climate change and its effects, mitigation and adaptation planning and actions are likely to occur at vastly different scales (Olsson et al. 2004). There is also an element of temporal mismatch when events such as election cycles preclude policies and programs from addressing longer-scale resolutions. Since scales are constantly made, negotiated and transformed as people interact in specific times and places, it is difficult to formulate policies that are responsive to such dynamic characteristics, particularly in regard to climate change, which is itself dynamic and uncertain.

The explicit use of certain scales in climate change discourse has both practical and political implications (Levin 1992, Brosius 1999, Tsing 2002, Brown and Purcell 2005). Typically, the scales deemed "important" by the more politically powerful actors (e.g., national political groups, development projects) often diminish or obscure those perspectives, scales, timeframes, and values of affected or vulnerable communities. Part of scalar political prioritization is the use and definition, or lack thereof, of various terms in order to manipulate such values. Tsing suggests that in exploring between and across scales we should "focus on zones of awkward engagement, where words mean something different across a divide even as people agree to speak" (Tsing 2005: xi). This would certainly be the case within multi-scale climate discourse in Peru, where terms like "mitigation," "adaptation," and "resilience" are rarely defined or are conceptualized differently by the variety of social actors that use them.

Recognizing the social nature of the (re)creation of scales and temporalities around climatic changes and responses is a critical component of potential discussion between groups who otherwise have distinct views on climate change. These scalar struggles are reflected in the evolution of water management in Peru and frame the ways in which climate changes, consequences, and potential actions are experienced in my research. Thus, scalar tensions provide a critical lens through which to examine various knowledge claims, degrees of vulnerability and the potential for adaptation in the Callejón de Huaylas. As with Escobar's hybrid nature—an "attempt to incorporate multiple constructions of nature in order to negotiate with translocal forces while maintaining a modicum of autonomy and cultural cohesion"—so too must the production of social scales be considered such a hybrid (1999: 13, Manson 2008, Latour 1993). When assessing plans or policies to address climatic changes, like Cronon (1995), we must ask "whose nature" is being represented or changed by such proposals. Following this sentiment, Swyngedouw states that the "'production of nature' is an integral part of the process of 'producing scale'" (2007:10).

Politics of Knowledge

Like those scholars working with the politics of scale, researchers that utilize theories of knowledge politics argue that the concepts of environment and environmental problems have been discursively constructed and filtered through various lenses and mediums. This approach acknowledges the importance of understanding who is creating dominant definitions, how these are circulated, and with what goals in mind. Philosopher Paul Feyerabend defines knowledge as the "body of propositions actually adhered to (whether formal or otherwise) that are routinely used to claim truth" (1987 in Reid et al. 2006:11). Zermoglio et al. (2005) define knowledge as the perceived reality of a group that guides behavior among the group with the external world. These definitions apply to any knowledge system, be it western scientific methodologies or those based on experience and oral traditions. The main focus of scholarship in this field has been a critique of modernist notions of objectivity and rationality, illuminating the relationship between power and scientific knowledge and recognizing multiple culturally constructed ideas of environment and environmental problems (Neumann 2005).

As part of this critique, the concept of studying traditional ecological knowledge (TEK) as an element of resource management became widespread in the 1980s (Berkes 1999).[17] TEK is a "cumulative body of knowledge, practice, and belief, evolving by adaptive process and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes 1999: 8). It specifically refers to ecological processes and was first systematically studied by anthropologists focusing on ethnoecology, which explores human and ecological relationships (see Fowler 1977, Toledo 1992, Ellen 1993, Nazarea 1999). Ethnoecology is considered to be part of ethnoscience,

[17] Growing interest in traditional ecological knowledge was part of a larger indigenous movement opposing the presence and exploitation of extractive industries, which together spawned concern for bioprospecting and intellectual property rights (e.g., Brush 1993, Brush and Stabinsky 1996)

defined as “the study of systems of knowledge developed by a given culture to classify the objects, activities and events of its universe” (Hardesty 1977: 291, Berkes 1999). Early work in ethnoscience was dominated by folk taxonomies (e.g., Conklin 1957, Goodenough 1957, Frake 1962, Sturtevant 1964, Berlin et al. 1974, Hunn 1989), but the field expanded to include indigenous environmental knowledge as it applied to a range of management scenarios (e.g., Lansing 1991, Zimmerer 1996, Olsson et al. 2004, Agrawal 2005, Ribot and Larson 2005), and is now widely accepted as having valid contributions to environmental management dilemmas.

Depending on the particular aspect of knowledge in focus, various labels are used throughout the literature, including: TEK, traditional knowledge, indigenous knowledge, and local knowledge, to name a few (Williams and Baines 1993, Brokensha et al. 1980, Cunningham 1991, Warren et al. 1995). Some scholars argue over the use of “traditional,” as this word suggests a simple and static system (Warren 1995), while others argue against the use of “indigenous” since not all societies that have historical continuity in a particular place are indigenous to that area (Netting 1981). Local knowledge refers to place-based experiential knowledge, largely oral and practice-based rather than learned through formal education (Gadgil et al. 2003, Zermoglio et al. 2005). But the term “local knowledge” applies to a fairly broad conception of knowledge and does not necessarily address the temporal depth or ecological orientation of the knowledge in question (Berkes 1999). Like the knowledge itself, the term used to describe it should (and does) shift depending on the context and aim of its use. Applied ecologist Fikret Berkes who works at the interface of natural and social sciences, suggests that the concept includes three components: local knowledge of environmental phenomena; considerations of practices employed for livelihood activities; and a system of beliefs about how a particular population interacts with natural process (1999). These components interact in such a way that ecological aspects cannot be separated from social and spiritual meanings, all of which constitute a “sense of place” (Basso 1996, Nazarea 1999).

Anthropologists have explored the relationship between scientific and local knowledge on a number of ecological fronts. Though there are often disputes about the validity of non-scientific methodologies, any differences between the various approaches to knowledge are exaggerated (Cordell 1995, Agrawal 1995b). Indeed, making a distinction between these approaches is pointless since even philosophers of science have not developed an appropriate criterion to define science as opposed to some “nonscience” (Agrawal 1995a). Arun Agrawal argues even further that the various forms of knowledge are in fact intertwined:

> Certainly, what is today known and classified as indigenous knowledge has been in intimate interaction with western knowledge since at least the fifteenth century. In the face of evidence that suggests contact, variation, transformation, exchange, communication, and learning over the last several centuries, it is difficult to adhere to a view of indigenous and western forms of knowledge being untouched by each other (1995b: 422).

By way of example, scholars in Peru and elsewhere have shown that some agricultural or irrigation systems believed to be local or indigenous are indeed “reified by the structures of modernity that marginalize them” (Hornburg 2005 in Dove 2006, Dove 2000, Zimmerer 2000).

Conflict between western science and indigenous knowledge are due to political relationships and agendas, and dependence upon the resources in question (e.g., Nader 1996, Berkes 1999). While being skeptical is an element of western scientific training, some western scientists are dismissive and intolerant of TEK and do not readily accept the proposition that western scientific knowledge is not the best and only way to gain knowledge (Levi-Strauss 1962, Feyerabend 1987, Lewis 1989, Nakashima 1998). However, many have shown the value of local knowledge, whether as a companion to scientific ways of knowing or as an aid to locally implemented development projects (Richards 1985, DeWalt 1994, Antweiler 1998, Purcell 1998, Sillitoe 1998, Ellen and Harris 2000, Sillitoe et al. 2002).[18] In many instances local farmers are well aware of the ecological risks of certain techniques and so operate to minimize potential damage (Forsyth 1996). For example, research by Conklin (1957), Sillitoe (1996) and Dove et al. (2010) changed western scientific ideas about shifting cultivation, showing that it can be managed as an ecologically appropriate farming system. Fairhead and Leach (1996) revised the attribution of deforestation in West Africa to local communities, showing instead that these same communities fostered and encouraged a complex woodland system that included both grasslands and forests within the landscape. Research into local knowledge systems has also enabled scholars to illustrate the inadequacy of copy-and-paste development programs for certain farming systems. Lansing (1991) provides a compelling portrait of how the introduction of modified crop varieties, which necessarily include added costly inputs that alter soil composition for other uses, had very negative consequences on local integrated systems of synchronized cultivation and water management.

Science and technology studies (STS) look explicitly at the power relationships and political manipulations of western science as part of their investigation into the co-production of science and society (e.g., Latour 1993, Jasanoff et al. 1995, Nader 1996). Like society and nature, "scientific knowledge is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identifies, norms, conventions, discourses, instruments and institutions—in short, in all the building blocks of what we term the social" (Jasanoff 2004:3). Laura Nader (1996) famously argued that Western scientific knowledge has been "bounded" as such an objective, rigorous practice in order to privilege certain knowledge over others when in fact, it is just as culturally embedded and porous as any other knowledge system.

[18] This is not to say that all traditional knowledge is ethical, accurate, adaptive or can be applied appropriately to other contexts.

Production, Application, and Circulation of Knowledge

Historically, knowledge has been treated as a product that "retains its form as it circulates from the different contexts of production and application" (Goldman and Turner 2011: 15). However, knowledge is now recognized as continually constructed and reconstructed alongside environmental and social shifts. Recent collaborations between political ecologists and STS scholars have elaborated on the existence and comparison of multiple knowledges and highlight that political influences that are intrinsically tied to the transmission and circulation of knowledges (Goldman and Turner 2011).

Knowledge is not only produced by local resource users or scientific studies, but knowledge is also (re)produced and changed by those involved in the circulation of knowledge, such as government officials or activists, which leads to multiple environmental knowledges. Political ecologists have argued for recognizing multiple knowledges since focusing on one aspect or area of knowledge production is inadequate given these various influences across scales (Rocheleau 1991, Murdoch and Clark 1994, Agrawal 1995, Goldman 2003, Nadasdy 2011). Multiple knowledge constructions are "not one holistic whole, but neither [are they] a relativist disconnected multiplicity" (Goldman and Turner 2011: 17). These knowledges are continually subject to complex political influences. While Harding (2003) claims the similarity among the multiple knowledges make them all "local knowledge systems," these knowledges are not always produced or used solely in one place. Instead, these knowledges can be produced initially by one body in a specific locale or for a specific audience. But are subsequently circulated through a variety of other entities, adjusted, sometimes re-appropriated, and eventually used in various conservation and development frameworks or activities (Mol 2002, Law 2004). Many applications end up being far removed from the source of knowledge production, resulting in the knowledge being influenced by political factors which are also far removed from the eventual application of any knowledge.

Together, the physical and political co-production both of society and nature play a significant role in the production, application and circulation of knowledges. Political ecology theorists have long approached nature and society as interrelated and coevolved (Williams 1980, Cronon 1995, Escobar 1996, Castree 2005). Variations in knowledge, understanding and meanings associated with nature play into the politics and decision-making of resource management (Fairhead and Leach 1996, Ferguson 1994, Ingold 1987, Moore 2005, Nuemann 1998, Zimmerer 1996). Indeed, "in this era of cloning, global climate change, payments for ecosystem services, and so forth, the blurring of the boundaries between "natural" and anthropogenic has become more obvious despite the fact that our understandings of what constitutes "natural" has always been shaped by views of society" (Goldman and Turner 2011: 18). These constructed and reproduced knowledges do not exist in a vacuum. It is "embodied within and imperfectly translated across power-laden social networks" (Goldman and Turner 2011: 16). Among the complex and multiple environmental knowledges, certain productions are considered more important, are carried further, or are viewed as having more authority than others (Latour 1993). As the narratives that result from such disembodied knowledge move through various media the data matters less than the message(s) to which they have become attached. Though the narratives likely carry at least a kernel of environmental knowledge, messages are prioritized and heavily circulated due to a particular political or institutional motivation (Roe 1991, Fairhead and Leach 1996, Leach and Mearns 1996, Escobar 1998, Neumann 1998, Bassett and Zuéli 2000, Stott and Sullivan 2000, Brockington 2002, Forsyth 2003).

Social Vulnerability

Vulnerability is generally defined as the sensitivity of a given system, its exposure to a particular threat, and its capacity to respond to and recover from hazards and disasters (Kelly and Adger 2000, Yohe and Tol 2002, Finan et al. 2002, Cutter and Finch 2008, Fussel 2007). Social vulnerability focuses specifically on the sensitivity of a population, the socioeconomic variables that influence the effects of the hazard and the ability of a population to respond to and recover from the hazard in question (Cutter et al. 2009). Bankoff et al. (2004) argue that the conceptualization of vulnerability is at once simple and complex: at its core, vulnerability is about poverty, resource degradation, and marginalization; however, at larger scales it is about the complex ways risks are generated from the articulations of local and global processes and powers. Understanding the way in which societies place certain people at greater risk than others is fundamental for understanding their vulnerability. In other words, "vulnerability comes at the confluence of underdevelopment, social and economic marginality, and the inability to garner sufficient resources to maintain the natural-resource base and to cope with the climatological and ecological instabilities" (Ribot et al. 1996: 28).

The widely-used concept of vulnerability was initially developed by geographers and researchers studying environmental risks and natural hazards (White and Haas 1975). This risk-hazard approach is geocentric, often employed by engineers and economists to determine the risks from certain hazards (Burton et al. 1978, Kates 1985, Downing et al. 1999). This approach did not view human behavior as having any significant effect on vulnerability, instead focusing on physical systems and infrastructure. In contrast, approaching disaster research from a political ecology perspective led scholars to argue that hazards are natural, but disasters are not; instead disasters occur due to the differential degree of exposure to natural hazards (O'Keefe et al. 1976, Blaikie et al 1994, Wisner et al. 2004). Focusing on the human drivers of vulnerability, political ecology scholars began to examine the social, political and economic factors that influence the ability of a population to respond to disasters (Forsyth 2004). This approach argues that *social structures* create vulnerability, not nature, agency or technology. As such, the political ecology approach to vulnerability asks: How are people and places affected differently by hazards? What explains this difference? What are the causes and consequences of differential susceptibility (Eakin and Luers 2006)? For instance, populations can be differentially affected by a hazard, such as earthquake or drought, depending on existing inequalities in resource distribution, land tenure insecurities, and historical marginalization or social stigmas.

This shift from a geocentric idea of vulnerability to social vulnerability saw the development of three major models: the pressure and release model (Blaikie et al. 1994); the hazard-of-place approach (Cutter 1996, Cutter et al. 2003); and the vulnerability/sustainability framework (Turner et al. 2003). The pressure and release model explains vulnerability in terms of global root causes, regional pressures, and local conditions. This model is focused on the physical dimensions of the hazard itself, rather than how the interactions of social and natural systems create or exacerbate hazards. The hazard-of-place approach and the coupled vulnerability/sustainability framework are more integrated assessments of vulnerability, recognizing both physical and social factors in determining the vulnerability of a community or individual (Yohe and Tol 2002, Adger 2003, Adger et al. 2003, Fussel 2007). However, the hazard-of-place approach limits its assessment to exposure and how the affects of hazard shift in different populations, and in different spatial and temporal scales without exploring the root causes of social vulnerability or the larger cultural contexts in which this vulnerability exists (Cutter et al. 2009). In contrast, the coupled vulnerability/sustainability frameworks start at this larger historical and cultural context to determine specific vulnerabilities. As such, it neglects the specific exposures, sensitivities and spatial patterns of various vulnerabilities.

Because of the myriad definitions and employments of vulnerability, Fussel (2007) presents a conceptual framework that consolidates the key elements from these approaches in order to minimize misunderstanding. He argues this is necessary because separately the frameworks utilize terms that are incompatible with one another and none of them are comprehensive enough to adequately integrate the others. Biophysical approaches to vulnerability assessments are largely geared towards the exposure to the threat, while social vulnerability is concerned with the sensitivity of a system and its ability to respond to change and hazards. The relationship between social and biophysical vulnerability varies in the application, or conceptualization of various models: social vulnerability as a determinant of biophysical vulnerability (Brooks 2003), biophysical as a determinant of social vulnerability (Klein and Nicholls 1999), or as two independent dimensions of a larger vulnerability framework (Cutter 1996). Within these various frameworks, Fussel identifies two domains that can incorporate the various terminologies and therefore shape his own approach: sphere and knowledge domain. Sphere encompasses the concern of various scholars for the range of scales in which vulnerability is experienced and knowledge domain encompasses the physical processes and social institutions that determine how vulnerability is experienced across populations. Fussel suggests that exploring the scale (internal, external, and cross-scale forces) and the knowledge domain (socioeconomic, biophysical, and integrated) of how hazards are experienced by populations are key elements in a transparent and comprehensive assessment of vulnerability.

Vulnerability to Climate Change

Vulnerability assessments are used to explore a variety of risks, but they have become a central theme of the global climate change discourse. Assessments are especially important for those who seek to understand the social dimensions of change (Turner et al. 2003, Kasperson et al. 2005, Roncoli 2006, Fussel 2007, Schneider et al. 2007). For those scholars and policy makers who are interested in implementing relevant policies in response to climatic changes, understanding the contexts in which differential vulnerabilities exist between populations across spatial and temporal scales is critical. While the matricies and frameworks reviewed above are useful in exploring vulnerability, there must also be attention paid to the "ethnovulnerability" of these populations, or the way in which populations create their own definition of vulnerability depending on what aspects of environmental or social change are most salient to their perceptions of livelihood survival or success. Like the concepts of knowledge and scale reviewed above, vulnerability and related concepts are also socially constructed and influenced by cultural forces. Climate change discourse leans heavily on the various concepts of vulnerability, but adaptation, resilience, and adaptive capacity are conceptually linked to vulnerability, as well as to other critical elements in many climate change circles. These concepts are broadly defined and employed in the climate change literature, so I review them here.

Adaptation, like vulnerability, has a long history of use in fields such as ecology, natural hazards and risk management (see Orlove 2009 for a review of adaptation concepts); but its use in climate change research is relatively new (Smit et al. 1999). The term is used to refer to adjustments in ecological, social, and economic systems in response to actual or expected climatic stimuli and their effects (Smit et al. 1999). Adaptation is often viewed as a tool meant to reduce the vulnerability of a population to projected climatic variation or change (Smit et al.

2001). Often, adaptation, or human responses in general, is assumed in analyses of climate change effects (Smithers and Smit 1997). While all societies are fundamentally adaptive, increased vulnerability is expected in social systems with increased exposure to variability or extreme events. In other words, consequences of climatic variations exacerbate ongoing stresses in vulnerable populations. This is the case, for instance, in those communities dependent on resources that are particularly sensitive to climatic change, such as highland Peruvian farmers who depend on glacial meltwater for their livelihoods.

Adaptation represents a complex, multi-level series of actions taken by governments, civil society, and individuals as a reaction to extreme events or as a planned response to impending changes. Though most adaptation takes place at individual and household scales, these actions are constrained by the institutional processes such as regulatory structures, property rights, and social norms (Adger et al. 2005). Decision-making related to climate change is a socially mediated process, reflecting relationships between individuals, networks, capabilities, social capital and the state (Adger 2001, Yohe and Tol 2002). Smit et al. (1999) argue that it is not sufficient to only determine the likely adaptation, there also must be some judgment of its appropriateness, effectiveness, or acceptability in order to make recommendations to governments. In order to do so, Smit et al. (1999) suggest considering three questions when examining adaptation in terms of action or planning: What is being adapted to? Who or what is doing the adapting? How does adaptation occur? Adaptations may differ by degree of purposefulness, timing, scale, effects, form and performance. To further complicate matters, Smit et al. suggest that adaptations can be categorized as autonomous or planned, they can take place in natural or socio-economic systems, they may be anticipatory or reactionary, and they can be framed as primarily technological, institutional, or behavioral (1999). The characteristics of the climate disturbance should be taken into account when exploring adaptation responses, as strategies of adaptation might differ depending on the scale of events, temporal properties such as frequency, duration, or suddenness, for example (Smithers and Smit 1997).

Adaptations are manifestations of the adaptive capacity of a given unit and are not necessarily immediately recognizable as successful or even as adaptations. In fact, defining success within the adaptation literature continues to present a challenge for researchers, but doing so is arguably a key factor in any assessment (Adger et al. 2005). Adaptive capacity, or the ability to respond to effects, depends on the extent to which the problem is understood, the knowledge accessible to potentially vulnerable groups, whether effective responses are recognized and available, and whether the society has the resources to implement such responses. Adger and Kelly (1999) emphasize not only the importance of the resources available to a vulnerable population, but also the extent to which individuals, groups, or communities are—or feel—"entitled" to these resources. Following the work of Sen (1981, 1990), Adger and Kelly outline an "architecture of entitlements" that refines adaptive capacity beyond the existence of resources, to really examine the availability of these resources to vulnerable populations. Entitlements are measured by direct access to resources and distribution patterns as well as through the larger institutional context in which entitlements are "formed, contested, and distributed over time and among groups" (Adger and Kelly 1999: 256). Some elements that influence local adaptive capacity are access to financial, technological and information resources, managerial ability, infrastructure, the institutional environment within which adaptations occur, political influence, and kinship networks (Watts and Bohle 1993, Hamdy et al. 1998, Adger 1999, Kelly and Adger 2000, Smit et al. 2001, Wisner et al. 2004, Adger et al. 2001, Blaikie and Brookfield 1987). In addition to such institutional constraints, capacity to adapt is also mediated by issues of socioeconomic class, race, and gender (Pelling 2003, Pelling and High 2005).

Enhancing adaptive capacity requires improving the resilience of a system to potential collapse, or increasing the ability to restructure the system after collapse (Folke 2006, Nelson et al. 2007). The concept of resilience originated in ecology, though it took two distinct paths within the discipline: one focuses on efficiency, control, constancy and predictability, while the other is concerned with persistence, adaptiveness, variability and unpredictability (Holling and Gunderson 2002). The second definition, known as ecosystem resilience (as opposed to engineering resilience), measures the magnitude of a shock or perturbation that can be absorbed by the system before its structure changes. Ecosystem resilience thus views a system as having multiple states instead of constantly returning to one steady state (Carpenter and Gunderson 2001, Walker et al. 2004). Instead of arguing whether a system is resilient or not, the ecosystem resilience theory suggests that resilience shifts as the resources available to a system change. While traditionally the concept is used in ecology, its use has been expanded to also measure the resilience of human institutions and social-ecological systems (Gunderson and Holling 2002, Folke 2006). Within the climate change literature, resilience is viewed in similar terms as adaptive capacity since the degree of resilience can shift based on resources and thus is also an element of vulnerability assessments (Gallopín 2006, Nelson et al. 2007). However, there does exist the potential for tension between "adaptedness" (not adaptability) and resilience. For example, if a system is highly adapted to its current environment, this could negatively affect its ability to adjust to large system shocks and therefore exercise resilience. The significant difference between adaptation and resilience literature is the focus on actors in the former versus the connectedness of the system components in the latter (Nelson et al. 2007). The benefit of examining shocks and changes to the system from a resilience framework is that challenges *and* opportunities can be evaluated instead of solely focusing on the negative implications of perturbations. Insights from a resilience framework allow for the integration of actor- and system-oriented perspectives when analyzing for adaptive capacity and adaptations.

While adaptation frameworks are useful and arguably necessary models, identifying and measuring success and determining potential limitations to adaptation continue to be significant challenges (Adger et al. 2005, Adger et al. 2009). These challenges are particularly salient, since it is widely recognized that some adaptations become dysfunctional and destructive in the long-term (Kates 2000, Finan et al. 2002, Adger et al. 2005). Similarly, if an action has a positive outcome in one setting, it could produce negative effects for nearby systems or on a larger scale. Adger et al. set up a series of evaluation criteria for successful adaptations at different scales, including effectiveness, efficiency, equality, and legitimacy (2005). Fundamentally, these criteria ask who wins, who loses and who makes decisions regarding adaptive actions. They suggest that effectiveness is gauged through the reduction of risk accomplished by policy or behavior and efficiency deals with transparently laying out costs and benefits from adaptation activities. Assessing equity and legitimacy in adaptation is difficult because of the multigenerational nature of the problem. Many current adaptive actions reinforce existing inequalities and do little to alleviate vulnerabilities. Equity is important however, as one major measure of success depends on the heterogeneity of adaptive capacity across an affected population, since differences in capacity, benefits, and objectives has been shown to be detrimental to sustainable resource management.

Adger et al. (2009) propose that many limitations to adaptability are socially constructed along four foci: ethics (how and what we value), knowledge (how and what we know), risk (how and what we perceive), and culture (how and why we live). Ethically, limits set on adaptation activity depend on the goals of these activities, which are in turn dependent on diverse and multiple variables. These diverse variables and multiple ethical positions can limit negotiations or normalize a particular set of values over others if not adequately understood at the outset of deliberations. Uncertainties in knowledge continue to exist around the science of climate change, but scholars do not consider these uncertainties necessarily limiting for adaptation (Adger et al. 2009). A thorough exploration of relevant and feasible adaptation options can overcome knowledge limitations or be designed for flexibility. The degree of risk perception at various scales can seriously hinder adaptation, particularly if risk is denied or perceived as simply too overwhelming, which leads to inertia. Culturally, the "systematic undervaluation of involuntary loss of places and culture disguises real, experienced but subjective limits to adaptation" (Adger et al. 2009: 399). These places and cultures are valuable independent of material assets, and are under-researched likely because of the difficulty imposed by constantly changing values. By exploring the adaptive capacities of populations in light of these four foci and addressing where limitations exist, Adger et al. (2009) suggest that social limitations to adaptation can be overcome even as physical uncertainties continue.

Conclusion

Scale and knowledge operate in socially constructed ways that differentially influence decision-making surrounding climate change planning, particularly in terms of vulnerability and adaptation. Likewise, definitions and ways of measuring vulnerability and adaptation are influenced by cultural variables. These theoretical interactions are salient to my research since the focal point of climatic effects in the Callejón de Huaylas is future water availability. The fluid properties and perceptions of water are not limited to scales, physically or socially created, but are also managed according to the various knowledge frameworks through which the resource is understood. Gaining and maintain access to this resource is both a critical variable for determining vulnerability to climate change and central to adaptation plans for the region. Water resources are felt to be critical both from the perspective of the communities themselves as well as within the larger institutional frameworks and discourses in which these communities operate. Institutions involved in the management of a given resource define the type of knowledge that is valued, and by so doing, invoke the scales at play. I will show in the following chapters how these theoretical concepts unfold in the Peruvian highlands. Specifically, Chapters 4 describes how the land and water management systems are shifting in the study community and Chapter 5 explores the various forms and sources of knowledge about environmental change that are perceived to affect these systems. Chapter 6 addresses issues of scalar political negotiations over water management at national and regional scales and Chapter 7 outlines a qualitative assessment of the vulnerability and adaptive capacity of Siete Imperios considering the projected consequences of climatic changes to the region and the perceived vulnerability among the community members.

CHAPTER 3

HISTORICAL AND POLITICAL CONTEXT

The micro-politics of resource struggles are animated by local history, mediated by cultural idioms, and gendered through the different practices men and women have pursued in defense of local livelihoods.

Donald S. Moore

Introduction

Historical shifts in power leave people to maneuver in material and symbolic terrains not entirely their own (Moore 1996). Conflicts occurring at a village or community scale include elements of historical shifts in the larger political economy, state interventions, and global environmentalist discourses. Cultural practices, based in specific social and political contexts, are the ways in which people make sense of conflicts and shifts such as these (Donham 1990). Symbolic and material struggles both act on and are transformed across landscapes (Gramsci 1971, Marx [1859] 1986. The ways in which meanings of the landscape are contested shape the outcome of environmental politics in a particular area. Considering the importance of historical influences on current perceptions, degrees of distrust, institutional negotiations, and vulnerabilities, I will trace the pre-colonial, colonial and nation-building influences on the highland communities in the Callejón de Huaylas.

In arguing for a theory of past as persistence, Adelman (1999) posits that institutions, social and economic asymmetries and the structures of power can be deeply embedded in historical paths. The deeply embedded nature of these structures and conditions causes most efforts to overcome such legacies to fail. Economic or cultural persistence is as heterogeneous as it is prevalent in Andean histories, but people are not captives of their history (Adelman 1999). While there are deep continuities in Andean history these structures—though continuous in some ways—do not maintain the same relationships nor are they without contestation. Adelman argues that the deep structures of colonialism initialized the course of development, or underdevelopment, in many areas. He also argues for the persistence of "reconstituted legacies" that constrain action to some degree while remaining flexible within those constraints. For example, the dual existence of market and exchange economies allow some Andean communities to decide by which terms they enter the commodities market. The ability to make these decisions allows communities to resist larger changes since they were not bound to the market economy. These deep continuities are ruptured at times through revolutions or large-scale natural disasters, which permanently shift the way people situate themselves.

Historical legacies and deep continuities are important because they influence current perspectives and interactions between highland communities and "the state." This is a critical relationship considering the multi-scaled efforts necessary to confront the effects of climate change for the region. International crisis dialogs about climate change, specifically glacier retreat and related disasters, have allowed the state to employ "disaster economics" which, under the guise of disaster response, implements whatever economic development interests are *de rigueur* for a particular administration (Carey 2010: 12). Events in the Callejón de Huaylas since the 1970s are an ideal case of "disaster economics"; however, long before these current concerns, social and political trajectories were set in motion by millennia of occupation that provide the necessary contextualization for the current physical, social and political landscapes of the region. Given the long, complex history of occupation documented history in Peru, its contextualization in the following chapter focuses on periods and trajectories that directly affected water flows and the power and cosmologies that influenced their management.

Pre-Colonial Legacies

Though most accounts of pre-conquest Peru focus on the Inca culture and expansion, there were many pre-state level societies that thrived in the Callejón de Huaylas. Due to the particular brand of statecraft employed by the Incas, to incorporate rather than annihilate or imprison their conquests, much of the culture specific to the region persisted to some degree through both the Incan and colonial conquest. Because of this, I review below the pertinent aspects of pre-colonial Andean culture. It is important to recognize that throughout the chronology, from the Chavín cult to Incan expansion, there remained a high degree of differentiation along the valley (Orlove 1985, Keatinge 1988, Wilson 1999).

Ancestors of the Inca

The Callejón de Huyalas is one of the earliest known sites of human occupation in the Andes. Dating to 10,125 B.P. the Guitarrero Cave yielded the earliest South American textiles and cultivated plants (Lynch 1980). Guitarrero Cave is located above Shupluy, near Mancos, in the district of Marcará though across the valley in the Cordillera Negra. These early settlements were small, relatively autonomous societies. Highland societies developed into more complex social organizations and by the Late Preceramic (2,500 B.C.) there is evidence of economies based in agriculture and long-distance trade (Burger 1992, Stanish 2001). At this point, small-scale irrigation systems began to complement rain-fed agriculture (Fung Pineda 1998). Evidence of larger-scale irrigation systems does not appear until the first ceremonial centers were built, which began in the north-central highlands with Chavín de Huantar around 900 B.C. (Lanning 1967). It is suggested that irrigation was adapted to the highlands from coastal technology due to the more extreme water availability scenarios on the desertified coast (Lanning 1967). Contrary to theorists who have argued for the hydraulic hypothesis, in which it is posited that the development of irrigation systems were directly related to evolving civilization (Steward 1955, Wittfogel 1955), in this region the historical development of water management resided in the hands of local communities (Lane 2009, Fagan 2011).

The complex chiefdom of Chavín was once believed to be the first civilization in the Andes (Tello 1943), but is now understood to have developed alongside several centers of population in the Late Initial Period, around 900 B.C. (Burger 1992, Stanish 2001, Kembel and Rick 2004). Located just outside the Santa valley, Chavín de Huantár itself was not a residential center, but a temple and site of religious pilgrimage (Bennet and Bird 1960, Lumbreras 1977, Druc 1998, Druc et al. 2001). The development of Chavín culture was likely due to its location at the intersection of coastal, highland and jungle (Bennet 1946, Lathrap 1971). This access to exotic goods, alongside impressive engineering projects evidenced at the temple allowed the "theocratic" manipulation of other groups, "convincing" them to follow Chavín rule instead of exerting violent control (Tello 1942, Lumbreras 1974, Burger 1992). The emerging elites who controlled trade with exotic locals and eventually the agricultural surplus were also the groups in control of the metallurgy, stone and ceramic production that would further extend and legitimize their power (Rick 2005). Chavín flourished as a highly influential center of pottery, textiles, and stone carvings until the Upper Formative, 500 B.C. to 400 A.D.

Emerging after the decline of the Chavín cult, from the early centuries A.D. until about 750, Recuay was the complex polity of the Callejón, competing with other ethnic groups for control of the highlands (Lau 2010). During this time the region witnessed advances in all skills (metallurgy, stone sculpture, textiles, agriculture, irrigation, etc.) as well as increasing social stratification and inequality, evidenced in the development of corporate groups, also known as *ayllus* (Bennet and Bird 1960, Lau 2010).[19] The Recuay were known for their incredibly sophisticated pottery and their use of warfare, specifically skillfully located defensive fortifications (Proulx 1982, Ibarra 2003, Herrera et al. 2006). This period saw an increase in warfare-oriented material culture and architecture throughout the northern highlands, suggesting that it was a time of socio-political unrest (Lau 2010).

Recuay culture transformed around 8th century A.D. when the Wari expanded into the valley (Bennett 1946, Rowe et al 1950, Tello 1970). Pottery styles and architecture shifted to reflect Wari symbolism and building style (Isbell 1991, Paredes et al. 2000, Ponte 2000, Lau 2000, 2001). Wari influence in the region was brief. A collection of cultures referred to as Akillpo replaced Wari around 900 and lasted until the Incan expansion of 1450 A.D. (Lanning 1965, Lau 2004). The Wari and Akillpo periods saw much technological advancement alongside increasing social stratification and political organization (Bennet and Bird 1960).

Overall, during the Late Intermediate Period (A.D. 1000 to 1480), there was not a permanent dominant entity in the Callejón de Huaylas; however, there was significant sophisticated hydraulic technology (Lane 2009, 2007). This would suggest that water infrastructure developed from a “bottom-up,” community-centered perspective. This period saw regional formulations based on political organization creating confederacies or military band

[19] Corporate groups, or *ayllus* in Andean literature, are “collective instruments of action” (Urton 1992: 258) or “a descent- framed organizational charter that allows problems of different scope and nature to be addressed by collectives of variable inclusiveness and size” (Moseley 1999: 3). These groups “subsume kinship as part of a wider, adaptive decision-making order” but several exist in a given community which allows for intra-community rivalry and social stratification between *ayllus* (Lau 2010: 330). The use of the term *ayllu* may or may not date back to this time, as we do not know if Recuay spoke Quechua, but there is evidence of corporate grouping (Lau 2010).

level organizations, well-organized urban areas, and great expansion of irrigation technology (Bennet and Bird 1960, Orlove 1985). These multiple political organizations, be they bands or federations, reflect the continued warfare between various entities in the central highlands. Archaeologists describe the period before the Inca, the Late Intermediate, as a particularly tense time period for climatic and political reasons. The Andean writer Waman Puma ([1615] 1980) called it the *auca runa*, the age of soldiers, a time of wars. Many argue that this local fractiousness is what helped the Inca spread so quickly throughout the Andes (Murra 1986, Moseley 2001).

Inca Expansion and Empire

Much has been written about the chronology of the Incan expansion (see Rowe 1982, Murra et al. 1986, Keatinge and Conrad 1993, Abercrombie 1998, Moseley 2001, D'Altroy 2002, Murra et al. 1986). What is pertinent to my study are the specific elements of the Incan expansion that have direct repercussions for the social and political organization of the Callejón de Huaylas.

The Inca began as a small political unit, similar to those mentioned above, in the famous city of Cuzco in the southern Andes. They are notorious for an incredibly rapid and extensive expansion, beginning in Cuzco in 1438 and spreading in all directions. By the time of the Spanish conquest in 1542, the Incans controlled most of highland Ecuador, Peru, north and central Chile, parts of highland Bolivia and northwestern Argentina. Though they are often touted for their superior statecraft, many scholars argue that they exploited a political repertoire of Andean lords that existed well before A.D. 1000 (Kirchhoff 1949, Murra 1982). The government of this vast empire consisted of Incan officials who "supervised a hierarchy of hereditary ethnic lords drafted into state service" (D'Altroy 2002). These local lords helped organize households into various sized groups for taxation and military purposes. Administratively, the Inca introduced Quechua as the official language, kept detailed financial accounts and population census, and improved the existing network of roads to connect their vast empire. The specifics of their rule depended on the social and political conditions of a particular region, though generally it revolved around ritualized exchange, pageantry, and state-sponsored revelry (D'Altroy 2002).

Provincial borders and rule were largely based on pre-existing political structures, though these were somewhat reorganized to reflect Incan preferences for specific forms of accounting (Murra 1972). Each province was divided into ranked parts (ranging from 50 to 10,000) and within these, households were grouped into *ayllu* units. An ethnic Inca ruled each province, but a hereditary local elite (*kuraka*) was appointed to head each household unit (though if he was found incompliant, he was replaced). Depending on the number of households in their charge, *kurakas* received benefits such as servants, wives, and personal estates. This structure allowed the central government access to the goings-on throughout their province without having to completely restructure local governance (D'Altroy 2002). Evidence for *ayllu* formation existed in the Callejón de Huaylas prior to Incan expansion, but the use of this unit for payment of tribute strengthened the communal concept throughout the region.[20]

Alongside the reification of communal property and prosperity, the Incan expansion also institutionalized labor tribute. Once a region was conquered by the Incas, they owned all lands and resources. Heads of household were required to participate in a rotating labor service, known as *mit'a* (to take a turn). Providing labor tribute was the way in which a community could access

[20]It has been argued that prior to Incan expansion, *ayllus* operated with parallel descent and a gendered division of labor (Zuidema 1977); however, Incan rule changed descent to a patrilinial inheritance of *ayllu* membership and also changed structures to tie *ayllus* to their tribute purposes, thereby masking the coercion of tribute and the creation of class relations (Silverblatt 1987).

their ancestral lands, but *mit'a* was also used to draft men for military service, road building, craft specialization, or other administrative services. It should be noted that systems of mutual obligation existed prior to Incan expansion in order for highland communities to manipulate the complex Andean landscape to the degree they did (Moseley 1975, Gero 1990, Burger 1992, Hastorf 1993, D'Altroy 2001). However, the Incan lords changed the *mit'a* from a communal labor force based on mutual obligations to a method of taxation that disrupted community food production (Murra 1982). Overall however, the notion of communal reciprocal labor persisted. Alternate forms of these labor exchanges can be found throughout the Incan and Spanish conquest, and modern communities continue to use this system for cooperative projects (Mayer 1974, Bolton and Mayer 1977, Godelier 1977, Murra 1980).

Political power throughout Andean history is closely connected to the control of water, uniformly viewed as the lifeblood of humanity in Inca and pre-Incan cosmology (Urton 1990, Zuidema 1990, Gose 1993, Sherbondy 1998, Gelles 2000). Scholars argue that the religious symbolism and rituals of the Inca were an element of their statecraft, meant to impose their authority and divine connection to water, the source of life in the Andes. However, contrary to popular belief, the Incan did not introduce irrigation to the Andes. Extensive and sophisticated irrigation networks were long in place before their expansion in 1450 A.D. (Lane 2009). Zuidema argues that the primary reason that social divisions such as the *ayllu* were preserved throughout the various conquests was for the upkeep of irrigation canals and roads (1986). Based on real or fictive kin, the *ayllu* preserves unity, duality and hierarchy. Social organization and principles of reciprocation are replicated in each generation. New members are born into a particular *ayllu*, and into social responsibilities initiated by their ancestors' relationships in the community. Though an *ayllu* is oriented towards communal behavior, this does not assure equality among or within *ayllu* groups. Political rank within a community can be associated with the position of a family in relation to the canal. For example, key positions would be along the river from which the canal is fed, or at a diversion point within the canal. The relative political power of neighborhoods within a community is determined in part by their location along the canal.

"Andean" Ritual and Cosmology

Though the organization and employment of labor tribute was extremely effective at amassing great power and wealth by the ethnic Incan lords, they claimed to be mainly interested in "bringing order to a chaotic world and to spread the true religion of the Sun [sic]" (D'Altroy 2001: 209). Again, much has been written on Incan or Andean cosmology (e.g., Urton 1981, Saloman and Urioste 1991), so here I will simply summarize the elements that still influence communities in the Callejón de Huaylas. As Saloman and Urioste (1991) point out, though Andean and Incan are oftentimes used interchangeably and the Incan Empire did have long-lasting influence on non-ethnic Incan religious beliefs, the Incan subjects did not subscribe to such abstract expressions of religion as the Incans did themselves. Andean myth oriented itself toward more tangible sacred objects, such as mountains, canals, and other entities that held meaning for their *ayllus*.

Andean cosmological traditions view nature as highly animate. Within it, there are male and female forces that strive for duality, balance and equality (Moseley 2001). *Pachamama* (mother Earth) is highly venerated, as evidenced by offerings and prayers in her honor throughout the agricultural calendar. Mountains are imbued with life, seen as influential spirit forces (*apus*) since they control the weather and are the primary sources of water, the lifeblood of *pachamama* (Bernbaum 1997, Reinhard 1985, Moseley 2001). Moseley (2001: 52) describes the cosmological-hydrological connections:

> Water, vital to life in the arid Cordillera, is believed to originate in a cosmic sea that the earth floats upon. Moisture is picked up from the sea and transported heavenward by the Milky Way—*Mayu*, the 'celestial river.' The star stream then releases rainfall on high *apu* peaks where essential moisture descends in runnels and rivers to feed crops, canals and *Pachamama* who nourishes humanity. Farmers watch *Mayu* closely, because solstices of the Milky Way coincide with onsets of the wet and dry seasons.

Continuing the cosmological framework of water movements, Urton (1981: 60) describes how "terrestrial rivers conduct water downward (rain → streams → rivers → downward), the celestial River recycles water upward (cosmic ocean → northern Milky Way → upward)." In many parts of the Andes these cosmological traditions continue, often alongside or even blended with introduced western religions such as Catholicism or evangelism. The strength, clarity, and connectedness of various communities with these traditional cosmologies varies greatly throughout the highlands. I will discuss the extent of these cosmological connections for the Callejón de Huaylas in the following chapter.

Colonial Legacies

The defeat of the Incan Empire by a small Spanish force was largely due to shifting allegiances of local polities (Murra 1984). Believing the Spanish would free them from Incan rule, many communities, most notably those of the Mantaro Valley, fed and sheltered Spanish armies for more than a decade (Murra 1984). This alliance, along with the ongoing civil war between two Incan brothers for the throne, provided enough advantage for the Spanish to defeat the empire in 1532. Due to disease and famine, the indigenous population dropped rapidly following the Spanish conquest and some estimate that the population was less than a third by the end of the sixteenth century (Orlove 1985, Moselely 2001). The Huaylas region experienced extreme demographic crisis from the Spanish conquest (Thurner 1997). Once the Inca were defeated, middle level non-ethnic Incan lords were so alienated from their communities of origin, that they were easily swayed to work with the Spanish army (Rowe 1982). Highland lords found themselves more powerful than ever, with the control of regional exchange between mines, and in possession of horses, firearms and silk. Those who lived through the transition from Inca to Spanish rule felt that society was "so transformed that the depths of change still resist historiographic conceptualization" (Saignes 1999: 59). In Huaylas however, ethnic lords were obligated to pay tribute for those Indians who had left or were killed during the conquest, a financial burden that necessitated the sale of Indian lands to pay the tribute (Thurner 1997).

The first few decades of Spanish rule were fraught with in-fighting among the Spanish settlers, until Viceroy Francisco Toledo arrived in 1568 and initiated the true colonial period (Murra 1984, Orlove 1985). Based on a detailed census employed to discover the mechanics of highland productivity, Toledo ordered the forced relocation of thousands of people from the hillsides into towns and villages. These *reducciones* strategically created visible and accessible villages that were easier to control.[21] Murra (1984) and others claim this was a reaction to Toledo's discovery of how important ecological complementarity was to the local production systems. As such, Murra argues that the two decades between Toledo's reign and the indigenous uprisings saw a continual decline of resources, population and the degree of self-government, "permanently impoverishing the Andean economy" (1970: 9). In addition to this campaign, Toledo made several other changes with broad implications: he adopted a version of the *mit'a* for

[21] Wernke (2007) argues that although many people discuss the *reducciones* of Toledo as being a significant break in traditional settlement patterns, little is known about how these took place across the landscape or how they relate to indigenous patterns of *ayllu* organization. Werke suggests they were a continuing trend of Inca rule rather than the dramatic departure they are typically portrayed to have been.

work in the mines which paid a minimum wage, and replaced tribute that was paid with goods with a tax that obligated indigenous populations to perform wage labor in exchange for cash. These changes resulted in the decline of interregional ties, which were replaced by localized subsistence-oriented economies where the household and other domestic units became the center of control (Larson 1980, Saignes 1999). Over the next two centuries, indigenous institutions continued to dissolve through “a period of gradual erosion of resources, population and degree of self-government” (Murra 1984). The pattern that emerged exists in some part today where households employ a mixed strategy of subsistence farming with market activities (Orlove 1985).

Resistance and Rebellion

Although there was bitter anti-Incan resentment when the Spanish first arrived, afterwards the Andean people quickly realized that Spanish rule was much more oppressive and began to yearn for the return of Incan rule. Rowe (1982) comments that the further Incan rule was in the past, the more desirable it became, so natives began creating an Incan national identity in opposition to the Spanish oppression. In 1781 there was a massive Andean revolt with an “underlying Andean, even Inca, justification” (Murra 1984: 126). These revolts were due to the increasing economic and political pressure from demands Spanish colonials created among peasant populations in the form of rising taxes and military conscription (Orlove 1985). These rebellions were largely indigenous, if occasionally assisted by various mixed racial groups, and were usually led by highland *kurakas*, indigenous leaders who previously had been instruments of colonial control (Stern 1987). There were several notable resistance movements during what is known by scholars as the Age of Andean Insurrection (1742-1782), but one movement in particular had a lasting effect in the Peruvian highlands (Stern 1987). This insurrection began in Cuzco, led by a wealthy *kuraka* now famous for taking the name Tupac Amaru II, a name which symbolizes resistance for highland Peru still today. Tupac Amaru II aimed to reinstate Incan control over ancestral lands and thereby claim sovereignty from the Spanish crown, but as the insurrection grew it "included components which were socially and ideologically as different from one another as each was from the Spanish culture which they opposed" (Campbell 1987: 128). This movement was suppressed, but not without great difficulty for the Spanish (Murra 1984). Once the rebellion was subdued, repressive anti-Indian measures were installed and sentiments of backwardness and violence were again attributed strongly with the Indians, widening the gulf between Indians and non-Indians (Walker 1999, Larson 2004). This racial scorn carried through independence activities and nation-building (Salomon 1985). Some argue that this revolt was in part related to the independence of Peru, which followed shortly thereafter, but others maintain it was a distinct, Andean rebellion (Kubler 1952, Bonilla 1981, Pease 1978).

During the colonial period, the emerging conceptions of the nation and republic were at odds (Thurner 1997, Walker 1999). The nation was associated with the collection of inhabitants or citizens while and republic was considered the nation's legitimate body of public governance. This constructed duality had real historical consequences (Thurner 1997). The large Indian population played a key role in the transformation from colony to republic (Walker 1999). Although many studies paint the native population as passive and static, indigenous leaders negotiated their participation in various legal and market affairs. The various peasant resistance movements constituted one way these populations negotiated with the republic since these struggles were connected to broader political movements. Communities would attach their resistance to a particular party or authority who respected their autonomy and had an agenda for social justice (Walker 1999, Mallon 1995).

Nation Building: "The Indian Problem"

The wars of independence (1819-1924), while successful, left Peru fractured politically and economically. Landowners and elites in Peru were resistant to liberal ideas and still fearful of Andean uprisings like those of the 1780s (Larson 2004).[22] It took invading armies from neighboring Andean nations to wrench Peru free from Spanish rule. The coastal, mineral and mercantile productivity of late-colonial years declined due to the disorder in the early decades of the new nation and a long series of short government regimes failed to consolidate the new nation (Bonilla 1987). This factiousness allowed "the old articulation of interests and ethnic identifications achieved by important factions of the Andean peasantry in answer to colonial domination, and gave way in the first half of the nineteenth century to a 'balkanization' of the peasants' interests" (Bonilla 1987: 220-221). The new state was designed on principles of the Enlightenment, but the actual operation of the state apparatus was based on maintaining old regime structures (Nugent 1997, Orlove 1985). Colonization was so hegemonic that the stigma attached long ago to "Indianness" has worked its way into "Indian" self-consciousness as well (Abercrombie 1991). Indian/non-Indian and other dichotomies were not only colonial remnants, but also distinct analytic arenas for the emerging nation-state. On the path to independence, the state felt the need to "modernize" Andean societies by breaking down existing institutions. Intense pressures were generated to stamp out the "backwardness" identified with Andean language, dress, settlement, and regional or ethnic autonomy in schools, churches and armed

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[22] In the context of the Peruvian politics liberal leaning politics were both anti-monarchy and pro-free market. These positions were threatening to traditional landowning elites because it would change the structures under which these elites had amassed wealth and power.

forces. Colonial legacies were less important in nation-making than the hierarchical, discontinuous, and internal boundaries of ethnicity, class, gender and corporation (Thurner 1997).

Indian tribute took on many changes that reflected the multiple visions for Peru from the end of colonialism through the struggles for independence and the emergence of the nation-state. In 1812 liberal Spanish constitutionalists abolished the Indian head-tax. This left both highland indigenous authorities and the landowning Spanish elite nervous about what would replace the system and it was restored briefly in 1814. The armies for independence again ended the tax in hopes of installing a more utopian government, complete with citizenship for Indians and the first agrarian reforms, granting permanent and absolute land possession to those indigenous groups occupying land (Larson 2004). The complexity of this decree became quickly apparent to the liberators, and as soon as they left, the new congress restored the head-tax and limited the land reforms (Larson 2004). The new head-tax, known as *contribución de indígenas*, was seen as crucial to the floundering national budget and remained in place until the 1850s. While reinstating the head-tax, the new government abolished any communal or other rights to land, self-rule or protection. The tax was now supposedly in exchange for possession of subsistence plots of land. Land ownership was one of the requirements for citizenship under the newly independent Peru. However, the exchange of head-tax for subsistence plots of land was engineered to suggest but not guarantee citizenship and property rights to peasants (Larson 2004, Thurner 1997).

During the early decades of nation-building census records show “resurgent Indianness” in the Peruvian highlands (Larson 2004: 145). The degree of *mestizaje* in Peru was significantly less than other Andean counterparts, especially in the highlands (Gootenberg 1991, Kubler

1952).[23] Though some argue that neither liberalizing policies nor market forces had much influence in the highlands until just after independence (Jacobsen 1997), Thurner (1997) shows how the indigenous leadership in the highlands of Ancash worked to obtain such separation from republican institutions. As the nation began to prosper due to emerging coastal economies, including the famous guano exports, the persistent ethnic and racial dichotomies appeared in terms of "modern coastal prosperity" (referred to as *mistis*) versus "backwards highland Indians" (Larson 2004). As the republic developed, the "Indian problem" was created (Larson 1999). The persistent Indianness of the highlands fueled the racism on the part of the coastal populations resulting in indigenous populations being used as the "other" upon which to create an otherwise unified state (Larson 1999). The consolidated and centralized "guano bourgeois" of Lima took aim at the highlands to promote and expand market capitalism and free-trade (Larson 2004, Gootenburg 1989, Bonilla 1974). The resulting legislation abolished any remaining Andean rights to communal property and lifeways, shifting indigenous populations toward a "universal" property and labor tax: "the republic needed to coerce the congenitally lazy and frugal Indians into the labor market by imposing a monetary head-tax" (Larson 2004: 155). Needless to say, these reforms again set off violent protests, uprisings and rebellions across the highlands resulting in heavy-handed efforts at suppression. These taxes encouraged the circular migration to the coastal plantations and peasants were increasingly viewed as the landless laboring class.

With the encroachment of Chile in the beginnings of the War of the Pacific (1879-1883), Peru enacted "war taxes" and attempted to mobilize highland peasants through force, which was ineffectual. Chile was set on annexing the southern coastal territory of Peru and Bolivia, and "no

[23] *Mestizaje* was a racial category under Spanish rule meaning mixed descent from European and indigenous parentage. As a bio-cultural process *mestizaje* was widespread in the northern Andes, Much to the chagrin of the Spanish elite, highland populations in Peru did not "disappear into *mestizaje*" though it did occur to a certain extent on the Peruvian coast (Larson 2004:152).

other Andean republic experienced such a costly and humiliating defeat as did Peru at the hands of Chile" (Larson 2004: 178). Chilean troops laid bare the regional factiousness among elites who failed to unify against the invading army and the country imploded into civil war. Though peasant populations mobilized effectively against the Chilean army, ultimately the war created the stage which allied the country's elites against the "internal enemies" (Larson 2004: 179, Mallon 1995). Peasant populations again found themselves the subject of racial scorn, as if they were at fault for the loss.

In Ancash, the late implementation of additional taxes and military conscription from the war with Chile exacerbated local tensions. These hikes in taxes and obligations arrived during a period of severe drought when many communities had recently lost access to highland hectares due to land privatization and enclosure.[24] Most Indian populations in the Callejón de Huaylas were living collectively in small *estancias* (ranches) governed by rotating indigenous authorities. These authorities were subordinate to provincial officials and therefore had to enforce the obligatory labor and tax structures. Unlike other highland areas, power relations between the national and local interests were still negotiated through ethnic intermediaries in the region (Larson 2004, Thurner 1997). Amidst this turbulence, Pedro Pablo Autusparia, the highest district-level indigenous official in the Callejón, petitioned the provincial officials for tax relief. When Autusparia was imprisoned and tortured by the provincial officials, thousands of peasants descended into the provincial capital of Huaráz from April to September of 1885. The provincial authorities were not able to contain the political violence and called for assistance from Lima.

[24] These areas had been critical to landless peasants for survival, but were closed by the landlords to extract further user fees and indentured labor by local peasants (Thurner 1997). Land was valuable to hacienda owner not for its production value, since his market was limited, but instead because it meant that the community could not develop local elites, and the resulting competition for labor (Spalding 1975).

This was not as purely an indigenous revolt as the Lima newspapers tried to convey. Townspeople and peasants were involved in the uprising, and as the violence escalated, guerrilla groups joined the fighting. Some townspeople were involved because they agreed with the cause, but others joined in order to better align themselves in the political arena of the time. Alongside the political violence, peasants and leaders petitioned and proposed various reforms in attempts to manipulate the larger political arena (Larson 2004). By participating in the politics, and not solely the violence, the people of the Callejón de Huaylas attempted to frame themselves as Indian citizens of Peru. Though the violence was defeated by military troops from Lima, the political petitions and threats kept the national tax collectors and other authorities from interfering in the valley for two decades (Thurner 1997, Larson 2004). Where the Callejón de Huaylas was rather commercially isolated until the War of the Pacific and ensuing rebellions, peasants in the region became "more economically stratified and culturally assimilated" (Larson 2004: 176). Rising *mestizaje* "ultimately reinforced ethnic and class differences—widening the difference between town and country, valley and highland, jacket and poncho" (Larson 2004: 177, Mallon 1983).

Thurner (1997) concludes his excellent history of Peruvian nation-making by asking, in the transition from colonial to national administration, what happened to peasant politics? Hobsbawm (1973) suggests that the "misencounter" between peasant objectives and the nation-state is due to a question of scale. The scalar focus for peasants is "the parish pump or the universe," not nationalism or its boundaries (Hobsbawm 1973: 8). However, the scale of peasant political consciousness is not limited to either pump or universe, but historically and culturally constructed (Thurner 1997). The Autusparia uprising was the product of "long-term political relations between Andean peasants, provincial elites, and the national state" (Thurner 1997:

139). Andean peasant populations found themselves somewhere between citizens with incomplete liberties and wanting to reinstate colonial structures that created the *Ley de Indias* which laid out Indian rights (granted for the purpose of extracting taxes). The other significant legacy in the transition to nation-state was the "peasantization" of indigenous societies (Thurner 1997: 142). As petty clientage increased in peasant-state relationships, the role of ethnic intermediaries became less that of mediator and more that of subordinate tax collector. Posts once held by intellectual, invested and literate (in both Quechua and Spanish) indigenous leaders were now annually rotating positions usually taken up by *mistis* with partisan interests or goals of monetary gain.[25] Thus, those holding the position were more dependent on others, usually non-Indian specialists, to assist them in any dealings with the state, enhancing direct control of Andean communities. The shift of this role from mediator to state instrument resulted in "misrepresentation and exploitation born of ethnic and class antipathy and miscommunication and, ultimately, with a growing cultural alienation that would plague *misti* political programs toward Indians (including *indigenism*) to this day" (Thurner 1997: 1471). This shift also left Andean societies without traditional means to cultivate ethnic intellectuals (Thurner 1997). These legacies would maintain the marginalization of Andean societies, so that the "postcolonial predicament of Andean peasants would continue to mean integration on separate terms, inclusion on the excluded fringes, disenfranchisement in the franchise" (Thurner 1997: 152).

Indigenismo

Though the nation moved toward cultural assimilation and increasing *mestizaje* in the mid-twentieth century, indigenous populations increased significantly in two "ethnogeographical islands," the Callejón de Huaylas and around Puno (Kubler 1952: 27-30, Thurner 1997). These

[25] *Misti* is a mildly derogatory term highland peasants use to refer to provincial authorities.

trends, along with the highly racial contextualization of the peasant rebellions and uprisings of the last century caused “heightened discourse of Peruvian dualism, which paradoxically essentialized and “othered” the Peruvian sierra as “natural” and “indigenous” as it refocused national discourse on “the Indian” as victimized subject” (Thurner 1997: 130-131). The results of these discourses were a period of scientific racism followed by indigenism.

Lima elites spun the numerous peasant rebellions that followed the War as the scapegoat for the larger political failures of the republic. The “Indian problem” and “race wars” during nation-making led Peruvian scholars to debate the “quintessential Indian character and the problems it posed to the nation” (Larson 2004: 197). Biological determinists and racial theorists debated the nature of the Indian, urging for “European blood to whiten the nation” (Larson 2004: 197). Others with a more positivist orientation argued for reforms to open the highlands to education, communication, and industry in order to better integrate and “improve” these populations (Larson 2004). This extreme racism inspired *indigenismo* among Cuzco intellectuals, a radical socialist but esssentializing view of Peruvian peasantry (Thurner 1997). Under the *indigenismo*, regional projects encouraged the spread of an “Inca utopia” as the “authentic cultural patrimony,” directly opposed to the modernist Eurocentricity of Lima (Larson 2004: 198).[26] *Indigenismo* took both political and ethnological trajectories, both aiming to include Andean perspectives in a re-written Peruvian history; however, they “usually portrayed them as backward victims oppressed by highland ‘feudalism,’ or as noble savages far removed from the historical and political forces shaping modern Peruvian life” (Thurner 1997: 146). Though

[26] The concept of “utopia” was first applied to Peruvian contexts by historian and activitist Alberto Flores Galindo in 1975 to refer to the ideas behind various revolutionary projects (Aguirre and Walker 2010). Inca utopia specifically refers to the ideas behind a movement to deny the exploitative relationship between Andean populations and the new republic, instead returning to a more egalitarian, organic, and Andean society. Though Incan rule was exploitative and repressive for most Andean people, the memory of Incan rule was preferred to that of the colonial powers or even the new republic (Flores Galindo 2010).

essentializing, this movement created the space that later allowed the exploration of Andean ethnicity as created, imposed categories, rather than natural (Salomon 1982).

Sovereignty, Disasters, and Development Aid: Contemporary History

After centuries of rocky dominance in the highlands, peasant struggles began to erode the political backing of the hacienda system. After a few faux passes at reform, the military government of General Juan Velasco Alvarado passed the Agrarian Reform of 1969 soon after he seized power (Lastarria-Cornhiel 1989, Seligmann 1993). Velasco immediately began implementing the extensive reforms. The reforms aimed to appease peasant unrest by truly transforming the system of land ownership, though it did so while in dialog with capitalist and modernist objectives of the state. In passing the Agricultural Reform, General Velasco proclaimed that peasants were now part of the national identity. Based on a Yugoslav model of social property, the state was aiming to establish state capitalism and modernization while minimizing class differences and thereby peasant unrest (Selignmann 1993). The land redistribution that was proposed as radical reform was in fact aimed paradoxically at ridding society of class while bringing the whole country together under capitalism. After redistribution rural peasant classes remained largely unchanged since the state replaced the landholding elites as landlords, and smallholder farmers were expected "to produce within a capitalist system but with little capital and few resources" (Lastarria-Cornhiel 1989: 152). Capital that was previously invested in maintaining agropastoral activities under the hacienda system was no longer available to the newly titled peasant communities.

The reform planned to redistribute at least ten million hectares (47% of available agricultural land), benefitting 300,000 peasant families by 1975, but only half of this had been achieved by 1974 (Cabarello 1977, Lastarria-Cornhiel 1989). While the reform shifted land titling from the hacienda owners to peasant communities, water remained a national resource. In the highlands, haciendas from 15-55 hectares were expropriated without exception (Lastarria-Cornhiel 1989). For those highland landowners who owned affected hectares of land, their land was valued on the basis of their tax declarations and a compensation package was offered to them, composed mostly of industrial bonds (Lastarria-Cornhiel 1989). This reform was more successful at eliminating bureaucratic barriers. In an effort to streamline the process of adjudication, an Agrarian Tribunal was established to hear disputes with well paid (and thus less corrupt) judges tasked with the objective to assist peasant claims instead of remaining neutral. Bilingual (Quechua and Spanish) public defenders were available for free and oral testimony was allowed in lieu of documented land claims. Even with these entities in place, most adjudication proceedings lasted three or four years.

As the redistribution of land was implemented throughout the highlands, the program shifted to the complementary purpose of promoting collective enterprises, which received 76% of the redistributed land (Barker 1980). Outside of these cooperatives, lands were received by *communidades campesinas.* As of 1989, c*ommunidades campesinas* were officially recognized as fundamentally democratic institutions, organizationally autonomous, using the land communally. According to Article 2º of the General Law of *Communidades Campesinas* (Ley Nº 24656):

> Camepsina Communities are public interest organizations, with legal existence and juridicial personality, composed of families that inhabit and control certain territories, linked by ancestral, social, economic, and cultural ties, expressed in the communal ownership of land, communal work, mutual aid, democratic governance and development of multisectoral activities, whose fines are oriented towards the full realization of its members and the country.

All territory of the community is considered communal land and can be allocated in order to best benefit community production. According to the law in order to be recognized as a member of the community you must be born in the community, be children of those living in the community or be "integrated" into the community. A person is recognized as a *comunero calificado* (qualified community member) if he is of age, has a stable residency of more than five years in the community, does not belong to another community, is inscribed in the register of community members (updated every two years), and agrees to comply with the statutes set out by the community for its members. Integrated community members have formed a stable partnership with a member of the community or have solicited membership and been accepted by the community.

While nearly 40% of the 349 c*omunidades campesinas* currently recognized in Ancash were recognized prior to the formation of the republic, the majority were recognized during the main campaign of Agrarian Reform. Siete Imperios was first recognized as a *comunidad campesina* in January 1976 and eventually awarded the title for the property in November 1997. According to archival records from the Ministry of Agriculture, there were several rounds of adjudication for lands now included as Siete Imperios. The delay between their recognition as a community in 1976 and being awarded the title in 1997 was due to the time it took the new community to pay off the "*deuda agraria*" (agricultural debt). This debt was based on the price of the lands the communities were being awarded. The communities paid the Ministry of Agriculture for the lands they acquired, who in turn, paid the former hacienda owners the base value of the lands they lost in the reform. Most communities were not required to pay for the lands they acquired due to the "excessive exploitation" they suffered under haciendas, but Siete Imperios was one of the first instances of land transfer under the Agrarian Refrom and had paid nearly half of the *deuda agraria* before this payment structure was abolished under the first administration of Alan Garcia (Interview 97). Siete Imperios was considered a highly successful transfer and used as an example throughout the country during the implementation of land reform.

Not surprisingly, there was strong opposition to the reform measures among affected landholders. In a solicitation to the director of the Ministry of Agriculture in 1981, the president of Siete Imperios requested action on an outstanding adjudication:

> In this plot there has been a series of problems and disagreements with the supposed owner Rosa Castillo, Dexter's widow, who knowing the above-mentioned situation of the indicated plot, is trying to recover it with very arrogant and contemptuous attitudes against the modest and indefensible farmers in my community, arguing that the Land Reform Act has ended [sic].

The president continues the appeal to the director, claiming the community "cannot take any form of force to counteract the undue abuses to which [they] are objected on the part of the supposed owner." Interviews among older members of the community that partook in the transition from hacienda to community recall the difficulties of the "time of exploitation" (Interview 101). The first president of the community recalls the difficulties families faced while "working" for the hacienda:

> Our parents were explored by the hacienda. They worked Monday to Friday for the hacienda without any compensation. They did not pay [our parents], only allowed them to utilize a small parcel of land, like rent. It was serious exploitation. It wasn't only our parents that had to work, but we shared the work too. For example, my father worked in the hacienda plowing the fields. He did not have enough time to work for the hacienda and also work our family's parcel of land, to feed his children and his wife. The two days off from the hacienda were not enough. So our parents worked from 3am on our plot before going to work for the hacienda, because two days was not enough to advance our plot. In two days you cannot do anything. So the children of the *campesino* (peasant) we too had to work pasturing animals so that our parents could go work for the hacienda. After working his own field in the early morning, my father had to go like crazy to work because if he didn't arrive on time, they threatened that they would take away his land. Equally our mothers had to work too. They went to harvest *pasto* (animal fodder) for

> their guinea pigs, milked their cows, washed their clothes. It was an ugly exploitation. (Interview 97)

The introduction of Agrarian Reform in the highlands of Ancash, regardless of its successes or failures, occurred during an incredibly tumultuous time. Almost simultaneously haciendas were dissolved, *communidades campesinas* were awarded or sold titles to expropriated land, a large protected area was established, two natural disasters occurred that wiped out or triggered migration in a significant percentage of the population and the aid that followed created its own ripple effects for the emerging infrastructure and institutions.

Huascarán National Park

Toward the end of the expropriation phase of the Agrarian Reform, national legislation was created to establish protected areas throughout Peru. Initial planning for Huascarán National Park (PNH) was proposed in 1960 and early timber and hunting restrictions were introduced locally in 1966. The planning of potential park boundaries and expropriation of land was greatly facilitated by the Agrarian Reform of 1969 and was recommended as a response to the disaster of 1970 (discussed below) as a way of allowing access to the unstable glaciers and glacial lakes which exacerbated this and other disasters (Barker 1980). PNH was officially created alongside ten other conservation units in 1975 to “preserve distinctive landscapes and endangered species and to augment the regional economy with revenues from tourism” (Barker 1980: 11). The main objectives of PNH are to conserve biological diversity, protect landscape quality and protect water quality and quantity. Encompassing most of the Cordillera Blanca, the park covers 3,400 km^2 (340,000 hectares) with 60 glaciated peaks over 5,700m, getting its name from the highest peak, Huascarán (6,768m). From its northern to southern border, it measures 158 km and on average is on average 20 km wide (see Figure 4). Ecologically, PNH is a complex mosaic of *puna*, high alpine meadows, and tundra containing rare *quenua* and *quisuar* forests and *icchu* grasses and endangered species of vicuña, puma, spectacled bear and the Andean condor and deer.

The park was expanded to include a buffer zone when it was designated as a United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Reserve in 1977, which encompasses the territory of several indigenous communities and brings their management decisions into national and international policy arenas (Byers 2000). PNH was designated as a World Natural Heritage Site in 1985 and is a Level II protected area according to the International Union for Conservation of Nature (IUCN). The boundary of the park core follows the 4,000 meter contour line where cultivation generally begins; however, migratory and rotational livestock grazing is prominent at higher elevations and there is evidence of this practice since the earliest settlement in Callejón (Lynch 1981). As with many other cases, "given this long occupation and the region's status as a biodiversity hotspot (Manne et al. 1999, Myers et al. 2000, Rodriguez and Young 2000), it is likely that local livelihoods have played a role in creating the landscape and the diversity conservationists wish to protect; at a minimum, it could be argued that they have not been strongly inimical" (Farris 2007: 7). Due to these traditional rights, communities are allowed access to, and the use of, resources within the park and the buffer zone (del Castillo et al. 1995). Negotiations between traditional land-use rights and park prohibitions continue. Like many conservation areas before them, PNH struggles with conflicting goals of conservation and maintaining resource-dependent livelihoods. Fortunately occupation within park boundaries is not an issue for PNH, but fears and accusations of overgrazing within park boundaries are common and grazing rights are contentious in some areas (Byers 2000, Fariss 2007).

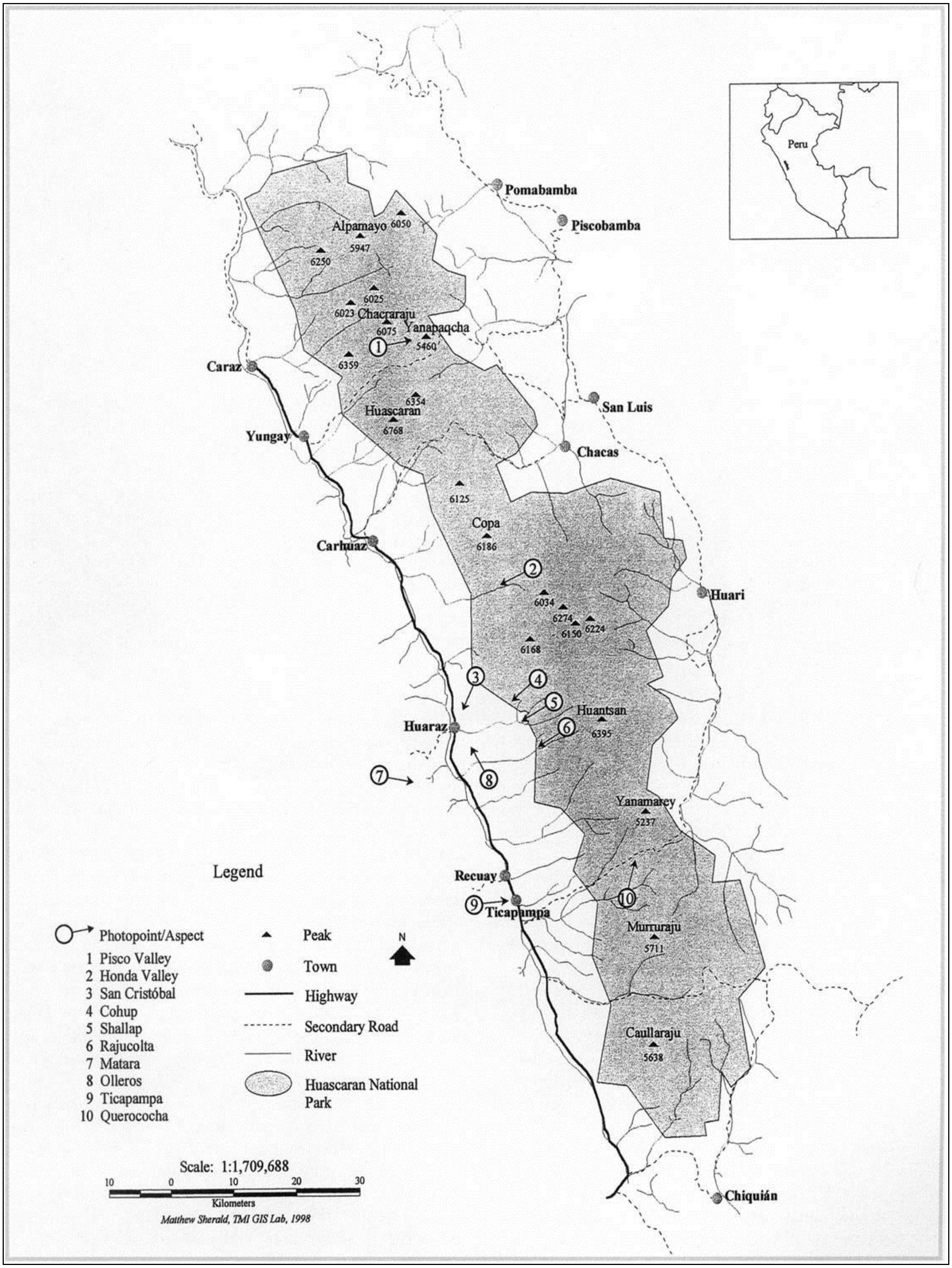

Figure 4 Huascarán National Park. Byers 2000.

Although there are presumptions about degradation within PNH, a large degree of uncertainty exists on whether these concerns are valid throughout the Callejón (Byers 2000). Degradation concerns focus on the reduction of native forests through overgrazing (Hensen 1991, Fjeldså and Kessler 1996), the introduction and rapid spread of eucalyptus and pine plantations, effects of grazing, mining and road construction (Lozada 1991, TMI 1996), and the effectiveness of buffer management strategies (Byers 2000). Comparing photographs taken by a cartographer Hanz Kinzl in 1932 with those taken in 1998 from the same vantage point, Byers (2000) analyzes these degradation concerns for the Quebrada Honda, the valley forming the northern border of Siete Imperios. The main results of this analysis are documentation of the construction of a road into the valley in 1990, an increase in cultivated land and enclosed fields, and loss of native forest cover along the valley walls. Of those sites studying under Byers' project, the Quebrada Honda was one of the few that showed any decrease in native forest cover. This loss, in addition to the increase in cultivated land, are both attributed to the accessibility and related increase in resource use created by the introduction of a road into the valley (Byers 2000). Heavier grazing practices and increased population and urbanization were also shown through Byers' (2000) preliminary study.

Though they are within the buffer zone, Siete Imperios has not experienced friction with PNH authorities because the park border sits above most traditionally utilized land. There is a large area used for what Farris calls "absentee herding" above Siete Imperios where families leave horses and cattle to graze without direct management. The border of PNH runs through the middle of this grazing land but my research did not indicate this was a significant conflict with PNH. Though park regulations require communities utilizing resources within the Park to establish a *junta de usuarios* (user group) in order to communicate with park officials to determine and monitor the extent of use within the park, Siete Imperios has not yet created such a committee (Tohan 2000, PNH 2003).

Research participants in Siete Imperios did mention that Park officials banned burning within the park. Farmers often burn off material left in a field after harvest and this practice has been heavily criticized by environmental authorities within the government and some NGO programs. Through targeting burning practices authorities place blame for localized environmental degradation and glacial recession at the feet of highland farmers. However, most agricultural burning occurs outside of PNH boundaries so has not yet been significantly altered by their prohibition of the practice. Burning practices that have been altered by the ban are those that take place annually at the foot of the glaciers to celebrate *Fiesta de San Juan* (St. John's Day).[27] Traditionally, people celebrate the *Fiesta de San Juan* by trekking to the glacier and burning offerings for the continued fertility of their livestock. Similar to *Fiestas de San Juan* across the globe, in the Callejón de Huaylas, celebrations include elements of fire (offerings), water (glacier), and fertility (livestock). This is one of the few ritual practices that persist in the region where community members actively commune with the glaciers in the Callejón, since they are included in the ritual as symbolic of water. Unfortunately, the inclusion of the glacier necessitates burning the offerings within PNH boundaries. Community members claim that before the ban, the valley sky was black on San Juan with all the ritual burning, but now only small billows of smoke dot the landscape. Community members cited the role of PNH and their decision to ban burning when discussing the glacier, particularly their continued interaction with it, or lack thereof.

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[27] Held of June 24th, the Fiesta de San Juan is a classic mix of European and Andean rituals as it celebrates both the birth of Saint John the Baptist and summer solstice. As the ritual was adapted to Andean contexts, San Juan became the protector of cattle, llamas and sheep and is identified (most strongly in Cuzco) with the Inca solestial celebration of Inti Raymi (Guss 1993).

Disasters and Development Aid

The earthquake of May 21, 1970 began as most tremors do in the region, as a gentle swaying. This quickly escalated to violent shaking following by the roar of an avalanche from Huascarán. When it struck, it was the worst natural disaster recorded in the Western Hemisphere:

> It registered 7.7 on the Richter scale and affected an area of about 83,000 square kilometers. It claimed approximately 70,000 lives, injured 140,000 people, and destroyed or damaged more than 160,000 buildings. In Yunguay the earthquake shook loose a slab of ice and rock about 800 meters wide and 1.2 kilometers long from the sheer northwest face of Huascaran... This mass, with a volume of a million cubic meters, fell on Glacier 511 where it picked up more material, growing perhaps to twenty-five million cubic meters of material. This immense mass of ice, mud, and rock careened down the mountainside at a velocity varying between 217 and 435 kilometers per hour. As it moved, it picked up huge masses of morainal material and hurled thousands of boulders, some weighing thousands of tons, down into the valley. Heat generated by the friction of the swiftly moving avalanche melted glacial ice, creating a gigantic, churning flow of mud and rock. The momentum of the slide carried it the sixteen kilometers from its origins in Huascaran to the valley floor in four minutes. The avalanche developed three separate lobes as it extended itself over the lower parts of the valley and into the river. (Oliver-Smith 1992:11-12)

Though the earthquake centered on the coast, the landslide that followed devastated the town of Yungay and much of the rest of the Callejón de Huaylas (see Figure 5 and 6). In the wake of the natural disaster, social, economic, and political upheaval followed. The lack of disaster response planning and the magnitude of the crisis in the Callejón de Huaylas prompted the government to establish the Committee for the Reconstruction and Rehabilitation of the Affected Zone (CRYRZA). Its president and offices were initially located in Lima, but a year later Velasco ordered the offices moved to Huaráz to encourage greater efficiency and evoke empathy from his staff for those affected by the disaster. CRYRZA had complete authority over any disaster response, including the distribution of aid, longer-term relocation and development plans and the activities of all other ministries in the region (Oliver-Smith 1992). As emergency relief faded into reconstruction efforts, the aid became increasingly institutionalized under CRYRZA.


Figure 5 Aerial photograph of Yunguay before May 1970. Photograph by Lloyd S. Cluff.

Requirements for registration with CRYRZA were unrealistic, requiring legal documents often lost to the disaster, and the unfair and inefficient distribution of aid sparked conflict. Because of the selective distribution, aid "stimulated friction and competition rather than cooperation. It continued to be an irritant in social interaction and community organization" (Oliver-Smith 1992: 151). Material aid was not considered useful, as opposed to loans or other types of aid that

Figure 6 Aerial photograph of Yunguay after May 1970. Photograph by Lloyd S. Cluff.

would allow survivors to rebuild sustainable livelihoods.[28] Oliver-Smith concludes that "recurrent waves of material donations create patterns of dependency, lowered self-esteem and morale, and conflict within and among social groups and sectors. Paternalistic forms of disaster aid which do not involve the recipients in decision making, management, and implementation, risk compounding the psychological and social impacts of disaster" (1992: 159).

The cities along the valley from Yunguay to Huaráz were destroyed by the coupled effects of the earthquake and the massive landslide, but those communities living in the upper

[28] Material aid took the form of second-hand clothes from Lima and unfamiliar canned goods from the US.

folds of the Cordilleras were less directly affected by the disaster itself. The landslide originating from Huascarán Norte (the glacier) missed Siete Imperios entirely since the communities sits above its path, but it was rocked by the earthquake. While the urban areas suffered massive casualties from buildings collapsing into narrow streets, those living in the rural communities like Siete Imperios were able to escape their crumbling adobe structures into open pasture. Though the risk exists for a similar landslide to originate from Copa Glacier, people in Siete Imperios feel well protected by the berm that lies between the community and the glacier. It is thought that the valley that sits between this berm and the glacier (where absentee herding occurs and the PNH border lies) would capture most of the landslide if one were to occur.

The magnitude of the disaster required a response that was well suited to the reform-minded government in power. The Callejón de Huaylas was the testing ground for the implementation of the Agricultural Reform of 1969 and other structural reforms, as well as pilot development policies. In the convergence of the disaster itself, disaster aid, and the structural reforms, "there [were] more experts per inch than fleas on a dog's tail and it would seem that every other vehicle [had] an official seal of some kind on the door" (Doughty 1970: 10). This culture of experts had a profound effect on the confidence, cooperation and adaptability of the highland communities of the Callejón. Just as communities were gaining control over the means of production through the expropriation of hacienda lands, the message from the government was that they were incapable of making productive decisions without outside help. Indeed, many communities found that without the capital of the landlords for fertilizer and other inputs, coupled with extreme inflation from increases in government spending, and an unfortunately timed drought, they were unable to keep as much of their newly titled land in production as needed (Oliver-Smith 1992). The waves of development agencies associated with the disaster of

1970 “not only failed to provide support or technical assistance, but managed at the same time to disempower local organizations and leaders” (Doughty 1999: 248).

After centuries of excising local and traditional beliefs, values and knowledge, the 1970 disaster ushered in development aid, modernization, and environmentalism which managed to further displace any remaining connections with a larger historical past for the capitalist, bourgeoisie Lima values. While the disaster economy allowed for the successful implementation of major structural reforms, “long-standing negative perceptions of governmental efficiency and integrity held throughout the provincial areas of the nation, where failure to fulfill political promises is legendary” (Doughty 1999: 250). Increased global attention to environmental issues, the influx of development aid and engineers, ongoing market integration, and “visibility” efforts increased the degree of vulnerability among highland agro-pastoralist communities.

Conclusion

Much like other Latin American countries, the history of Peru is a tale of duality and mutuality. Prior to the Spanish conquest, various polities sought to dominate the north-central highlands. The Incan Empire was clearly the most successful, spreading from Cuzco in all directions, using highly sophisticated statecraft which aimed to integrate and profit from its subjects without fully exploiting them. Though ethnic distinctions (e.g., Incan vs. subject) and social stratification within ethnic populations (e.g., slave, warrior, lord) were clear under Incan rule, these paled in comparison to the racism that began under Spanish rule. As Spanish rule was consolidated, multiple institutions were introduced to extract the most resources possible from the colonies, based largely around further exploitation of the Incan tribute system, while restructuring highland societies to better control and tax them. Dual societies emerged, one a *creole* or *mestizo* middle- and upper-class elite, and the other an indebted, poor peasantry that remained largely indigenous in the Callejón de Huaylas. As the colonial government levied increasingly oppressive taxes on the peasant populations for the gain of the crown and the colony, peasants began to revolt. Continuous revolts and uprisings created a fear among the *mestizo* elite, who began evoking narratives of "savage and barbaric Indians."

Wars of independence swept across the continent in the early nineteenth century, followed by a devastating war with Chile over southern coastal territories. In losing this war, infighting led to a civil war that further debilitated production systems in much of the highlands. While highland peasant populations mobilized largely in support of their new nation against Chile, but after the fighting subsided they were quickly reminded of their second class citizenship. Whereas the colonial government had heavily taxed the highland populations, it had also afforded them a certain degree of security and rights to land. In contrast, the new republic of Peru abolished the tribute system of the crown and with it any semblance of land rights for the highland peasants. New taxes were then introduced, but peasants did not have access to any land on which to create surpluses that went towards taxation. Revolts and uprisings continued as peasants recognized their continued disenfranchisement under the new republic. These uprisings eventually led to platforms of reforms among the democratic and military regimes that came to power in the early twentieth century. The military regime of Velasco was able to implement a radical and large scale Agrarian Reform that excised property from landowners and redistributed this land among communities living in these highland regions.

In the following chapters I will show how the persistent racism that has played a role in the development of the Callejón, perpetuating the narrative of poverty and vulnerability, and preventing highland communities from recognizing or realizing their adaptive capacities.

CHAPTER 4

LAND TENURE AND WATER MANAGEMENT

Water mingles with every kind of natural phenomenon; and more than one might imagine, it has also mingled with the particular destiny of mankind.

Fernand Braudel

Introduction

Crises involving water scarcity are just as much a product of cultural values, social contexts, economic activities, and power relationships as they are a result of biophysical forces and conditions (Donahue and Johnston 1998, Pelling 1999, Gelles 2000, Adger 2001, Jacobson and McNeish 2006). Water scarcity is due to supply and demand changes in the hydrological cycle coupled with the consequences of human activities guided by the various valuations of water involved. Water allocations based on political and economic interests often exceed actual water availability. Thus, water scarcity can be a product of social systems. The ability to respond effectively to water scarcity is complicated by the contradictions between agendas and actions that value water as an essential and profitable commodity (Whiteford and Whiteford 2005). These valuations may reflect the customs, social conditions, and relationships that privilege access to some users while withholding from others. Johnston (2005) argues that crises and conflicts resulting from multiple allocations, meanings, and values stem from national and international policies that define water as a right, yet water is increasingly managed through privatized infrastructure and governance that views water as a commodity.

In the Peruvian highlands, a critical obstacle for development has historically been and continues to be the irregular distribution of water (Gelles 2000, Trawick 2003, Magrin et al. 2007). The difficulty with water distribution reflects physical and climatic circumstances (e.g., topographical complexity, glacial loss, and ENSO events) as well as political dimensions of conflicting valuations of water and tendencies toward privatization mentioned above. Due to the heavily glaciated mountains, the Cordillera Blanca historically has had abundant water, but water is becoming less available due to a combination of environmental and social changes, and, especially with the rapid glacial retreat, threatening to become inadequate. In this chapter I describe the land allocation and water systems of Siete Imperios in order to showcase the perceptions of shifting water availability within the community. The ethnographic details that follow are synthesized from the interviews, focus groups and participant observations I carried out between 2009 and 2011 in Siete Imperios.

Land and Livelihood

For centuries before being colonized, Andean highland populations were very successful due to the employment of social structures that allowed them to simultaneously manipulate several geographically dispersed ecological tiers in what is considered fragile and low yielding environments (Murra 1972, Eckholm 1975, Thomas and Winterhalder 1976, Guillet 1983). This ecological complementarity persists today in the dual economies of agriculture and pastoralism, which utilize distinct ecological zones at varying times, and form the backbone of the high altitude strategy. Households cultivate many small fields, with specially selected crops scattered throughout the ecological zones available to their community, and rotate a variety of livestock through these zones (Orlove and Custred 1980, Mace and Houston 1989, Zimmerer 1996).

Communal social organization, even disturbed as it was throughout Incan and colonial resettlements, reflects the scheduling and rotation of labor as needed throughout these zones.

Complementarity is in part made possible by communal management strategies exercised by *campesina communties*, including Siete Imperios. Communal ownership is dictated by the laws that established *campesina communities*, but the specifics of management are at the discretion of the individual communities. Following the establishment of Siete Imperios, agricultural land was communally farmed and the produce split according to the needs of each family, or sold to pay the deuda agrarian or purchase necessary supplies. Likewise, pastures were communally grazed. As the community grew, the tension between family groups and community administration grew and the community decided to divide communal lands among families to farm as they chose. Current members were given approximately two hectares of land—most likely in several small parcels throughout the community or sector—on which to build a house, farm, or use as they wish. Grazing access remained communal for some time following, though eventually was changed to follow suit with farming plots. Grazing lots in non-agriculturally productive land are now awarded to families in parcels of 20 by 50 meters. As new community members are inscribed, they are also awarded lots of agricultural and grazing land.[29] In exchange for being awarded communal land, each family provides labor for community tasks as needed.[30]

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[29] Currently, there is a significant population of *convivientes* in Siete Imperios. These are adults who are not yet inscribed as full *comuneros* or *socios* (community members). *Convivientes* were born in the community and are children of full *socios*, but those interviewed for this research stated that the reason they are not inscribed is a lack of land. The community cannot offer these new adults sufficient plots to sustain a family and so cannot inscribe them into the community. These *convivientes* live and farm alongside or in place of their parents and are expected to participate fully in community work and meetings. When the parents pass, their land will be split up between the *conviviente* children, but will not likely be sufficient to support the families of their children. While the majority of people living within the borders of Siete Imperios are *socios* or *convivientes* of the community, there are a handful of private plots. These are typically decedents of the hacienda owners who have maintained a plot of land in the area or, in a few cases, are families who opted out of joining the community when it was initially established in lieu of renting land from the plots left to hacienda owners or descendents.

[30] Referred to as *faena*, these tasks might be cleaning the road, or part of the canal system or assisting in the installation of the potable water system. If the family is unable to perform the required task, they can send a

Chacras

In some highland communities there continue to be both communally and individually controlled *chacras* (agricultural plots) where a complex schedule of communal grazing land shifts through fields as they go fallow, so that communal and individual activities must be coordinated. This is not the case in Siete Imperios, where individual *chacra* rights are recognized and households decide when and what to plant, on pesticide and fertilizer use, and how long, or more likely, whether to let a field rest. *Chacras* at rest are also used by the household for grazing. Though each household is responsible for its own *chacra* management, there is a seasonal calendar that guides most agricultural activities. There are two annual plantings in Siete Imperios, the *campaña grande* (wet season) and the *campaña chica* (dry season). Those households that have irrigated plots plant during both *campañas*, but all households plant during *campaña grande* as it occurs just before the onset of rains (September or October). Because each household has several small plots spread throughout the community, most have a mix of irrigated and *secano* (dry) lands. Whether or not a plot is irrigated determines the *campaña* in which it is planted. These fields are generally harvested between February and March of the following year, depending on the effects of rain, temperatures, and other weather-related events during their maturation. It is during the planting and harvesting of this *campaña grande* when households would traditionally hold a *minka* (historically, *mit'a*) with family members to divide the labor. However, 8% of interview respondents (N=11) who mentioned this practice also spontaneously added that this very rarely occurs now. Instead, if they require help families hold what is referred to as a *jornal* where workers are paid in cash instead of with a portion of the harvest. Figure 7 shows the general sequencing of cultivation for communities in the Cordillera Blanca.

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substitute in their place or pay a fine to the community. Heads of households are also required to attend general assembly meetings of the community, usually occurring once a month.

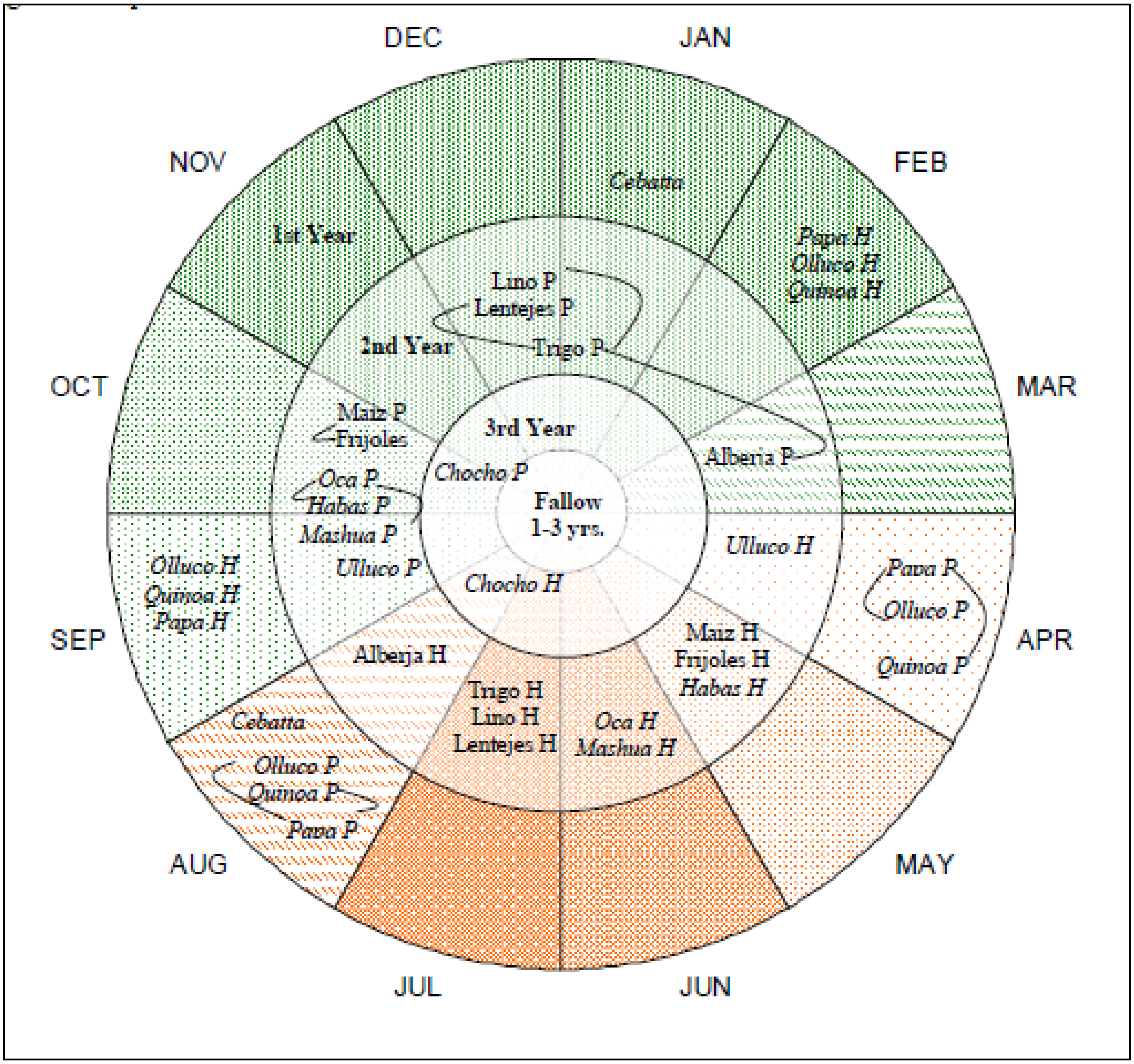

Figure 7 Example of an agricultural calendar. Ferris 2007: 70.

Animal Husbandry

Most households managed a variety of livestock including cattle, horses, mules, sheep, goats, and pigs. Livestock provides households with meat and milk (and sometimes cheese), wool, manure, draft labor, and transport. However, meat and dairy products are only consumed on special occasions, few families make their own clothes anymore, and, as I discuss in Chapter 5, manure has been largely replaced by chemical fertilizers. Livestock is pastured differently depending on the season. During periods of agricultural activity where certain livestock is necessary, animals are rotated around nearby fields in fallow, which are usually small and so require close management to keep animals from eating maturing crops. After the *campaña grande* is harvested, herds are pastured in these chacras where stalks and other salvage remains. As this is exhausted and the dry season progresses, women and girls (largely responsible for livestock management) practice a "compressed" transhumance, moving animals to higher pastures on a daily basis (Farris 2007: 74, Guillet 1983, Stevens 1993). Some families opt to keep livestock in their nearby plots feeding them with stored or purchased crop salvage, perhaps because they are keeping fewer fields in fallow and have fewer grazing opportunities. Livestock in Siete Imperios seemed to be considered akin to bank accounts for households. If a crop failed, or a family member fell ill, livestock would be sold as needed to cover the costs. Also, those families who were to be the *mayordomo* (host) of upcoming festivities would be raising several animals for the feast. Not surprisingly then, households in Siete Imperios that owned livestock were viewed as wealthier than those with just a few chickens or guinea pigs. When explaining her situation to me during an interview, an older widow explained, "I am poor, I have no animals."

Communal Management

There is an extensive literature on the successful elements of common property management regimes, such as those employed by Siete Imperios (see Ostrom 2007 for an overview). Important factors for successful communal management are the degree of heterogeneity, trust, and reciprocity among community members (Ostrom 1998, Ahn and Ostrom 2008). Threats to the integrity of communal management within Siete Imperios are discussed in detail in Chapter

7, but here I address an aspect of differentiation within the community stemming principally from land and water distribution.

There is a great deal of similarity in economic activities across the seven sectors of Siete Imperios; however, dramatic differences in topography between the sectors seem to reflect and perpetuate political marginalization within the community. While causal direction is difficult to assign (does sector location determine social, economic, and political standing, or vice versa?), the terrain and location of a sector with regard to infrastructure for electricity and potable water plays a role in marginalizing some households or sectors. Recent development projects have brought electricity and potable water to Siete Imperios, but these services do not extend to each household in every sector, reportedly due to the difficult terrain in some areas. For example, the houses and plots of families in Yanahuanca are established along steep slopes deep within the incised valley of Condormarka River (river bordering Siete Imperios to the north). Members of these households report being told they would have to pay about S/.2,000 (~US$6,000) to buy the necessary equipment to bring electricity to their houses. Communal institutions that are built on equality and trust can be undermined but such uneven development.

Canal improvement projects, potable water systems, and electricity connections that serve some sectors of the community and not others exacerbate social inequalities. Community members living in Yanahuanca often vocalized their feelings of inequality in comparison to more centralized sectors. When we met in the market or happened to catch the same taxi up the mountain, I was often asked by community members from this sector whether I was only interviewing people in Centro I or Centro II, implying Yanahuanca and other more remote sectors were always left out of such projects. The community has attempted to rectify this disparity among its members by creating an urbanized area near the main plaza of Copa Grande.

Households from sectors without electricity or potable water were given a plot in this area, which all have electricity and potable water connections, where they can build a secondary house if they so choose. Increasing heterogeneity among community members, or among sectors, threatens the integrity of communal management. Disenfranchised members of the community lose faith in the equality of communal management structures, further weakening them.

Water Sources and Allocation

Changes in social knowledge, organization, and technology are displayed in the interactions of a community and its landscape over time, and can be viewed specifically through the evolution of irrigation in highland Peru (Erickson 1992, Bunker 2006). Early communities created complex irrigation systems and associated terraces in order to cultivate very difficult land.[31] The canals constructed to feed these irrigation systems and the systems themselves require significant labor investments initially but simplify the labor necessary for irrigation in the long-term. Resettlement of populations during Inca and colonial regimes caused abandonment of many terraces and associated irrigation systems (Denevan 2001). Colonial and hacienda control emphasized commercial agriculture over subsistence practices, which led to further abandonment of agricultural terraces and a loss of the associated knowledge. As the abandoned terraces collapsed and subsequently increased soil erosion, the dominance of the hacienda further weakened the systems of meaning and authority that supported stewardship of the irrigation ditches. Conflict over water, even within communities, was usually traced to families of Spanish descent who attempted to change irrigation technology and structure while denying peasant farmers access to irrigation water for their own small plots (Gelles 2000).

[31] Though there is evidence for terracing from earlier times, the current system of irrigation in Siete Imperios is based on inundation of non-terraced plots.

Current canal maintenance in Siete Imperios lacks the ritualistic framework found so often in historical accounts of Andean water management. Maintenance and stewardship now is largely a reflection of the requirements put forth by the national agricultural and water codes, adhered to in part out of a desire for further development assistance from state channeled funds. Rituals surrounding water management and distribution perhaps were not disseminated as strongly in the Cordillera Blanca as in other, more arid areas of Peru due to the proximity of communities to glaciers, where meltwater is abundant. While access to canals has been important since the establishment of the community, the recent installation of a new potable water system has brought a shift in the perception of water quality and has had a noted effect on water quantity as well. In addition to *acequias* (canals) and the potable water system, there are two other sources for water in Siete Imperios: springs and rainfall. Usually families utilize all of these systems in any given day (with the obvious caveat that rainfall is only utilized during the rainy season). What follows is a discussion of the current state of these sources and the perceptions of the community on the future availability of each given the observed environmental changes.

Acequias

The main system for water distribution in the community is an extensive network of *acequias* that diverts glacial meltwater from high within the borders of Huascarán National Park. The water flows down through the *pampas* (grasslands) and foothills into the various smaller canals of the community and eventually to Marcará, where it then rejoins the Santa River. These *acequias* are also known as canals and ditches, and I will use the terms interchangeably.

Once recognized as as a community, almost the first act of the newly established Siete Imperios was to improve the rustic canal system that was used by the hacienda owners, which

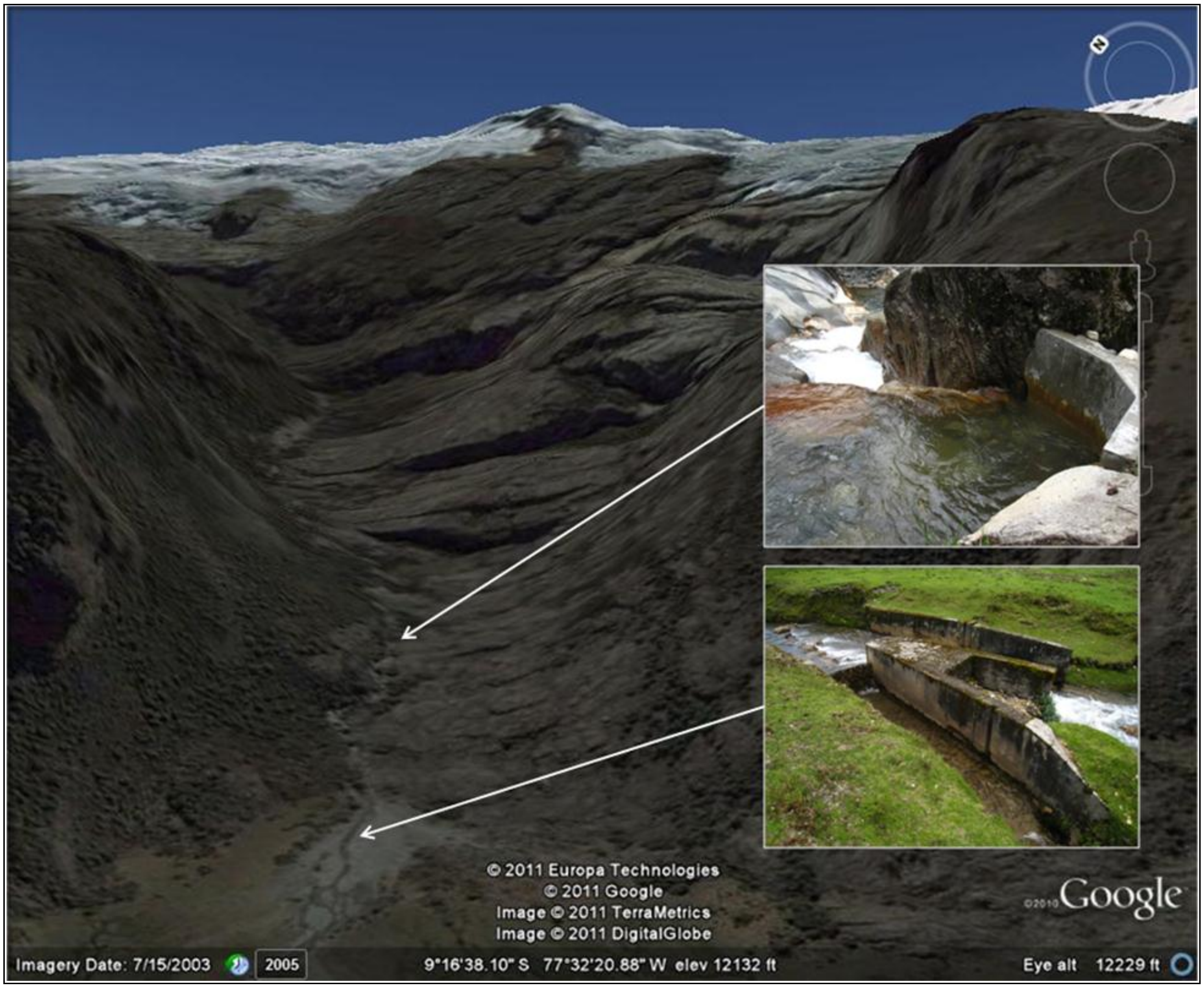

Figure 8 Pictures of potable water intake and canal system over GoogleEarth map.

had been almost entirely destroyed by the earthquake of 1970. Prior to this improvement, peasant parcels were purely rain-fed since the irrigation canals were only used for hacienda fields and animals. Older community members remember the initial canal improvement with pride. At the time there were far fewer community members and all of them, working in long shifts, slowly brought necessary cement up the then rough and steep foot paths from the valley on the backs of donkeys to line the existing canal and build the mechanism to control the water flow (see Figure 8 above). The canal improvement project was partially funded by one of the many organizations working in the valley after the disaster of 1970. This funded allowed the community to line the

Figure 9 Canal Allankay (glacier in the background hidden by clouds). Photograph by author.

new canal. From the intake and diversion mechanism down to the community plaza, the main canal is lined with cement or stone. In these initial years of canal improvement, water in the *acequias* is reported to have moved more directly from the intake down to the Santa River, with few diversions.

The current *acequia* system diverts meltwater just below the borders of Huascarán National Park from where the Allankey River begins (see Figure 8). The flow of water in the main canal is controlled by the main grate shown in Figure 8. In the hotter, drier months when there is an abundance of meltwater, or when there is a particularly heavy rain event, the canals are partially closed to help assist in controlling the overflow into the rivers, subsequent canal systems, and agricultural plots. In the months of scant meltwater, the grates are opened fully to allow as much water as possible to flow downstream. As water flows down through the community, families divert necessary water into their fields for irrigation purposes via secondary canals that extend from the main canals.

Through the Ministry of Agriculture, specifically the National Program of Watershed Management and Soil Conservation (PRONAMACHCS), an additional “canal improvement” project has been undertaken in Siete Imperios. The concrete lined Canal Yanacoto had just been completed as I arrived. Running ~1.4 km, the new secondary branch of the canal network was built to divert water from Allankay to pass through the upper reaches of Huecochec. Previously, residents of Huecochec diverted water from the Condormarka River, which serves as the border with a neighboring *comunidad campesina* Copa Chico. This diversion was not only dangerous, as this river becomes quite deep and fast during certain parts of the year, but was also the source of small conflicts with Copa Chico residents in the dry seasons months where riverflow is limited (this conflict is discussed in detail in Chapter 6). It should be noted, that not all such shared river diversions necessarily led to inter-community conflicts. For example, residents in the lower southernmost reaches of Siete Imperios still divert water without problems from Chancos River canals within the large *comunidad campesina* Vicos to the south. Along the new concrete-lined canal water flow is managed with permanent gates (*conpuertas*) that can be raised or lowered to control the movement of water among those households it serves (Figure 10). The rest of the canal network is comprised of hand-dug canals that are manipulated through makeshift diversion mechanisms (Figure 11). What was a rather direct system of water diversion when the community was established has now become a network of concrete-lined and dirt

Figure 10 Metal diversion mechanism on concrete-lined canal. Photograph by author.


Figure 11 Example of makeshift diversion mechanisms on earthen canal. Photograph by author.

canals that range in size and permanence as the system has been slowly expanded to suit the growing community and changing water demand and availability.

While community members are happy to be the focus of district or departmental development projects, canal improvement is met with mixed emotions. The addition of this concrete-lined canal in the central area of Siete imperios creates some resentment by those who feel ignored by development projects such as these, which usually focus on the central areas of the community instead of the outskirts. The concrete-lined canals require less routine maintenance than earthen-lined segments, which erode after heavy rains or misuse. Other community members are concerned that the addition of so many canals causes more water to be lost due to the increase in leakage and evapotranspiration as the water is diverted into smaller and smaller canals. One community member noted that the fields around the new canal "no longer function as *chacra*, they are now like a small lake" because of leaking water from the canal (Interview 38).

Though all members who use the *acequia* to irrigate must be registered annually with the department of Ancash, the people of Siete Imperios do not pay for the use of their irrigation canals. In the nearby village of Caraspampa (north and downstream of Copa Chico on the road to Carhuaz and directly across the ravine of the Condormarka River), farmers instituted a system of paying per hectare of land they irrigate in 2007. The knowledge of this recently instituted pay-per-hectare system, along with other cases of water becoming more privatized, worries those in Copa that the monetary costs of living will rise beyond their abilities to pay for these services. Instead of payment, members are required to participate in annual canal maintenance in exchange for use. Within the community, there is a committee that oversees maintenance of the irrigation canals. This group determines routine maintenance schedules and organizes necessary responses to emergency blockages. Typically, the annual irrigation maintenance and cleaning occurs after the rainy season ends as this is when the worst erosion has taken place and before the onset of the dry season where irrigation canals are heavily used. This annual cleaning takes part in sections from the lower reaches of the community up to where the concrete lining begins in the upper reaches of Siete Imperios. Small groups of *socios* (community members) are responsible for each section of the canal. Each group spends a day working with machetes, shovels, and foot plows to clear the excess material from the canal that has gathered during the rainy season. This annual cleaning ensures that water flows most efficiently through the canals when it is most needed and not "*botado*" (thrown out, meaning overflow and therefore wasted) due to accidental blockages in the network.

Once the cleaning has been completed and the dry season begins, the rhythm of life in Siete Imperios revolves around irrigation scheduling. A secondary role of the irrigation committee is to ensure irrigation water is adequately and equally distributed among community members. Each sector has an *aguero* (water monitor) who keeps an irrigation schedule for who is allowed to utilize water on which days. The timing and amount of water scheduled for a family is based on how much land and which crops are being irrigated. A formula decides how many hours one is able to divert water before access must be discontinued and the water will be moved to the next plot. While this schedule has existed since its use was mandated during the Agrarian Reform of 1969, individuals in Siete Imperios claim it was never necessary until recently. In the past there was enough canal water that many families could irrigate at once without problems and neighbors were able to discuss schedules among themselves.

Recently, the irrigation schedule has become more important as there is a perception of diminishing water availability, though this varies depending on the sector. In some areas families are not concerned about the schedule since they are able to use irrigation water when necessary, but in others families are going back for second irrigation turns or irrigating at night if their fields were not fully saturated before the water was diverted. This importance of the *aguero* and the irrigation schedule are spatially specific: the schedule becomes more important the farther downstream or afield of the irrigation network the plots lie. Those who have fields in the lower sectors and those farthest away from the center of Siete Imperios are more concerned than those who are closer to the main irrigation canals. Figure 12 (below) shows the percentage of respondents by sector who felt that water sources were changing and Figure 13 shows those that reported the water they received as insufficient for their agricultural and domestic needs. All of those respondents from Centro II who addressed the question of changing water availability and whether they had sufficient water for their needs responded negatively. This is a large and diverse sector of Siete Imperios, where many households lie deep in ravines where irrigation ditches cannot reach. Huecochec has been involved in recent inter-community discussions over sharing Rio Condormarka and so it is not surprising that many of the respondents report changing water availability. The low percentage of respondents reporting insufficient water is likey a reflection of the river access discussions (explained further in Chapter 6) being resolved by the extension of the Allankay canal across Huecochec, which replaced any irrigation water lost due to changes in river access (discussed above). Tuyo Alto and Tuyo Bajo are both in the lower reaches of Siete Imperios and therefore it is no surprise that a large percentage of them report changing water availability. The relatively low percentage of respondents in Tuyo Alto and Tuyo Bajo that report insufficient water is likely due to their satisfaction with the local *aguero*, but also because this area was very dry prior to the installation of the Allankay *acequia* after the hacienda. These respondents reported being pleased to have access to irrigation water, remembering earlier times when they were sent long distances by their parents in search of water.

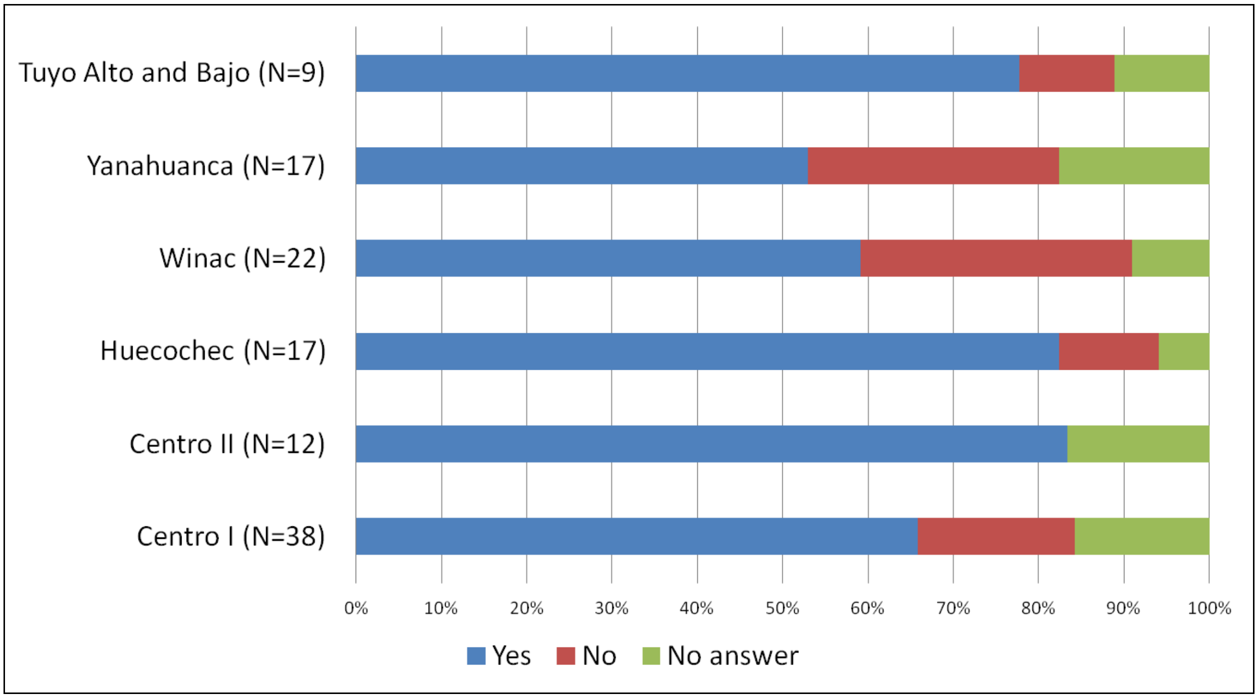

Figure 12 Reported Changes in Water Availability

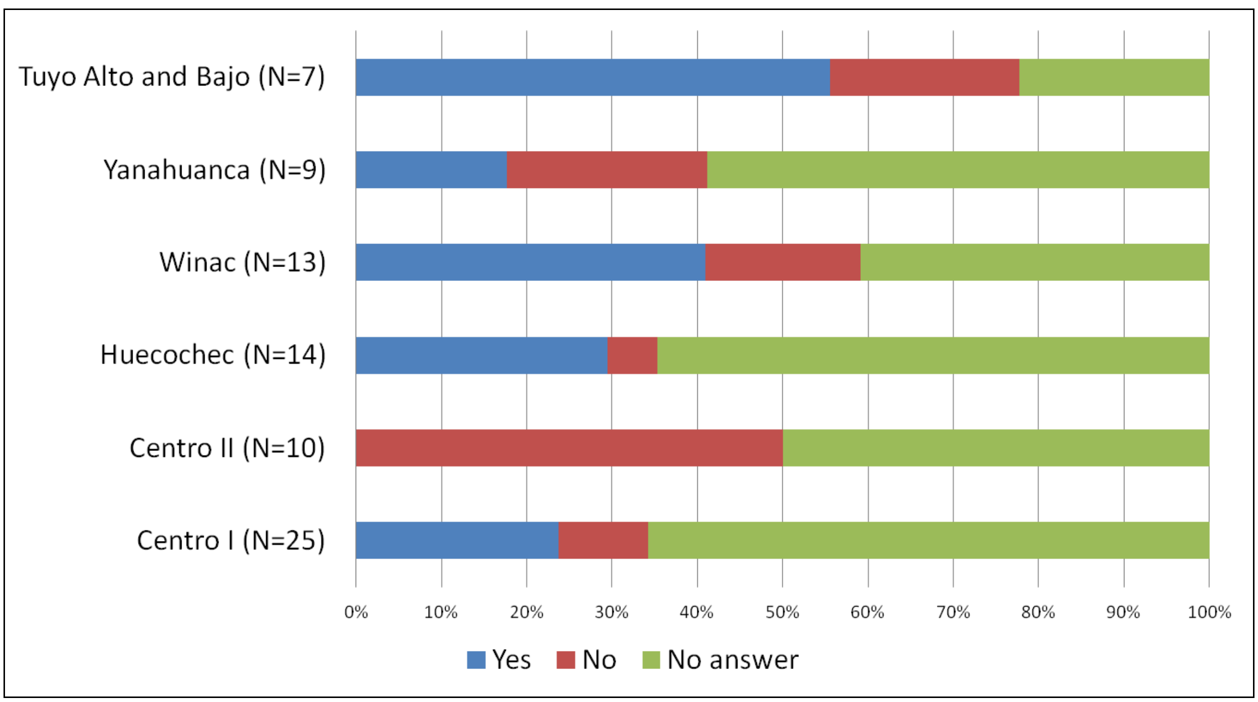

Figure 13 Reported Water Insufficiency

As discussed above, houses in Centro I are well connected to both irrigation and potable water delivery networks. The high percentage of respondents that report changing water availability and insufficient water is somewhat surprising. One explanation could be that due to the urbanization, there are a growing number of families who are in newly built second homes in Centro I, so these respondents could be reporting based on their experience of their sector of origin. Another explanation for the high numbers here is that concern over changing water availability is wide-spread in the community regardless of whether a household is directly affected by the changes. Relatively, respondents from Winac show less concern for changing water availability, but higher percentages reporting insufficient water. Like other sectors, Winac has a significant amount of houses that are far afield from the irrigation and potable water networks, which could explain their reports of insufficient water. Yanahuanca shows similar numbers to Winac, which reflects their similarity geographically in relation to water delivery systems. Other than Centro II, Yanahuanca and Winac report the fewest concerns for changing water availability, but the highest reports of insufficient water. The accessibility of irrigation water varies across the sectors of Siete Imperios and these differences reflect the sense of water insecurity reported by interview participants.

Potable Water

In 2005 a potable water system was initiated for Siete Imperios. The system was financed by the district of Marcará though funds awarded from the department of Ancash through the Canón Minero.[32] During a public budget-planning meeting for the district community, community

[32] The Canón Minero was initiated by the International Finance Corporation to direct tax money from the major mining operations toward "sustainable development" projects in the areas where mining occurs. Mining taxes generated in Ancash—mostly from Antamina—are earmarked for the specific districts and provinces where the mining occurs, but some of the fund can be redistributed throughout the department. The head engineer estimated

presidents present and discuss their needs for the next three years. Technical advisers for the administration evaluate all the proposals based on population of the community in question, zoning, and need. Projects improving the delivery of basic services such as potable water and sanitation are prioritized above most others. The main engineer for the potable water and sanitation project who works throughout the department on such infrastructure projects quoted me prices of S/.500,000 (~US$1,500,000) for the potable water system, S/.400,000 (~US$1,200,000) for the sanitation backbone and another S/.130,000 (~US$390,000) for the treatment plant once it is sited.[33] A subsequent benefit was that community members were hired by the district to work on the installation of both potable water and sanitation systems.

The intake for potable water is just above where the canal system begins, within the border of Huascarán National Park. This system moves water underground through a series of pipes, pumps, and pressure breaks out to individual taps. This water is treated with chlorine and is protected from the agricultural contaminants that come into frequent contact with the open canal system (e.g., animal and human fecal matter and dead livestock or rodents). The system was completed and inaugurated in 2009. The community held a grand inauguration ceremony in December that I was able to attend. The mayor and his advisers came up from Marcará. We marched with the full band from the center of the community to the location of the two smaller pumps and the main reservoir, each of which had been decorated with an arc of braided eucalyptus branches and toilet paper. At each place a blessing was said and a short speech from the mayor was given. Godparents were chosen and they broke a symbolic bottle filled with

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that Marcará receives 6-8 million soles each year, compared to San Marcos, the district where Antamina operates, which makes 190-220 million soles each year.

[33] Although the skeleton of a sanitation system was installed simultaneously with the potable water system, the treatment ponds for this system had yet to be sited when I concluded my fieldwork.

Figure 14 Marcará intake and pressure break system. Photographs by author.

water. I was chosen to be the *madrina* (godmother) for one of the smaller pumps.[34] After the final inauguration we all marched back to the center while the band played to celebrate with the traditional dish of *cuy* and potatoes. I was invited to sit with the mayor and his party for the meal, which was set up in the decaying communal meeting rooms, while the rest of those in attendance sat on the ground in the plaza to be served. Afterward, the band continued to play and everyone danced while passing around bottles of beer.

An intake for potable water to Marcará was installed at the same time as the one for Siete Imperios. The water captured by these intake systems bypass community canals, which decreases the overall flow of water in the rivers and canal systems within the community. Marcará now has direct access to drinking water, avoiding the need to negotiate with Siete Imperios over future declines in availability. Deciding to install potable water in Siete Imperios along with the Marcará input could have been a negotiation on the part of the district to have more direct access to water considering future scenarios of availability. If this were the case, consciously or not, Siete Imperios traded lower water flow in the rivers for a potable water system.

Once the potable water system was fully installed it was turned over to the community for all future maintenance. A new committee was formed to organize and direct maintenance activities. This committee invokes a *faena* for any cleaning or repair that is necessary. As part of their community responsibility, each household must install and maintain their own tap, referred to as a *canón*, which is usually installed outside the house (see Figure 15), and they must pay S./1 (~US$0.30) per month to the committee that oversees system maintenance. When new members are initiated into the community they pay a one-time fee of S./3 (~US$1.0) in addition to their monthly tariff.

[34] Becoming a *madrina* has differing degrees of significance depending on which ceremony is taking place—a marriage, the dedication of a new school or house, or baptism—this was largely a ceremonial necessity since the mayor did not have a wife.


Figure 15 Potable water tap. Photograph by author

Upon installation of the potable water system, authorities in Siete Imperios have tried to influence how and when potable water is used compared to the *acequia* or other sources of water through statements at community meetings. In my experience, this has yet to become a widely accepted practice within the community. While some families strictly use and vocalize their use of the *canón* only for cooking and washing dishes—the suggested use—others use the *canón* for everything from washing clothes to watering animals. This type of use may be prevalent in part because the potable water system is new and so appropriate uses are still to be determined, but these household taps are also incredibly convenient for families who have to walk significant distances to find a *pukial*, or a main canal (as opposed to a smaller, closer one that is only open during certain times for irrigation). Community members reported instances of fines being levied when one family's excessive use of the *cañon* causes another family to lose water pressure.

Springs

Beyond these two highly-regulated institutions surrounding *acequias* and the potable water system, many families utilize the natural springs found throughout the community. Springs are known by several names—*manantial*, *filtración*, and *pukial*—some of which allude to the water's source. *Manantiales* are naturally-occurring shallow seepages that make an area swampy. These types of springs are good sources of drinking water for animals but not for potable applications, nor are they productive agricultural areas. *Filtraciones* are areas where excess water gathers, either naturally, or from irrigation or leaking water management systems. Again, these are not ideal areas for agricultural activities, and are often areas of high traffic, making other uses rather unappealing as well. *Pukiales* match the true definition of a spring, where water bubbles up from underground at a specific source. When these are small, the source is protected by a mantel of rock to ensure it is not trampled by people or animals, but in some cases these springs create significant and deep pools of water. Some of the larger or deeper springs maintain at least some water year-round, while others only appear during the rainy season, during flooding events, or when the community is not heavily irrigating. Some springs are known throughout the community for their mineral properties, which are found to be beneficial for some medicinal practices (see Figure 16 below). Prior to the expansion of the *acequias* and the installation of the potable water system, these springs were the go-to source for all family water-related activities, including cooking, washing, and bathing animals and people, while rainwater remained the primary source for agricultural activities. With the development of other water delivery systems that are more convenient, springs have become relegated to a back-up source for many families. However, there are still families on the outskirts of the service area that depend heavily, if not entirely, on springs for their water needs.[35] If a family does have and use a nearby *pukial*, there is a similar conservatory logic in play as that which is applied to the potable water systems. Some families notably try to avoid washing dishes or clothes directly in the *pukials* as the soap film leaves the water stagnant and unpleasant for other uses. However, I observed other families who used the *pukial* for all water uses and did not distinguish washing clothes or dishes from using water for drinking. This is mentioned in interviews as a point of tension between families that share a *pukial* who view this point differently. While *pukiales* do not have structured or institutionalized ownership or usufruct rights, it seems as though proximity determines who can use a *pukial* for certain activities. While anyone walking by can take a drink or fill a small container with water from any *pukial*, washing rights and animal use seem to be loosely controlled by the families living close by.

Those who still use these sources regularly report shifts in their water levels, tastes, and temperatures. Certain springs are said to have disappeared with the introduction of additional canals or the general decrease in water availability. The question of whether or not springs are perceived to be connected to glacial meltwater is debatable, both scientifically and from observations on the part of the community. Some view springs as being connected to the larger glacial-meltwater-river cycle, but others view the underground source of spring water as being completely different from glacial sources. For example, one community member suggests that

[35] The addition of potable water and sanitation has exacerbated feelings of inequality among community members. These systems were introduced in part to encourage urbanization and for this reason, along with the coupled physical and economic constraints, cannot extend into the more far-reaching areas of the community. These families already feel a sense of alienation since walking to community meetings or activities is a time- and calorie-consuming task and many of these families do not have enough income to build a (second) house in their centralized plot where these services are available.

Figure 16 Pukial with mineral properties in Huecochec. Photograph by author.

many *pukiales* have dried up due to the potable water tap: “What we call *manantiales* no longer exist; *pukiales* have dried up because of the potable water too; almost no water leaves [the ground] now” (Interview 2). While most research participants feel that spring water will also eventually dry up if the glacier disappears, being in proximity to a spring or even simply knowing someone who lives in proximity to one, is valued in itself. This is due to the relief a spring can provide from short-term water shortages due to problems with the *canón* or the *acequia*.

Rainfall

Though rainwater is an important source of water for the community, as evidenced by its use to mark time in the agricultural calendar described above, it is less predictable than meltwater and less valued overall. Farmers claim that the seasonality which so marks the agricultural and cultural calendars is now much more chaotic, referred to in one interview as “crazy rain” (Interview 8). Though rainfall is characteristically unpredictable within the season, these patterns are becoming increasingly less predictable in timing, duration, and intensity. When asked about the agricultural calendar, a research participant laments “the rain has no season. If you plant ahead there isn’t any [rain], if you plant later there isn’t any [rain]. To wait too long isn’t good, but planting too early doesn’t work either. Nothing works for the crops” (Interview 9). While the overall yearly amount of precipitation remains fairly steady, the frequency and intensity of rainfall is shifting so that there are more often extreme rainfall events (Coudrain et al. 2005, Bradley et al. 2006, Magrin et al. 2007). There are also more frequent incidences of dry periods within the rainy season, the timing of which could significantly stunt crop growth or dry out seedlings.

While it is possible to cultivate sufficient agricultural produce with only rainwater inputs, rainwater is not considered for human or animal consumption. Agricultural activities were rain-fed for many years in the highlands before additional canals were dug and large pumps installed, and some sections of the community continue with this practice. Farmers living in these areas where gravity-fed systems do not reach their plots identify as *secano* (dry people). These people schedule planting in order to take advantage of the rainy season, but make no attempt to store or harvest rainwater for later use nor do they use rainwater for household or animal consumption. Water for household or animal use is sought out and usually found in the form of streams or springs, sometimes nearby but often requiring localized travel.

When asked in interviews about harvesting rainwater, five respondents of 28 who were asked directly considered this practice to be a valid strategy. This may partly be because there is no rain to harvest when the *acequias* and other water delivery methods are at their driest, but is also because rainwater is considered polluted.[36] When I attempted to capture rainwater in my *tina* (a small tin basin), my host family was very adamant that not only should I not use the water but also that I must wash out my *tina* thoroughly before attempting to use it again for any other purposes. Rainwater is believed by many in the community to be polluted due to traditional practices of burning trash and fields to prepare for planting as well as from contamination from local mines.[37] This view is widely held and promoted by NGOs, government agencies, and local scientists, and is often discussed on radio programs and visits to the communities, but I have not found any empirical studies supporting this specific claim. The intensity of this campaign is largely due to HNP promoting the ban of burning within park boundaries.

[36] Though I was unable to ascertain why exactly community members believe rainwater to be polluted, there is a growing consciousness of acid rain due to mining activities in the valley (Tamblyn 1999).

[37] Barrick's Pierina gold mine is located across the valley in the Cordillera Negra to the south, but is clearly visible from the study community, and there are also several small-scale mining activities occurring within the sub-basin of Marcará.

Changing Water Availability

As I have shown throughout this chapter, members of Siete Imperios understand the connection between the glacier, its meltwater and their use of water. Of the 80 participants who were asked about actions that could be taken, the 19 who proposed action focused more on securing access to the most water (in relation to other communities) as the river is increasingly tapped above the Siete Imperios community by downstream users. Once the gatekeeper of meltwater due to their location within the watershed, any control Siete Imperios once had over water flows has been usurped by pumps. Several research participants directly related the diminishing availability of water to when Marcará began taking water from above the community. While scarcity related to ongoing glacial loss is clearly a concern, community members consider the more immediate threat to be the political dimensions of water management and control. One community official had proposed allowing all current *convivientes* to become full community members so as to increase the numbers of members Siete Imperios could register as water users on district and departmental lists, thus ensuring a larger share of water be allocated to Siete Imperios. However, population growth also causes concern among the older members of the community, some of whom remember the days just after its establishment, when there were only 50 families. The growth, though saught after for scalar political reasons, causes the connections between families to be strained and more opportunity for the egalitarian nature of the community to erode since organic and external projects cannot always benefit the entire community due to its size. For these respondents, local and national population pressure is partially to blame for the resource scarcity: "We lack water now not only because of the number of people, but also our own government of Peru is causing problems. It wants to privatize, it wants to sell, it wants to take our water" (Interview 19)

Although the emotional language was reserved for talking about future water availability in connection with glacial loss, 70% (N=92) of interviewees felt water availability was already changing. Figure 17 below shows the frequencies of reports on which water sources where changing (some interviewees mentioned more than one source). Among these 92 informants who were concerned about changing water availability, the most frequently mentioned source of change were rivers (53%, N=49) followed by *acequias* (39%, N=36). These sources would be the most commonly observed among members of the community, and are most directly related to the glacier. In contrast *pukiales* and potable water systems, are either not always viewed to be directly linked to the glacier in the case of the *pukial*, or in the case of the potable water system, water is moved and sometimes pumped through many miles of tubes which if broken or otherwise affected, are likely to cause delivery problems. *Pukiales* were the next frequent souce reported to be changing (23%, N=21). Changes in pukial levels are reported to be affected by the increasing pumps and tubes that have been introduced with the potable water system and additional canals. Only a few respondents felt the potable water system was changing (10%, N=9), likely since it was very recently installed for most families. Of the 92 informants who reported changing water availabililty, 9% (N=8) then said no sources were changing, and 16% (N=15) were not specific about which sources of water they had observed to be changing.

Considering the concerns for water availability, I asked how often the tap or *acequia* went dry and how individuals responded when this occurred. When asked hypothetically about what they would do if the potable water tap and *acequia* were dry simultaneously, most community members anticipated that their first response would be to approach the authorities to fix the problem (N=44). Their assumption was that there is not a lack of water but rather a problem somewhere in the delivery system, such as a broken pipe, clogged intake, or the result

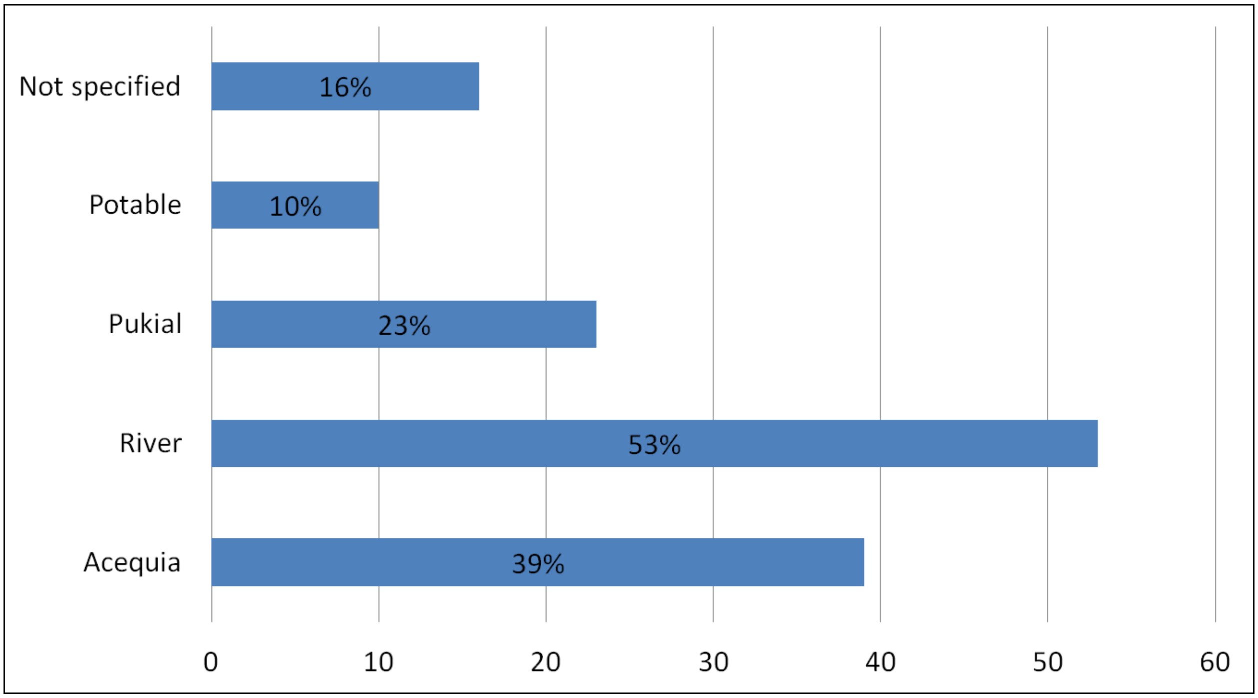

Figure 17 Frequencies of Reported Water Changes (N=92)

of a political conflict that is blocking access. When I asked what they would do if this response did not result in water arriving in the *acequia* or potable water tap, individuals suggested using nearby springs, asking a neighbor, or walking long distances to search for water. These responses suggest that even when their personal tap or *acequia* is dry, physical scarcity does not immediately occur to most participants. They assume water is available, just blocked in some way from flowing through the delivery network. This response also shows that the community members consider their community authorities to be responsive and effective, because they first approach these authorities with the task of clearing the blockage instead of circumventing the management hierarchy.

However, when directly asked what will happen when the glacier disappears, respondents took another tack entirely (89% of respondents (N=117) reported that the glacier would disappear). It is important first to note that I never introduced the topic of glacier change or loss directly and only asked this question if the interviewee had broached the topic of the glacier "ending" or "leaving" earlier in the interview. Almost universally, the answer to this question was a stoic acceptance of an impending end (81% of those participants (N=80) that responded to this question). Most often the response was simply, "We will die without water," though some community members posed it more as a question, "How will we live without water?" or explained their response with a simple equation, "First is water." When asked whether moving to another place or into the city was an option, most scoffed at the idea, stating matter-of-factly that these glaciers are the source of all water in Peru so if there was not any water here, there would not be water anywhere else either. Many feel as though there are no solutions to losing the glaciers. The glacier is melting and no amount of money or technology will fix it. Where does such acceptance come from? Did it imply passivity or stem from a feeling of being overwhelmed by such a loss?

As I began to analyze the interview transcripts and other materials I had collected during my fieldwork, I began to recognize traces of elements that correspond with Andean cosmologies which have been documented by my predecessors. One is the concept of cataclysm, the idea of multiple worlds each appearing after the devastating end of the previous one. Generally, throughout my interviews, when I asked about myths, elements of cosmology, or even recent history, most interview participants did not remember the stories told to them by their parents or grandparents. However, there were a few instances when I was told a version of a myth that alludes to the concept of cataclysm from a deeper Andean cosmology, the origin myth of *Iskey Inti* (Two Suns). One of the versions I heard was from a young woman who had migrated to Siete Imperios from Hualcán for marriage. William Stein (1982), who worked in Hualcán, a community to the north of Siete Imperios, recounted the Iskey Inti myth in his work as told to him by Miguel Paucar in 1952:

> Father God ordained that present Christian people would live a thousand years, and the ancient people a thousand years. When a thousand years had passed, there were to be three sons: the Father, the Spirit, and the Saint, all God's children. And He ordained that each one live a thousand years. Then the Holy Spirit made His bird live two thousand years, and that is why we are going to live [the same]. When we have ended the two thousand years, we are going to finish with the final judgment. God's ancient people were created so that they would never die. But they were killing each other, taking from each other their property of stones and land. They were killing themselves. In those times, stones lived and grew. And those people knew at what time it was going to rain and not rain. They also made stones build at their pleasure. When they came to know the day when they would die, they began to break up all their buildings. They also knew that they were going to die in a hailstorm of fire. Then they buried themselves inside their homes so that they would not die in the fire. So God said: "How are we going to kill these people?" Then He said: "Let's make some wells of water." These turned into an ocean. Then two suns came out. There and then He made the water boil and after that they all died. (quoted in Stein 1982: 251)

This myth has many themes from Andean cosmologies, but clearly also identifies with Christian teachings. Of particular interest is the idea of multiple worlds, one appearing after the cataclysmic end of the previous, which is a tenet of both Andean cosmologies and akin to the apocalyptic thinking of certain Christian teachings (Ortíz 1973, Ossio 1973, Earls and Silverblatt 1977, Salomon 1982, Allen 1984, Boyer 1992, Wojcik 1997, Cohen 1999).

In the above myth, we see how the perceived solution to a world that is being plagued by war, environmental change, or oppression is its cataclysmic end. When I asked in focus groups and interviews why the observed environmental changes are occurring, the most common response was something to the effect that the world's advancement was causing these problems. When pushed to expand on their answer, some indicated that the increasing use of technologies and other lifestyle choices is changing the world, such as contamination by cars, burning, and mining, but others connected it directly to a larger narrative of cosmological time. Glacial recession specifically was viewed as a natural phenomenon of time: "time is advancing" or "its time has come." In almost every interview, I was told that "we will die when the glacier is gone."

Viewing the glacier and the current world as if it had a finite existence could be linked to traditional myths of cyclical time.

Another source of this view is religious teachings. In addition to the long-standing Catholic influences in Siete Imperios, some members of the community have become involved in the Seventh Day Adventist church.[38] Adventists strive to thoroughly educate their followers about the causes and consequences of climate change; however, it also teaches that nothing can nor should be done because this world must end in order for God to create a new and better world for true believers. Adventists do have a small but significant and vocal following within Siete Imperios; however those who have not joined the church have a strongly negative view of them. Many call them liars, as Adventists have repeatedly set dates for the end of the world which have passed without event, or call them cultists, since followers are extremely persistent in their testimonies and evangelizing speeches. Either through evangelizing doctrine or a more traditional cosmology, this analysis suggests that cosmological elements do exist in responses to climate change.

Conclusion

Through an exploration of the current water and land distribution systems in Siete Imperios, this chapter addresses my first research question: *How are climate changes **perceived** to affect water availability in the Rio Santa watersheds?* Research participants in Siete Imperios very clearly connect glacial loss to concerns over future water availability. The majority of those interviewed in Siete Imperios feel that once the glacier is gone no water will remain in the area, leading to conflict, mass migration, or death:

[38] Following the disaster of 1970, these and many other religious groups arrived in the valley (Bode 1990). Though some groups had been established with small followings prior to the disaster, Bode quotes a research participant as saying the religious groups were expanding "luxuriantly" (1990: 340).

> With what water are we going to live when [the glacier] ends, what water will we drink…when the ice ends with what water will we live? Before there was plenty [of water] and now it escapes. Before there was plenty of water in the river. The river was impossible to cross. Now these rivers are dry. Time is advancing and water is escaping; [water] will end. (Interview 37)

> I think that from now, tomorrow, later, I think we will suffer for water. Water there is life so if there is not water, there is no life. For so many humans and for the animals too, and the seedlings that we are planting, it will not be seen for tomorrow or later to eat and to live, this will be sad. (Interview 113)

Many residents already note decreasing water availability in the area, citing both environmental and socio-economic reasons. They are concerned with increased temperatures and glacial recession but also with the numerous additions to the canal system and the many intakes for potable water (for both Siete Imperios and Marcará). These many diversions are causing the amount of water available to any one system to be significantly less than in previous years when water was said to run much more directly from the intake down to the valley. As one community member stated (Interview 109): “There is totally less [water] now, no more than a fifth comes now, it is not like the times before when more came, but now they have taken [water] with different canals and it does not arrive [like before].” Though there are serious concerns about future decreases in river flow due to observed and projected glacial loss, for community members in Siete Imperios current water scarcity is more of an outcome of socio-political dynamics, a constructed scarcity of increased diversions and demand for regional water supplies, which is likely driven by the socio-political dynamics of projected physical scarcity.

Water management institutions, be they state or local, are linked with knowledge. Water-dependent activities occur at specific times depending on the season or social rhythms and utilize specified source of water. The successful application of knowledge for accessing and managing water—a critical resource—is influenced by the physical shifts in patterns but also the large-scale institutions that mandate access and management of water. Increased demand for water in the face of rising populations and increasing temperatures has caused downstream cities and users to tap sources at the headwaters, bypassing the highland communities, and thus disrupting seasonal patterns of flow. The changes in flow due to physical shifts and infrastructure improvements leave highland farmers applying traditional knowledge to systems not only changed by climatic variations but also disrupted by increasing diversion of glacial meltwater. In the next chapter I will explore the environmental changes observed by community members that are perceived to be affecting land productivity and water availability within Siete Imperios.

CHAPTER 5

OBSERVED ENVIRONMENTAL CHANGE

Climate change is not something that may happen in the near or far future but is an immediate, lived reality that indigenous and local people struggle to apprehend, negotiate, and respond to.

Susan A. Crate and Mark Nuttall

Introduction

Local perspectives on climatic changes can be important counterparts to scientific observations and models of environmental change, for example, adding nuances to regional models or signaling ecological connections not previously identified. Some argue that social and biophysical sciences need to build "a common language to appreciate the full history and prehistory embedded in human responses to climate" in order to adequately address the full temporal, spatial, and cultural effects of climate change (McIntosh et al. 2000: 11). Beyond the potential contribution to climate science, exploring local perspectives of environmental change, the timeframes in which observations occur, and the meaning associated with observed change has real consequences for understanding how these populations might engage with both internal and external adaptation activities. Like many local or indigenous populations around the world whose livelihoods depend on their knowledge and use of their environment, the members of Siete Imperios are well aware of the significant environmental changes occurring around them. Based on interviews and focus groups with community members, this chapter will explore the reported environmental changes under observation in Siete Imperios and how these environmental changes are perceived to affect the social and cultural fabric of the community.

Observed Environmental Change

Throughout my fieldwork, I began interviews and focus groups by asking about the environment of Siete Imperios: How has the environment changed? What was it like before? What were the mountains like when you were young? Research participants were usually quick to respond with both environmental and social changes they observed throughout their lifetimes. Observations of glacial loss, which were expressed by almost everyone interviewed, and concerns over water availability were the most frequent responses to my query about environmental change. These concerns were followed in frequency by discussions of shifting rainfall, changing seasonal patterns, and decreases in agricultural yields. Less frequent, but equally emphatic responses focused on increased instances of sickness and disease among plants, animals and humans, increased chemical inputs for agricultural fields and livestock, and vegetation and species changes (see Figure 18). In the following section, I address how these individuals in Siete

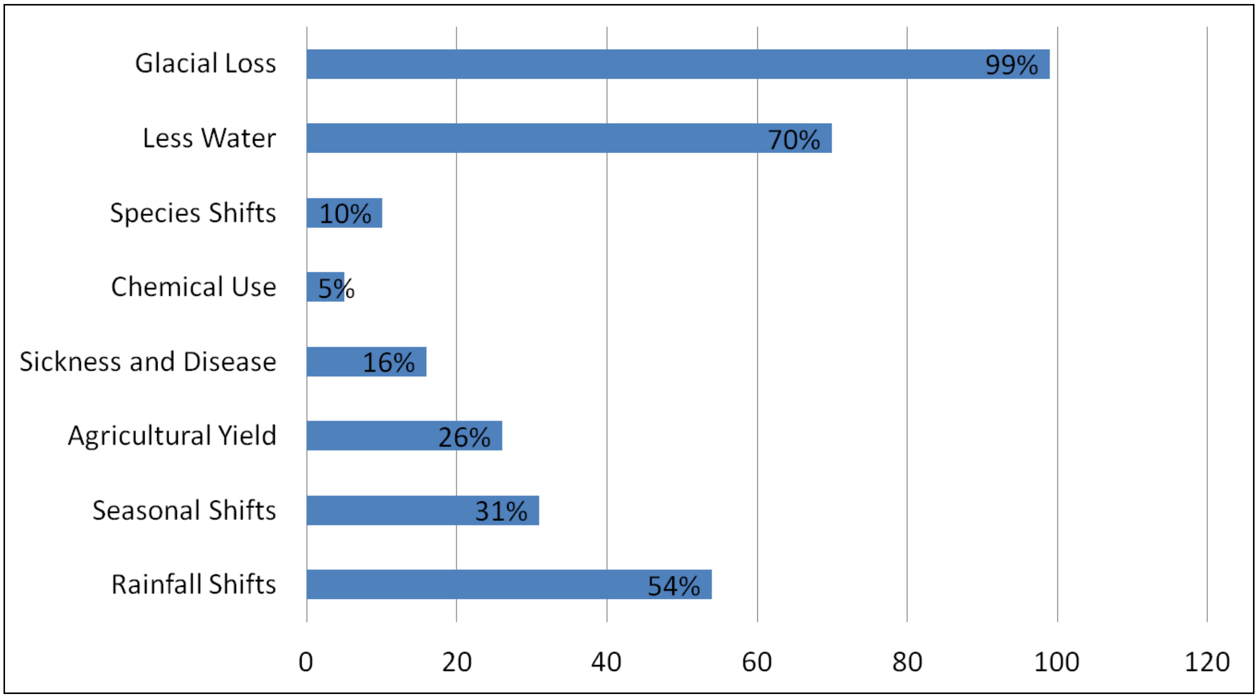

Figure 18 Frequencies of Observed Environmental Changes (N=132)

Imperios discuss these changes.[39] It should be noted that I asked directly about glacier changes, rainfall patterns and concerns for water resources if they were not introduced organically. When introducing these topics, I made every attempt to avoid leading the respondent and asked opened ended about whether these variables were changing, and how.

Glacier Loss

Almost every person interviewed for this research observed that the glacier has receded significantly in his or her lifetime (99%, N=131). Most of their observations stem from frequently visiting the ice in their youth, when glaciers came lower into the foothills and were much easier to access (71%, N=94). Though there are annual ritualistic visits with the glacier, the most common interaction between the individuals of Siete Imperios and the Copa Glacier occurred while leading animals to pasture in the fields above the community or checking on those cattle and horses left in the larger grazing plot near the *acequia* intake. While pasturing animals in grazing land high above the community, significant time is spent in areas that were once near the ice. The following quotes are excerpts from interviews that provide examples of such observations:

> What is changing more than anything is the glacier. Now the glacier is ending. I don't know why this should be. When I was 10, 11 years old, I went to the glacier and I found it to be much lower. Now little by little it is farther away, it is ending. (Interview 113)

> There has been much recession, a lot. From where I first knew [the glacier] it has possibly receding something like 800 meters or one kilometer. (Interview 123)

> Yes [the glacier] is changing very much. Yes, it is advancing farther; it is leaving now, before it was not like this little, the other glaciers were normal too. No, the end is coming for [Copa Glacier] now. (Interview 115)

[39] Since rainfall and concerns over water availability are largely covered in the previous chapter, for this chapter I will only discuss them as they relate to the other observed changes in Siete Imperios.

Figure 19 View of Tsukushqa. Photograph by author.

Research participants readily point out places much lower on the mountain where they once went to pasture animals and gather special flowers that grew just under the ice fields, or point to places where the glacier used to be when they harvested ice to sell in the valley towns or use at home. What was once an easy and enjoyable side trip while pasturing animals is now a several hour trek resulting in fewer and less frequent visits to the ice:

> We went [to the glacier] as we pastured, with animals we went in like an hour and a half. But now when would you get to the glacier? To get to the glacier it would be something like four hours, or more. [The glacier] is growing old, it is falling. Now it is all ending.
>
> The glacier is leaving. When I was young, where we call *Tarushyakunan* [Quecha name meaning where deer drink water] is where the glacier was. And now, where? How many meters has it climbed? (Interview 111)

Most people refer to a specific place on the mountain when asked where they remember the glacier being in their youth. These names and places are as diverse as the interview participants themselves. It seems each family had their own distinct pathways through the hills above Siete Imperios. This is likely because each household had a district pattern of *chacras* and grazing land that would take them to different corners of the community from their neighbor. However, an often cited measurement of glacier recession offered to strangers who do not intimately know the community topography is the peak known as *Tsukushqa* in Quechua, which means “with hat” pictured in Figure 19 above. This hat refers to the glacial snow that once covered this mountain. In interviews, this peak is now described as a nose because it is no longer capped with snow (for example, Interview 15).

The fields and foothills below Copa Glacier are referred to by many names throughout the community. In the sea of place names, most community members reference two specific entrance points to the glacier itself: Allankay and *Minas*.[40] The first follows the main canal, Allankay, around the berm, across the communal grazing land where the canal begins and up the rock wall where the potable water intake was installed (see ‘A’ on Figure 20 below). One research participant recalls having “met” (*he conocido*) the glacier when it extended down over what is now the intake, a place referred to as *Rakinan* meaning “to distribute” in Quechua (Interview 126). Older participants remember the glacier edge being as low as the *pampa* of Allankay in the 1970s. The second path, and southside entry point to the glacier is referred to as *Minas* and roughly follows the Condormarka Valley (see ‘B’ on Figure 20 below). This area is referred to as *Minas* because it was once a small, artisanal mine. Older research participants reported that they remember the glacier edge being as low as *Taya Pampa* (Taya Fields). Taya is

[40] This section is my best estimate of naming sequences for the glacier paths. When naming pathways, interview participants would indicate where the glacier was by directing me to “that cloud” or “the waterfall,” both of which are common occurences on the mountain.

Figure 20 Panoramic of Copa Glacier. Photograph by author.

a native shrub, and refers to a point where there is a large stand of taya shrubs (*Baccharis* sp.) and quenual trees (*Polylepis racemosa*) below *Minas*.

As the glacier "deteriorated," community members had to climb further up the mountain to access the ice (Focus Group 7). Some of the earlier entry points have retreated to a steep rock wall and are no longer passable. Above *Taya Pampa* interviewees refer to *Ocsha Jorqamuna*, *Tacsha Uchpa*, and *Jatun Uchpa*. Following along the path from Huecochec (the southern most sector of Siete Imperios) toward *Minas* are several other named points: *Ichic Silla* and *Jatun Silla* (Little Chair and Big Chair, respectively, which refer to the two flatish foothills that can be seen between points A and B in Figure 20), *Jatun Lapitoc* and *Ichic Lapitoc*, *Condormarca* and *Ichic Condormarca*, *Pucyu Pachan*, *Shecya Pachan*, *Ichic Huecho* and *Jatun Huecho*, *Qaqa Punku*, *Shullanqa*, *Kichki Ruri*, *Qontsi*, *Ichik Huaqrish*, *Jatun Huaqrish*, *Racrac*, and *Cunca*. Near *Minas* there is also a site referred to as *Raju Cargamuna*, which is a Quechua name meaning a place where people carry ice (Interview 78, Focus Group 7).[41] Respondents note that the glacier

[41] Quechua names not translated in the text did not have known meanings to research participants (who would refer me to "where the cloud is resting" to try and direct my gaze). Most named sites have dual parts: *ichic* and *jatun*,

is beginning to recede from *Minas*, which will elicit additional place names if people continue to visit the ice from Siete Imperios.

Visits to the glacier are often recounted as joyful experiences, sometimes with mystical properties. In the often echoed memories of one woman, "we went looking for flowers, played in the snow, and pursued rainbows." Memories are filled with these happy imagines and terms like "running," "playing," "throwing ourselves into the snow" (for example, Interview 79). Snowfall does not occur in the community boundaries, only very near to the peaks themselves, so snowfall is a welcome alternative to the rain or hail that falls below 4,000 meters. Arriving at *Minas* is "easy like climbing stairs," though there are a few more difficult places where people were worried about being "*aplastado*" (crushed) by the ice (Interview 78). Occasionally while playing or resting at the glacier's edge, a *desrumbe* (avalanche) would begin to rumble across the ice, inciting fear and causing those nearby to run down the mountain. The amount and volume of *desrumbes* heard or seen (evidenced by a cloud of snow) in previous years was often reported to be much greater than what can be heard now. During my time in the community, I only heard two distinct grumblings of the glacier, when community members claim they could hear the "brummmm, brummmm" of the glacier "*cada rato*" (all the time).

An important element of these casual visits to the glacier was gathering ice to make *raspadillas*, or snow cones, at the glacier edge. Coming from the Spanish verb *raspar* which means to scrape, the treat is also known by its Quechua name, *shikashika*, onomatopoeia for the scraping sound of the wood plane across the ice. During glacial visits, community members would collect ice that has fallen from the glacier, or they scramble up to the ice field itself and chop off a block of the more solid ice. In either case, the ice is placed in a *lliklla*, or carrying

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meaning little and big respectively. This naming system is reminiscent of the dualities often found in traditional Andean cosmology.


Figure 21 Making raspadilla at the glacier edge. Photograph by author.

cloth which is an element of the traditional dress in the region, and slammed against the ground to break the ice into more manageable pieces (see Figure 21). People often speak of being taught by their parents and grandparents to "*silbar antes de entrar*," or to sing a few notes to the glacier before entering the ice field. This practice was meant to encourage any large pieces of ice at the entrance on the verge of falling off to do so before people entered the ice field. Singing to the glacier was said to help avoid potential injuries when small avalanches occurred. If ice did fall when they sang, it made harvesting the ice much less work as they could gather the pieces that fell instead of climbing further and having to work at extracting blocks of ice. Singing for ice became part of the tradition.

In the past, flavoring was added using special native flowers, known as *Rima-Rima*, that were gathered along the paths on the way to collect glacier ice. These beautiful and fragrant flowers are said to have made the sweetest *raspadilla*, though even when the practice of using these flowers was at its height, they were scarce and only certain people knew where to find them. Using native flowers for flavoring is no longer practiced, even among those families making *raspadillas* while visiting the glacier. There are now large quantities of colorants and essences offered in the markets which are much easier to obtain and very inexpensive. When accompanying families while collecting glacial ice for their own use, native flowers used in the past were not sought out, or even mentioned, and instead packets of artificial drink flavorings were mixed with sugar.

Those who are interested in extracting ice to sell or otherwise use in the community report having to climb continually higher for the “good quality” ice that does not have rocks or impurities, and is more consistent. There are two main categories of ice discussed with regard to the glacier: porous and granulated. Porous natural ice has more consistency, is more compact, stronger, has a blue crystal color, lasts longer and is said to shine. This is the ice that can be sold in the valley. Granulated natural ice is weaker, whiter, it is “very soft and has a bad consistency, it is like sugar,” and breaks apart easily when you work with it, “it disintegrates like sand,” and would not endure a trip down the mountain (Hyde 2008). Previously ice at the glacial edge was relatively sturdy and predictable. The ice was still strong, clear and shining; still safe for extraction with donkeys and able to last the journey down the mountain. Those who visit the glacier have observed many changes in the consistency of glacial ice over the last several decades. Now the glacier has “deteriorated” so that there are no longer solid fields of ice greeting you when you approach the edge. It is more often described as a crumbling slope of slush.

Though it is much more difficult to reach the glacier itself, hardly any research participants reported feeling like the glacier was dangerous or having any fear of visiting the peaks in the past.[42] However, a few interview participants recounted *encantos* (stories or spells) their parents told them to dissuade them from doing certain dangerous things, like going out at night or getting too near the glacial lake. Most had to do with visions of various elements appearing in the high fields or lake: "in the *punas*, when we went there with our animals, they say things would appear like people or foxes, demons too" (Interview 79). "Be careful or the spirits will pursue you," parents would warn and people remember being frightened by the smallest sounds because of these "*mentiras*" (lies) told to them by their parents about spirits in the *puna* carrying them away. During a February 2010 focus group, one participant recounted the story of her uncles and brothers who went into the high *puna* at night to look for stolen cattle and saw a boy playing the violin and singing. They identified it as a spell and grabbed a big stick for protection. The boy was naked with hair down to his buttocks. The vision bothered the search party who sent the dogs after the boy, but all they grabbed were "*espinas*" (spines from a cactus) as the boy disappeared (Focus Group 27). The visions and music of this boy usually occur near small pools of water during the night fog of a new moon. People refer to him as *ichic ollqu* (small boy) and sometimes see him laughing at them across the acequia or merely see the instruments he is known to play, violins and tambourines, floating in the rivers. It is said that *ichic ollqu* can "*meterse*" (insert himself) in the stomach of women suggesting he is a myth that is meant to dissuade young women from being out alone at night for fear of them becoming pregnant. In the story of the search party who saw him above, they were concerned he was going after their "married women" to impregnate them.

[42] One research participant from Hualcan, above Yunguay where the 1970 disaster occurred, was the exception. She had a palpitable fear of the glacier ice and speaks at length about the community of Hualcan living in fear of future glacial disasters.

In other stories, glacial lakes played the threatening role. In continuance with larger cosmological practices, glacial lakes are either male or female and are known for falling in love with people of the opposite sex who dare to approach or enter the lake. If the lake fell in love, it would generate a wave from inside itself to capture its heart's desire and carry it to the depths of the lake to be its spouse. Perhaps to entice the victim into the lake, certain toys or objects would appear like a mirage in the middle of the lake, tempting individuals to enter the lake to retrieve the object. In the lake above Siete Imperios, Lejiacocha, it is said there is a spell on the lake so whatever you most want will appear there to you. In addition to being under a spell, this lake is "*chúcharo*" to the people of Siete Imperios, which means it is very difficult to reach and people are not accustomed to the journey as they are with the Copa Glacier.

Seasonal Shifts

Concerns about the seasonal calendar generally (31%, N=41), and rainfall specifically (54%, N=71), was a clear theme for those participants who were asked about environmental changes. Farmers claim that the seasonality which so marks the agricultural and cultural calendars is now much more chaotic. Rain, wind, hail, or frosts that once occurred "in their time" are now less predictable. In the interviews of community members, the concern regarding the unpredictability of weather patterns was obvious:

> Now we suffer with the rain, now it does not come. The temperature has totally changed too, it is hotter. Seedlings burn, sometimes there is land that burns, the heat burns quickly. Before in June the rains came until July, in August rains would pause, then return in September and in October it would still be falling. Now it does not fall, not until sometime in January, February, or March still...Now everything is changing completely. [Rains are] excessive now. [They come] and cause collapse, bring hail, everything. Before it was not like this, it fell normally. Now everything, everything, all of it has changed. Years before were normal, now, this year it is really hot. Sometimes land heats up and burns the planted crops. It is not the same, everything has changed. Now it is hot and later the rain will fall. For our animals poison and sickness comes, carbuncle disease

> grabs everything. People too [are sick]. Everything, everything has changed. Everything fucks us. (Interview 111)

Interestingly, though variability and shifts were a common concern, interviewees did not have the same perception of the type of shifts, variations, or the potential outcomes of these shifts. Some research participants felt that the rains were significantly less than they experienced in previous years, making remarks such as “now it is only raining a little” and “the rains have changed, before it rained plenty and now there is less rain,” while others felt that rainfall was now much more intense, to the point where “now I am afraid of the rain.” Some farmers feel that rainfall is better for the plants because “it better saturates the fields,” while others claim that

Figure 22 Frost damage on young corn. Photograph by author.

plants “prefer” one source over the other. Rainfall is said to be harder and colder. These hard rains wash out seedlings, ruining entire harvests, and leave standing water that encourages fungal growth on the hooves of their animals. These harsh rains also exacerbate erosion and damage irrigation canals, paths, and roads. Residents remember once playing in the rain, but these harder, colder showers are less enticing for such frivolity. These heavier rainstorms are now more likely to bring with them “hail like crazy” (*runtu* in Quechua) and lightening (Focus Group 4). When hail falls early in the rainy season, it can damage or even ruin young crops. A woman reported crying whenever it hailed because she had planted so little and the hail could easily “end” her crops causing her to worry about what her children would eat (Interview 85).

Some residents claim that frosts are more frequent, especially in months where there used to be constant rainfall. Frosts which can damage and even “*terminar*” (end) young crops typically occur in the dry season months (see Figure 22). During the clear skies of June, July, and August frosts often occur as there is no cloudcover that would otherwise “*abrigar*” (shelter) the soil. Frosts that fall during these months are not considered harmful because food crops are mature enough to withstand it or have been harvested. “*Pasto*” (grains planted or that volunteer in fallow fields used for animal feed) is the only thing potentially vulnerable to frost in these months. Frosts that fall during the dry season cannot “*argarrar*” (grab) the food crops like it would when it falls during the major planting *campañas*.

However, when the rains “escape” (how community members refer to a pause in the rainy season) as they tend to do around November or December, any potential frosts can cause major damage to newly planted crops. During these months critical food crops such as corn, beans, and potato are young and vulnerable to heavy frosts. Community members recall years before when these mid-rainy season frosts “finished” entire fields of food crops. Farmers in Siete

Imperios keep an eye on the glacier when they want to calculate the possibility of frost during the rainy season agricultural cycle. A popular belief that was often cited when talking about the importance of the glacier to life in Siete Imperios was that the glacier "*se negrea*" (turns black) when rain is imminent.[43] Conversely, if the rains have "escaped" signaling the potential for frost, the glacier is beautifully white and shining brightly.

Many of the research participants who reported concerns with seasonal shifts were specifically concerned with the changes in temperature (85% of those concerned with seasonal shifts reported in Figure 18, N=35). Most felt that year-round the day was much hotter than in previous years. Some claimed the sun itself was changing, rising faster and hotter but not lasting as long. These temperature shifts affect all aspects of life. People reported that "*nos aburrimos*" (we become bored) when they go to work during the day because the sun is so hot they are forced to rest mid-day. As research participants exclaimed, "it is like the sun is in the ground it is so hot" (Focus Group 6), and "the pathways are like ovens" (Interview 110). The heat causes the crops to wilt and dry out. Even when the rains are falling regularly or fields are fully irrigated, the ground "*chup*a" (sucks or drinks) much more water than before and dries out quicker between irrigation turns.

Not only is it hotter during the day, but research participants felt it was much colder than usual at night and in the mornings too. Respondents report feeling very cold in the mornings and afternoons, but that by mid-day the sun is very strong with many more "*reflejos*" (reflections). Essentially, they feel the diurnal temperature extremes are growing more so:

> The difference is that it used to be better protected, the day was more tranquil. The sun lasted a while and had fewer reflections. But now, in the morning you feel cold and during the day the heat burns you. So the sun is sinking, no? Before it was pretty, temperate, but now in the mornings and afternoons it is cold, but during the day the sun

[43] I was unable to elicit further definition of this "*custombre*" (custom), systematically observe whether this was an accurate predictor for the presence of rain, or find physical basis for this occurrence.

> wants to burn you. During the day you cannot even put on a black or blue shirt or you burn worse. (Interview 19)

Respondents most often note temperature increases during the dry season. Though there are greater diurnal shifts in temperature than seasonal shifts, the dry seasons of June, July, and August are historically cooler months because of the clear skies. Now, when the rains "leave" it is hotter than seasonally expected from previous years. These temperature changes are linked with other environmental observations. Respondents claim that the increasing temperatures are responsible for the rapidity with which the glaciers are "advancing" or "deteriorating." The combination of rising temperatures with overextended water networks result in there not being sufficient water during the hottest months. This is further exacerbated by the fields needing to be irrigated more often because of the hotter days.

Agricultural Productivity

Following glacial recession and seasonal shifts, by far the change most often noted is the decline in agricultural and animal productivity (26% as shown in Figure 18, N=34). Respondents reported lower yields per hectare, which causes more fields to be kept in agricultural production and therefore decreases the amount of fallow pasture available for grazing. Because the fields are producing less and the population is growing "the fields cannot rest because we have so few. The fields are not sufficient [for our subsistence] so we have to work, work, work the little piece of earth" (Interview 118). However, without the fallow period, and subsequent livestock fertilization, synthetic chemical fertilization of fields increases in importance. Since the synthetic fertilizers and pesticides must be purchased (as opposed to using the natural byproduct of livestock) sometimes a farmer or household cannot afford the inputs. Without fertilizer, "*la chacra no da*" (the fields do not produce), so they are left fallow until inputs can be purchased.

Another farmer agrees, “before we had more forests, but now we don’t allow anything to grow [naturally] because we are always harvesting, harvesting. Now we don’t let anything rest” (Interview 70). Not leaving a field fallow also allows any disease that may have “grabbed” a crop to continue infecting future crops, requiring further chemical inputs in the form of pesticides, which concomitantly can potentially cause resistant strains of the disease in question.

These chemical inputs, mostly fertilizer and pesticides, were often cited as a cause for concern on several fronts. Although most recognized that the fields would not produce anything without them, many older residents lamented the turn from using manure to chemical fertilizers. Not only did families use local animal manure in earlier years, but one research participant recalls families that used *guano* (bird droppings) from coastal islands. During the decline of the hacienda and with the influx of foreign aid, synthetic fertilizers appeared and for several years helped the declining production, but they are now being blamed for newly collapsing productivity. People are concerned that fields are too accustomed to chemical fertilizers and so need more and more to produce even a small harvest. One farmer felt the chemical fertilizers themselves were “devaluing” the *chacras* (Interview 70). Claiming shortsightedness on the part of most community members, one research participant was concerned that families assume “their piece of land will support them until the end” and do not concern themselves with the possible consequences of so many chemical inputs (Interview 52):

> Now we plant corn, potato, wheat and we have to go and buy venom [pesticides]. This venom we put on the crops and then eat these poisoned crops, and sometimes sell them. When we put fertilizer on the potatoes, the crops give a good production but is this potato safe? They say ‘yes, we have harvested well’ but what are they eating? Some don’t realize. (Interview 19)

Research participants who discussed chemical inputs were concerned that perpetually increasing the fertilizer was weakening the soil in the fields, the crops, and the people who eat the product.

The amount of money required for good production these days seems exorbitant to those community member who remember when fields were fertilized with manure from their own cattle or sheep.

Farmers in Siete Imperios also felt that the varieties they knew in their childhood were no longer in production. “Wheats, potatoes, olluco, mashua” and other varities were “*mas agradable*” (more agreeable) but now olluco and masha are no longer cultivated (Interview 52). The varieties of potato grown in the communities now are not native varieties, but “new seeds.” When I asked whether farmers were interested in planting native varieties, they replied in the affirmative but did not know where these seeds could be found. A few of the older community members mentioned seed banks in Huanúco and Ayacucho, in southern Peru, where “*semilleros*” (nurseries) of native plants are kept and farmers can go to learn about how to care for these natives varieties (Interview 52). When the founding families were experimenting with the ratio of agricultural to pastoral inputs in the early years of the community, community leaders also visited other areas of Peru to purchase *vicuña* or *alpaca* and to incorporate ancestral knowledge about these varieties.

Disease and Species Shifts

Other changes observed by residents of Siete Imperios are increased instances of disease (16% as reported in Figure 18, N=21) and shifts or losses of species (10%, N=13). Both of these observations are often connected with the effects of chemicals used in agriculture as discussed above or to a more general concept of “contamination.” Contamination is thought to spread through the air from the nearby mines, increased car traffic, or agricultural burning practices.

There are reports of increased incidences of sickness and disease among people, crops, and animals. Some suggest this is at least partially due to the overuse of pesticides and chemical fertilizers described above. Several respondents were worried about the effects of these chemical inputs on the health of themselves and their families:

> In the time of our parents they planted with manure, now everything is synthetic. We use pesticides with poison [on plants]. We use whatever [medicine] to cure ourselves [instead of natural plants]. For this reason, the potato is also weaker, it does not have nutrients, now it does not have its strength. Now there is the potato sickness, it ends the corn and the potato. We call it the *rancha* and it ends the corn. Before these things did not exist. When I was young they did not exist.We used to eat healthy but now we use pesticides on herbs, on potatoes, on our food. [Food] almost no longer has value. (Interview 111)

Several community members felt that food grown with natural fertilizer was "*mas sano*" (healthier) than what is currently harvested in Siete Imperios. I witnessed this concern about the safety of chemical inputs on several occasions. One instance occurred while observing field maintenance activities with my co-mother's family, which entailed digging out the ditches between rows of corn to pile aerated soil on the stalks. The women were following the men down each row putting a handful of fertilizer, little white pellets, on each stalk before the men piled on the soil. Clearly the act of digging and moving the soil was a job for the men, so I offered to help the women. They refused to allow me, saying that the fertilizer is poison that burns your hands. They were not using any protective hand coverings, but were concerned for my hands that were clearly not accustomed to hard labor by comparison.

Some research participants felt the result of these chemical inputs, in addition to the increased use of non-herbal medicine in the community, was a weaker physical constitution of younger generations. The increase in non-use of herbal medicine is exacerbated by the reported decline in the existence of native, wild-growing medicinal plants, thereby affecting the survival of the associated knowledge of herbal medicine. Some community members proudly proclaimed that they had never taken western medicine, “not a pill or a shot”, with the exception of vaccinations when they were young. They claim that by using natural plants and herbs, they are healthy without a cough or anything else “grabbing” them. When they do get a cold or cough, they approach the “*cura*” (healer) to prepare a remedy. Interviewees feel that younger generations who are depending on the health posts as opposed to the medicinal plants and healers, are much weaker than older generations who did not have access to such interventions. As one informant observes:

> My mother is 98 years old and is young still. We are no longer equal to the earlier humans, the elders. The elders today are younger than we are. Some of them live until 80 or 90 years old, but now even when we are 25 or 30 we are sick and weak. Generations before did not know medicines, but now they are everywhere. (Interview 19)

Some blame the increased incidence of sickness on disease vectors moving up the mountains. Recently, rats have appeared in the Callejón de Huaylas, and are now a common occurrence in Siete Imperios. As a result of this shift, many households have recently begun to keep cats in order to fend off rat populations. Like dogs, cats are viewed as working animals. One morning I awoke to shouts from my host family, “Señorita, wake up, there is a rat in your room.” At the time the household only had a small kitten who was no match for the fattened rat burrowing in my dresser. Once I opened the door, Juana threw the poor kitten at the rat and we all watched as it hissed and ran away. After cursing the cat, Juana grabbed a piece of wood and proceeded to chase the rat around the room, eventually bashing it to death *in* the bottom drawer of my dresser. This reaction illustrated the discomfort with rats and what they represent, as well as the limitations of using cats to guard against the vermin.

Informants also reported increased incidences of disease within their agricultural produce. Interviews indicate diseases for the potato, corn, and wheat. These diseases are referred to as “*mancha*” (stain), “*rancha*” (*Phytophthora infestans*, late blight on potatoes), and “*qasra*”

(Quechua terminology for blight). *Qasra* causes plants to dry out. Even though there might be "water running from all over," the plant turns yellow and stops growing (Interview 14). Other instances of disease are not visible until the plant is mature. Instead of putting out fruit, the roots begin to rot and the plant dies. Sometimes the plants do fruit, but these fruits do not grow and have no taste when eaten. Research participants link these diseases to a variety of causes, for example, temperature changes, too much rain, weak seeds, or pollution. These diseases are sometimes perpetuated by not letting a field rest. Planting "*en seguido*" (immediately following) is said to weaken the field, allowing for diseases referred to as "*collar*," "*llampa wallqa*" and "*anca*," which result in crops that are "dammed" (Interview 14). Potatoes stricken with this disease grow tremendous balls of roots but no potatoes sprout. "*Anca*" causes potatoes to grow covered in "wounds."

Alongside plant diseases, most of the livestock are also experiencing an increase in disease. *Remedios* (medicines) are now necessary for sheep, guinea pigs, cows, and pigs when older generations report that animals did not have any diseases. These diseases "grab" all the animals, and even "attack" the humans (Interview 14). An often mentioned disease was "*hongos*" (literally mushrooms, but likely means general fungus growths) that often grow on the feet of sheep. "At least three of my sheep are eating on their knees" because they are lame and cannot stand on their feet because of the disease (Interview 14). I saw several sheep that walked this way while being taken to pasture. Residents of Siete Imperios claim this disease spreads when animals stand in mud for too long "day and night" when the rains do not break.

There are various instances mentioned in interviews and focus groups about shifting habitats or the disappearance of certain species. Non-native trees grow at higher elevations than in previous years, along with certain varieties of potato and corn. As recently as a decade ago, corn was not a feasible crop to grow in the higher reaches of Siete Imperios because of the altitude, but now nearly every family rotates it into their field during the year. Native species of flowers (rima rima), trees (alder), and medicinal plants (hierba santa) are reported to be diminishing or altogether lost. Young women often visited areas just below the glacier to gather these special flowers and plants which only grew there. Some are said to have medicinal benefits, or are particularly valued when placed in the band of the ubiquitous wool hat worn by local women, and said to induce attraction from men. These special flowers and medicinal plants are said to have become much less plentiful. Some suggest they have "dried up" due to the increasing water needs of the area while others believe they have been overharvested.

Several native, non-domesticated animals were reported to have disappeared in recent years. Toads, frogs, and snakes were the most frequently mentioned. Before there were:

> Huge snakes, like this [holding his hands up to show a big snake], there were many of them. Now there aren't any, they have disappeared. There used to be many toads here too, always here in the water. There were frogs too in this zone. They have disappeared too, before they were immense here, singing melodies, but not now. (Interview 19)

Other interviewees mentioned fewer birds and butterflies too. People felt these animals were dying because of "contamination." Most of these animals reported to be disappearing depend on water for their habitat. Because of their relationship to water, and the way water fluctuates with the onset or departure of the rainy season, the appearance of some of these species are cited as heralding the beginning or the close of the rainy season.

Eroding Environmental Knowledge

People in Siete Imperios worry that knowledge is being lost in many domains—farming practices, soil knowledge, manure use, and ways of cooking and feeding families without depending too heavily on purchased supplies. The analysis of interviews shows loss being described largely within two individual, yet related domains. The first is the loss of interest and certain social activities around environmental locations, such as the glaciers and the hills just below them as these environments change and the glaciers disappear. The second domain of loss is concerned with shifting generational values that form the basis for life and livelihoods in Siete Imperios. An example of one aspect of these shifting values, is the development of the commercial *raspadilla* trade, discussed in detail below. Once a treat communities like Siete Imperios could enjoy while going about their pasturing in higher altitudes, now purchasing this treat in the valleys is the easier way to obtain it. The shift from making ones own *raspadilla* to having to purchase it in town is symbolic of a larger shift from community self-reliance to being increasingly dependent on the larger economics of the region and the country. Research participants see this shift as being partially driven by environmental changes affecting their agropastroral existence.

Glacier as Social Space

Most note that while the glacier was once a social place for young adults or families to gather, now hardly anyone goes because it is so much farther away and is in some areas more dangerous due to the steep rock walls left by the most recent recession. As discussed above, community members would visit the glacier while pasturing animals in the high *punas* or checking those animals left in the communal pasture lands just below the ice. These visits were opportunities for people to combine their household tasks with clearly pleasurable, social activities surrounding the glacier. Though older and younger generations are usually not traveling to the glacier together, there is a shared experience between generations. This shared experience with the glacier helped to perpetuate intergenerational ties through oral histories of past experiences with the ice, stories of place-names, and myths to warn of certain behavior or elements of the higher altitude mountains felt to be dangerous.

Other than these mundane social activities, the few ritualized activities cosmologically connected to a larger "Andean" history that I observed in Siete Imperios revolve around traveling to the glaciated areas of the mountains. New Year's Day was often marked by families or groups of friends hiking up to the glacier edge and spending the day playing and communing with the glacier and the mountain. But the most significant is the *Fiesta de San Juan* on June 24th, which celebrates both the birth of Saint John the Baptist and summer solstice. Traditionally, communities observe San Juan by trekking to the glacier and burning offerings for the continued fertility of their livestock. Burning practices undertaken for the Fiesta of San Juan have been restricted by the Huascarán National Park under the guise of conservation, which has resulted in a significant drop in participation. As described in Chapter 4, the skies used to be black on San Juan with all the burning but community members now report only seeing a few small plumes of smoke across the valley. The day once marked with celebration and ritual is now blending into the rest. Had I not been aware such a festival existed on June 24th, I would not likely have noticed the few illegal fires burning inside the park boundaries. When I asked if people were concerned that they were no longer able to ask for blessings for their cattle, they seemed nonchalant, "it is just lies, Señorita, customs of our ancestors, nothing more."

As the glacier itself becomes more difficult to reach, fewer families will participate in these celebrations. The time commitment is greater and to reach the actual ice is a much more technical process than in previous years, when it came down into the foothills and could be accessed by almost anyone. The sometimes vertical rock walls left bare by the most recent recession requires significant climbing skill and most community members do not make the attempt. Beyond the decline in ritual celebrations, fewer families keep cattle or horses in the higher fields, so regular visits are much less necessary. Some say certain paths to the glacier are lost now due to fewer people visiting the glacier. "Who goes to the glacier now?" many community members asked me rhetorically, "young people do not know the glacier."

Glacial Loss Develops a Trade

Raspadilla, once consumed during the regular visits to the glacier, or even the main motivation for visiting the ice, are now almost solely available commercially in markets or during seasonal *fiestas*.[44] Today these treats are sold by street vendors with tricycle carts, typically in the major plazas along the valley. A commercially-made *raspadilla* consists of shavings from a large block of glacial ice combined with several thick syrup flavorings, honey, and sometimes milk. *Raspadilla* is enjoyed either in a pint glass with a spoon if you plan to sit and eat nearby, or with a straw in a plastic cup if it will be eaten on the go. Most people choose the glass, taking the time to sit and enjoy the refreshing treat while seeking shade from the hot mid-day sun.

Extracting ice for use in Siete Imperios or to sell in the valley markets is a more involved task than collecting ice for the casual glacier-side *raspadilla*. Since those gathering ice for these impromptu *raspadillas* were not overly concerned with whether the ice would last longer than a few days, they preferred the crumbling ice at the glacier edge as it was easy to turn into *raspadilla*. If the extractors plan to bring the ice down the mountain, the more solid ice is sought out, kept intact, and immediately wrapped for protection. Those contracted for extracting

[44] Regional accounts describe commercial *raspadillas* as a well-established practice in the valley dating to before the 1950s (Stein 1961). These commercial *raspadillas* existed alongside the practice of making *in situ raspadillas* during visits near the glacier. Individuals with access to the glaciers throughout the Cordillera Blanca, including Siete Imperios, would extract blocks of glacial ice to sell in town when in need of money. Local *raspadilla* vendors and community members recall commercial *raspadillas* revolving largely around the first *fiestas patronales*, which are celebrations of when a particular town or community was established following the Agrarian Reform of 1969. In contrast, most, if not all, ice used for commercial *raspadillas* in 2009 was collected by a specific group of people living in communities above Yungay who travel to the Huandoy glacier to extract ice blocks.

commercially viable ice climb onto the glacier to extract the ice blocks and carry them down to the point where the donkeys are tethered at the start of the ice fields. Then they load the ice blocks onto the donkeys and lead them back to small storage facilities in their respective villages. When it is harvested for sale, ice is extracted in blocks of about 50 kilos and paired to travel down the mountain. Once loaded onto the donkeys, ice blocks are typically covered by a native *ichu* grass that grows in high altitudes. This natural covering is then layered with large white plastic bags, previously used to store rice, which further protects the ice.

Previously, carrying glacial ice down the mountain was undertaken by the same families that sold the ice at festivals or in city plazas and by those who lived close enough to the ice edge to occasionally extract and sell blocks of ice for supplemental income. As the glaciers receded further up the mountain, there was simultaneously more and less opportunity for supplementing agricultural livelihoods. As the glacier receded, the task of traveling to the glacier became much more onerous as one needed to climb further, over increasingly difficult paths to reach the desired ice. Farmers who infrequently made the journey for supplemental income turned to other activities, like working for a neighbor or on paid municipal projects. This left open the opportunity for specialization in glacial extraction, which is what followed. As the glaciers became more difficult to reach for opportunistic glacial extractors, specialized groups established a business out of extracting ice to sell in the markets. Referred to throughout the valley as *nieveros* (people of the snow), these are the only people extracting glacial ice commercially today. Environmental changes have resulted in restricted access to glacial ice, but simultaneously has made purchasing glacial ice easier now that *nieveros* were dedicated to the task. Under this changed extraction economy, *raspadilla* vendors have multiplied. In the Callejón de Huaylas international tourists, along with local populations and Peruvian tourists, help to maintain the *raspadilla* trade, supporting the additional vendors.[45]

The price of glacial ice has risen because of the change in path accessibility and deterioration of the glaciers. As the glaciers continue to recede ice extraction becomes a significantly longer undertaking and those extracting ice are putting themselves in danger by being in close proximity to sites of small, but dangerous avalanches. Now most ice is extracted from Huandoy as other glaciers have receded to the point where the ice is no longer viable for *raspadilla*, and the access points are no longer accessible—or are too dangerous. These paths are risky because the glacier is very unstable and landslides are often reported. Several glaciers that are easily accessible and previously used as tourist destinations have since been closed due to increasing instability from recession. For years the transport of ice from remote areas has been on the backs of donkeys. Even now the paths to the glacier are not suitable for any type of transport and *nieveros* report that with increasing frequency the rock walls left behind by the most recent recession are not even suitable for the donkeys to climb. As a result donkeys must be tethered farther and farther away from the point of extraction, and *nieveros* must climb back and forth from the point of extraction with heavy blocks of ice. Similarly, the ice at the edge of the glaciers is often unsuitable for use as it is too crumbly and melts too quickly. Not only does this unstable ice cause a problem for those eventually purchasing the blocks of ice, but it is also extremely dangerous for the *nieveros* themselves, who have to climb further and more frequently

[45] Tourists travel from all over the world to climb the glaciers, scale the rock walls, and visit the numerous cultural sites in the valley. Vendors and tour companies tout Huaylas *raspadilla* as a treat that cannot be found in other parts of Peru, or even most of the world. Although there are *raspadilla* vendors on the coast and in the rainforest, these are made with manufactured ice from potable water systems or river water. There are few places in the Andes where you can purchase a *raspadilla* from natural glacial ice; most Andean cities are too far from glacial zones to sell natural ice *raspadillas* because the cost to transport the glacial ice is too high.

into the glacier to extract acceptable blocks of ice, increasing the possibility of accidents.[46] Though glaciers in the Callejón are known to be increasingly unstable, the demand for glacial ice has not waned.[47]

In the Callejón de Huaylas region, as with much of the Andes, there has been long-term devaluation of indigenous culture and practices since colonial times. The value of *raspadillas* as a local treat is now being undermined by the increase in the availability of and value placed on national and international confections that are increasingly available throughout the valley. The continual improvement of roads and the spread of electricity allow national and international goods to be increasingly available and able to be served cold, which creates direct competition with locally made cold treats. Typically local products are less-valued than those from Lima or imported from other countries. In contrast *raspadilla* is more expensive than these mass produced treats. A *raspadilla* is typically sold for one Nuevo Sol (~US$ 0.15) where a packet of gum or other sugary treat is usually sold for half that, or even sometimes a tenth of the price. While treats based on glacial ice retain significant value for the part they play in local tradition and identity, rises in price will make them unaffordable for local families. If the practice of using glacial ice is discontinued due to changing glacial conditions, it will no longer hold even the traditional appeal as manufactured ice is felt to be less authentic and holds no value for locals.

[46] Several years ago there was a small avalanche from Hualcan while *nieveros* were extracting ice. Of the 22 people working on the glacier that day, 11 were buried but were able to dig themselves out, but nine died. Those who were farther off the ice, shaping or loading blocks, were able to run to safety and escaped unharmed.

[47] *Nieveros* report that the blocks they bring to market are sometimes gone in under two hours. *Nieveros* report that 60 or 70 blocks of ice go solely to the city of Yungay, which is only one of the main cities in the valley requesting ice (Hyde 2008).

Shifting Values

The commercialization of *raspadilla* exemplifies feelings on the part of community members that life revolves around money now more than ever before. Though these shifts can be traced to external policies and fiscal scenarios, it is also a result of environmental and social changes within the community that are tied to lower agricultural production, forcing families to seek out supplemental income to meet basic needs. This shift to more cash-based lifestyles was reported as a concern by several research participants. They felt it caused a change in the social fabric of the community. More and more relationships, subsistence activities, and "needs" revolved around money instead of social networks.

The practice of *minka*, discussed in Chapters 4 and 6, is another example of a significant cultural shift toward a market economy that is related to environmental changes. Community members claim that *minka* no longer operates as it used to because there is not enough surplus production to adequately compensate participants without using cash. Families are forgoing fallow periods and continuously planting fields, but still feel there was not sufficient production for their immediate needs, let alone sharing this harvest with multiple families. Environmental limitations are perceived to be changing the social fabric and connectivity of families within the community. The declining agricultural yields have caused families to become rather focused on the "ambition of their land" at the peril of how these changes are influencing larger, longer-term trends for the community (Interview 52).

Yet another example of changing trends that are perceived as a loss by older community members is the shifts in types of dress. Though traditional styles are still the norm throughout Siete Imperios, the materials and origin of these garments has changed. The man in Figure 23 is wearing a store bought sweater under his poncho, but his pants, poncho, and hat are all examples of the type of dress one would have found more frequently during and just after the hacienda when many families wove their own clothes. These hand-woven garments are said to be "*abrigada*" (warmer), last longer, and better protect from rain. However, today, most families purchase their clothes from the markets, usually at greater costs and lower quality. Sometimes the material is synthetic as opposed to pure wool, which dramatically affects its warming capacity especially when wet.[48] In the past most families kept several sheep and spun, dyed, and wove their own clothes. Several families with whom I dined with regularly spoke of having had a small business within the community weaving and selling traditional garments. None of these families still practiced these crafts. This shift reflects both changing environmental conditions as they affect the amount and varieties of livestock kept by families, but also a shift in values, with younger generations preferring externally made products (be it beer, clothes, food, or treats) to those that originate within the community.

During an interview with a former community president, a broader perspective on the shift in generational values became apparent:

> When I was president the community was more respectful. Now we think that the youth will improve our community, but our community is declining. The older generations will explain to you what they are seeing with the new leaders. Before I was president, our parents were more respectful toward the president and the president also was more respectful of us. But now, in the assembly meetings, the community agrees to strike [against the community administration] and this does not show respect for the leaders. As a result, the leaders do not respect us and we are worse off for it. This is why there is no progress in our community. Although we have resources, but we do not know where these resources go. They are spent badly, they are invested badly, and they are badly managed by the community leaders. We think that the youth will maybe be better, but they have no more capacity than we do. The youth do not show any concern for the administration of the community, they are only concerned with personal interests. Since they did not suffer through the [haciendas] nothing here interests them other than spending money. (Interview 47)

[48] During my tenure among the community, a *pollera* (woolen skirt, often worn in layers) easily cost S./60-100 in the market depending on the detail. An average woman in Siete Imperios would easily own ten or more *polleras*. These are often worn in layers and changed often throughout the day depending on the activity.

Figure 23 Example of traditional woven wool attire. Photograph by author.

These bad investments and widespread disrespect stand in stark contrast to the sense of pride older community members portray when recounting the communal efforts undertaken in the initial decades of the community. When I asked why there was such a decline in respect for the elders or authority figures, the former president responded:

> Our parents organized [against the hacienda and to set up the community] and because of this we hurt too and so we have continued fighting. Now, our youth automatically become socios of the community and do not need to fight or anything. When we had problems facing us we worked to confront them and we suffered since the beginning. But here, the youth, nothing. Since my children were born, they do not suffer at all, they do not realize. They just sell our resources and do what they do. This is why our community, Siete Imperios, is in failure. If not [for the apathy], we would be better. We would have at least a *local* [communal structure where meetings were held], but here we don't have a decent *local*. During my time [as president] we had a *local*.[49]

These excerpts illustrate that the older generations feel there is a great deal of apathy among the youth of Siete Imperios. This apathy is perceived to have stemmed from the ease with which the current generation has access to the necessities. Older generations had to step in for their parents during the time of the hacienda or the household would starve. In the early years of the community, *socios* had to plant and harvest enough food to survive on in addition to sufficient surplus to sell in the market to pay the "agricultural debt" for their newly acquired land. It was often mentioned that younger generations take the relatively easy access to basic necessities for granted. Instead of working to improve their economic situation or investing in their future, younger generations are critiqued for seeking out luxury items and generally preferring a different lifestyle to that of their parents. Like the dismissal of indigenous culture often found among other segments of Peruvian society, the youth of Siete Imperios do not hold the egalitarian, self-sufficient values and customs of their parents and grandparents in high regard, preferring instead the faster paced, modern lifestyle of the cities.

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[49] In the plaza of Copa Grande there were three buildings that were once used as the community *local*, but they have fallen into disrepair. The roofs are collapsing and the adobe is crumbling. Its only use now is when children play marbles among the debris.

Conclusion

This chapter outlines the most frequent observations of environmental change among community members in Siete Imperios. In order of frequency, individuals in Siete Imperios are concerned with glacial loss, seasonal shifts, declines in agricultural yields, and increased incidences of sickness, disease and species shifts or losses. These environmental changes in Siete Imperios are often perceived to be related to social and political shifts. Although some social changes can be directly related to observed environmental changes, others are due to shifting attitudes and values on the part of younger generations. Older generations are concerned about changing ties to the land, differences in farming techniques, and shifting priorities. Modern lifestyles are said to be less attuned and therefore less responsive to changes in the environment. As such, many observations of environmental change were expressed with a sense of loss for the places and ecosystems once known, but also for the associated lifestyles and values. The loss of physical places, such as glaciers and associated environs, "involve a loss of attendant cultural and social significance" that is sometimes less visible to economically oriented or large-scale calculations of climate change (Adger et al. 2009: 348; Turner et al. 2008).

Water concerns are not among the most frequently cited environmental changes currently observed in Siete Imperios, though the beginnings of water stress can be noted. The current stress stems more from increaseing demands for the resource and overextension of the service networks than from environmental change or related glacial loss. However, when asked about future concerns related to the observed glacial loss, water availability alone was the focus. “We will die without water,” “we will die of thirst,” or “what will we eat without water?” were almost verbatim the immediate responses to queries about life after the glacier (for example, Interview 8, Interview 12 and Interview 34). Considering the current concerns of constructed water scarcity and the projected declines in the resource, in the next chapter I will further explore the scalar political dimensions of water management, including the implications of "new" water laws on the ability of the community to control access to and manage the resource.

CHAPTER 6

NEGOTIATING FOR CONTROL OF A RESOURCE

If the only tool you have is a hammer, you will treat every problem as if it were a nail.

Abraham Maslow

Introduction

Peru is a particularly relevant place to study water negotiation given its unique geography. There is an overabundance of freshwater in the scarcely populated eastern lowlands and next to none in the highly populated coastal cities. Peru's population and its water-intensive commercial agriculture are concentrated on the desert coast, while the water resources exist almost exclusively in the highlands and Amazon basin. The coastal desert would be completely arid without the Andean rivers that originate from glacial meltwater. In spite of this reality, large commercial agricultural operations depend entirely on irrigation systems that distribute meltwater from these Andean rivers, and large population centers continue to grow. Because of this paradox—not the actual volume of available water—the International Organization of Water predicts that Peru will be the only Latin American country suffering from water stress by 2025.[50] The economic needs of these coastal enterprises and cities often conflict with the needs of those living upstream. Historically political priorities are awarded to the coastal economic ventures, highland mining operations, and hydropower, all of which have significant influences on the quality and quantity of water availability for human consumption.

[50] Cited in IPROGA and Muqui (no date) without a citation to original Organizacion Internacional del Agua report.

These nationwide conflicts over water distribution are mirrored in the department of Ancash and again within the Callejón de Huaylas. For national, departmental, and district governance there are layered social, environmental, and political negotiations pertaining to water availability and management. The various regimes surrounding water management are the product of centuries of conquest and shifting ideologies (see Chapter 3) but also the complexities in the hydrological system itself. These complexities revolve around the existence of many microclimates, the multifaceted unknowns of how tropical glaciers link to water cycles, the lack of information regarding groundwater, and, of course, the uncertain effects of global climate changes (see Chapter 1).

Given the layered and interrelated scales influencing water management in the Callejón, my second research question asks: *On what scale(s) is changing water availability being negotiated and how these negotiations influence water availability in Siete Imperios?* While water management is a reality across scales—though the knowledge, priorities, sources, and politics surely differ—the knowledge and acknowledgement of (and ability to address) changing water *availability* within the hydrological system is not a given, especially in this area of historically abundant water. In this chapter, I will discuss the evolution of national water management legislation, concerns about privatization and future access, and existing conflicts over water access, ownership and quality in the region. These sections will show how various user populations and authorities are negotiating water access and availability, which will lead to the discussion in Chapter 6 of how these negotiations and institutional fluctuations influence the vulnerability and adaptive capacity for Siete Imperios and other highland communities with regard to water.

Development of National Water Legislation

National legislation addressing water resources first appeared in 1902. Although colonial powers had addressed water administration, previous legislation was largely oriented towards water use in mining activities (Bernex et al. 2004). This early code was meant to formally depart from the Spanish custodial laws. However, it was critiqued as a "bouquet, legal popurrí, formed of flowers, or of fragments of foreign laws, applicable to an imaginary Peru" (quoted in Luque, nd).[51] Although the then-current constitution recognized water as patrimony of the state, the water code ignored such language and maintained status quo benefits for those landowners of previous regimes. Under this law, distribution and management of the rivers was assigned to *juntas de regantes* (irrigation boards) comprised of agricultural landowners. Essentially, this served to keep water privatized and controlled in the hands of hacienda owners. This water code also allowed the state to make claims on water for the large-scale coastal irrigation projects in order to increase productive agricultural land.

While the water codes of 1902 had little affect on the highlands directly (since it maintained status quo from Spanish rule), the introduction of the Agrarian Reform of 1969 and the related *Ley General de Aguas* (General Water Law; LGA) brought the highlands to the forefront of management and regulation. While the 1969 law did flatly declare water as state property, negating individual rights, the LGA only explicitly recognized water as it was used for commercial irrigation, not domestic consumption or other subsistence uses. Under this law, water management was completely centrally controlled. The Ministry of Agriculture was the authority on a national level, followed by Technical Administrators for Irrigation Districts, since irrigation was the greatest water use. This law strengthened special-purpose irrigation associations and linked them with regional levels of water management (Guillet 1992).

[51] http://www.monografias.com/trabajos19/ley-de-aguas/ley-de-aguas.shtml (accessed July 2, 2011)

Communities were part of unofficial user groups established around individual sub-basins and tasked with maintaining the canals, setting up a tariff structure, and establishing and regulating a system of water distribution for irrigation. The implementation of water restructuring under the Agrarian Reform of 1969 was highly variable throughout the highlands of Peru. Some areas adopted the restructuring in its entirety, while others only adopted parts of it or rejected it altogether.

With the laws on decentralization and the establishment of regional governments water administration inched out of the centralized mode. Beginning in 2003, power and responsibility was transferred to departments. Recognizing the need for further adjustment to water policies, a National Water Resources Management Strategy was passed in 2004 to promote further integration by means of institutional and legal frameworks. This new strategy led to the creation of the *Autoridad Nacional de Auga* (National Authority of Water; ANA) with 14 administrative zones containing watersheds from the Pacific, Atlantic, and intermontane basins. This was an attempt to integrate rather than exacerbate conflicts between the basins, each of which have dramatically different water regimes. This strategy laid out the hydrological reality of Peru and discussed the steps toward a strategy to provide "water for all." The most recent version of this document recognizes the main challenges of water in the country as: "1) addressing the increasing demand for water in both the domestic and economic sectors; 2) improving the spatial and temporal distribution of water; 3) improving and preserving the quality of surface and groundwater; 4) improving the efficiency of water; and 5) mitigating the effect of extreme events associated with climate change at the domestic and productive sectors" (National Strategy for Water Resources 2009).

Ley de Recursos Hídricos

The overall goal of the 2009 *Ley de Recursos Hídricos* (Water Resources Law; LRH) was to better align the country with international best practices of water management. The main tenets of this new law were to move away from centrally managed, coastal-focused schemes for large-scale commercial irrigation toward decentralized, river basin-focused management approaches and to recognize the plurality of uses and users. The new law recognizes that water has sociocultural, economic, and environmental value and must be managed to integrate these valuations. The prioritized use of water under this new legislation is domestic access and consumption. The law redefines water user rights around this priority use of water, as opposed to the sole focus on irrigation in earlier legislation. Unlike previous water laws and regulations, the 2009 legislation incorporates groundwater considerations and introduces sanctions. These main changes in water management legislation better align Peru with what is considered by some to be the international good practice standards of Integrated Water Resources Management (IWRM). IWRM has become rather hegemonic in global discourses surrounding water management, similar to sustainability and development before it (Orlove and Canton 2010). Also like these discourses, there is no universally accepted definition of IWRM and legislation implemented in its name does not exhibit uniform policies or practices (Orlove and Canton 2010). However, IWRM initiatives are generally multi-sector and multi-scalar approaches that explore technological solutions as elements of a larger response (instead of the only response) to address limited water availability.[52]

[52] Recent debates surrounding water management are increasingly recognizing that water is not solely the domain of technical experts but also a social phenomena, even a “total social fact” (Mauss 1990, Strang 2004, Pahl-Wolst 2007, Orlove and Canton 2010). Mauss' concept of total social fact applies to water because "in these 'total' social phenomena, as we propose calling them, all kinds of institutions are given expression at one and the same time—religious, juridical, and moral, which relate to both politics and the family; likewise economic ones, which suppose special forms of production and consumption, or rather, of performing total services and distribution. This is not to

In order to follow IWRM guidelines and better manage water resource under the new legislation, there are newly established national and regional institutions. The 2009 law establishes a National System for Water Resources Management (SNGRH), bureaucratically housed in the National System for Environmental Management. The SNGRH articulates the national position on the newly integrated and multisectoral management, sustainable use, conservation, and enhancement of water resources while encouraging participation on the part of various users within the watersheds and aquifers. SNGRH includes ANA; the Ministries of the Environment, Agriculture, Housing Construction and Sanitation, Health, Production, Energy and Mines; public institutions related to water management at the national, regional and local governance levels; River Basin Councils; operators of public and private, sectoral and multisectoral hydraulic systems; both agrarian and non-agrarian water user organizations; and *campesina* and native communities (LRH, Ley Nº 29338).

ANA is the highest technical authority in the National System for Water Resources Management, and it dictates the rules and procedures necessary to achieve integrated water management. It is present throughout the country at the watershed levels through Water Management Authorities (*Autoridades Administrativas del Agua*) and Local Water Administrations (*Administraciones Locales del Agua*). However, contrary to the language on decentralization and watershed management throughout strategy documents and the new water law itself, local ANA branches are accountable to the national ANA offices and not regional or local governments (Alegría 2009). Within ANA there is an executive board (*Consejo Directivo*) and a leader (*Jefatura*) who together plan and implement the overall direction of technical,

take into account the aesthetic phenomena to which these facts lead, and the contours of the phenomena that these institutions manifest" (1990: 3).

administrative, political, and institutional strategies. The board of ANA has twelve members of which one is a representative from *comunidades campesinas* and one from native communities.

In addition to ANA, the new water law creates a National Water Resources Court (*Tribunal Nacional de Resolución de Controversias Hídricas*), River Basin Councils (*Consejo de Cuenca*; RBC) and officially acknowledges and supports the regional and local water user organizations that were only unofficially encouraged prior to the 2009 law. The law itself does not provide much detail on the Court or the RBCs but goes into detail on the user groups. The Court is a national-level autonomous body of ANA that resolves administrative complaints and appeals against ANA decisions. RBCs include regional and local government officials and user group representatives. They were created at the request of regional governments in order to be included in the planning, coordination, and implementation of water management plans. These groups supersede political boundaries to focus more on watershed limits. RBCs are chaired by the department president and seem to have limited power; they are only budgeted a part of the water use fees (Alegría 2009). User groups are defined as civil groups who share a subterranean or surface water source. Committees of users are the smallest recognized level of organization under the law and consist of various *juntas de usuarios* and other user committees. Committees of users are able to participate in multisectoral management and sustainable use of water resources. The *junta de usuarios* are civil groups organized around a communal hydraulic system. These groups are tasked with operating and maintaining the infrastructure, distributing the water within the infrastructure, and managing the tariffs for use. Other committees are organized around subterranean sources at the level of individual wells, surface sources at the level of minor canals, and filtration water sources at the level of water outcropping or spring.

Campesina communities are recognized under this identification as user organizations and are able to organize around natural sources according to their own customs.

This 2009 LRH recognizes three priority uses of water: basic human needs (*uso primario*), public delivery system for water (*uso poblacional*) and productive use (*uso productivo*) in that order. The first priority is free use and access to any public water source to meet basic non-profit needs for an individual or family as long as neither the source of water nor its quality is altered. The second priority of the public delivery of potable water is guaranteed by the state "in sufficient quantity and secure and quality conditions to satisfy personal and domestic needs" (LRH, Ley Nº 29338). Productive use of water includes agricultural use (livestock and crops), aquaculture and fishing, energy, industrial, medical, mining, recreation, tourism, and transport. Other than the first priority use for basic human needs, all other uses of water require a license or permission from ANA.

Challenges to the Ley de Recursos Hídricos

Peruvian scholars claim that the LRH does not satisfactorily address the actual problems of water management in Peru (e.g., Urteaga 2009, Algería 2009, Panfichi and Coronel 2010). The most pointed critiques of the LRH are that it favors economic efficiency and centralized control over "integrated, participative, and multi-sectoral management," cited as the basic tenets of the LRH. A study carried out by the Institution for the Promotion of Water Management (IPROGA) and Red Muqui just after the LRH was passed concludes these tenets are in fact non-existent in the legislation.[53] Scholars claim Peru is following Harvey's "accumulation by dispossession" model

[53] IPROGA is a national-level NGO for the study and promotion of sustainable water use. While this organization was central to encouraging a more sustainable vision of water management nationally, their main area of focus for project implementation or participation is in the south: Lima, Huancavelica, Apurimac, and Ayachucho. Red Muqui

of neoliberal governments by dispossessing communities of their water in the interest of other economic actors (Gil and Boelens 2010, Panfichi Coronel 2010, Urteaga 2009). Driven and supported by private investment, national and regional government entities are generally complacent in the dispossession of water through various means, including the commodification and privatization of land and the subsequent eviction of peasant populations, converting traditional property management rights into private property rights, weakening commons rights, commoditization of labor and suppression of alternative forms of production, appropriation of assets, monetization of exchange and taxation, and the use of credit system (Harvey 2007) . Local governments, however, being closer to affected populations are often less comfortable with the erosion of water rights as they are increasingly awarded (legally or implicitly) to private investment schemes (Pereyra 2009). This distinction is likely why the ultimate authority of water management continues to lay with national-level organizations, even under the LRH, whose stated goal is to decentralize such management.

IPROGA and Red Muqui claim that with the new institutional hierarchies outlined in the law and the omission of legislated mechanisms that encourage participation and integration on a practical level, support of decentralized management is nonexistent (IPROGA and Red Muqui, Alegría 2009, Urteaga 2009, Panfichi and Coronel 2010). Scholars are joined in this critique by the Peruvian Campesina Confederation (CCP), which states that “everything will be decided in Lima” with the obvious bias introduced by centralized decision-making (CCP 2009). ANA is designed to be the central decision-making agency, a scenario that goes directly against decentralization efforts and does not encourage citizen participation. The law guarantees certain roles—Board of Directors, Chief, and the administrative authorities—but these are all centralized

is a network of national and local institutions with the goal of promoting sustainable development through the empowerment of communities.

in the national ANA offices, have limited regional or local representation, and will monopolize decision-making. Beyond these issues of anti-decentralization, ANA itself has limited autonomy institutionally. While they are recognized as the "highest authority" for water management, the entire organization lies within the Ministry of Agriculture. This makes the already-limited vision of "integrated water management" susceptible to the political and economic pressures affecting the Ministry of Agriculture.

Though the LRH officially recognizes RBCs as governing bodies, they have little actual jurisdiction or power over resource management without approval from ANA. The goals to "articulate the actions according to the rules of the Regulation, of the special projects; special hydraulic projects and national and binational hydroelectric projects; competent environmental authorities; the entities providing sanitation services; the National Service of Meteorology and Hydrogeology and the Marintime Authority of Peru" do not include local and regional governments or RBCs. RBCs should be the head of planning for water management projects for sustainability purposes (as well as for potential adaptations and general relevance), just as they are for general planning within their jurisdictions. Regional and local Water Resource Management Plans are only valid once they are approved by ANA. RBCs are largely relegated to consulting roles without decision-making capabilities.

Other critiques in the IPROGA and Red Muqui report focus on the lack of integration with ecological goals within the LRH, such as pollution and true watershed-scale focus, as well as relationships with *campesina* and native communities and the potential for addressing climatic changes. Prioritizing the "promotion of sustainable use, conservation, and the protection of water quality and increase of water and its associated assets" over other uses limits the integration of LRH with efforts towards the recuperation of polluted water sources. Instead of integrated water management institutions, the LRH creates separate entities that manage water delivery systems without paying adequate attention to the watersheds as a whole. This limitation of only referring to the relationship between humans and water, and not of that between humans and water, soils, bedrock, topography, vegetation, etc., ignores the ecosystemic and environmental value of water and watersheds. Without explicitly focusing on protecting those areas that generate, clean, and maintain existing water sources, the LRH runs the risk of improving water delivery systems at the expense of ecosystem health and sustainability. IPROGA and Red Muqui also criticize the use of present tense in the law and the lack of guarantee for future availability of water or its quality, current and future, arguing that, considering the predicted climatic scenarios regarding water availability, this should be critical language for any water policy.

Though the new law does recognize the rights of *campesina* communities to use water that runs through their lands and their respective headwaters, it adds that this use should "not affect the rights of third-parties," which creates significant limitations to *campesina* water use considering the amount of users and uses downstream of Andean headwaters. LRH does not provide any protection of communities against larger infrastructure projects that could adversely affect water availability in a region. IPROGA and Red Muqui assert that major infrastructure projects within community territory should be required to consult and reach agreement with the community, as these projects will affect the land itself and the water availability that the *campesina* lifestyle depends on.

The coordination laid out between ANA and the Ministry of the Environment in the LRH is not sufficient to implement the *Programa Nacional de Adaptacion al Cambio Climatico* (National Program of Adaptation to Climate Change). The law exhibits limited integration with other water-oriented plans and strategies, particularly those focusing on climate change adaptation and mitigation like the *Estrategia Nacional de Cambio Climático* (National Strategy for Climate Change) and the *Plan Nacional (y Regionales) de Adaptación al Cambio Climático* (National and Regional Plans for Adaptation to Climate Change). True integrative intention would ensure that these plans are developed and implemented in articulation with the regional *Planes de Gestion de Recursos Hídricos* (Plans for Water Resource Management), since a great variation in climate change effects will be experienced at the watershed level.[54]

These critiques end with a call for more "plural" representation on the various administrative entities, election (as opposed to appointment) of the ANA Chief, and a recommendation that the RBCs become democratic autonomous entities within their own watershed, which would allow for a true decentralization and integration of watershed management. Having autonomy and decision-making power in addition to technical capacity and financing will improve the relevance of *Planes de Gestion de Recursos Hídricos* for each watershed and in turn promote more intervention and participation in the resulting management.[55]

A Regional Water Resource Management Plan for the Huarmay-Chicama watershed does not yet exist, but the plan will cover 37,000 km^2 including the Callejón de Huaylas and the major coastal cities of Trujillo, Chimbote, and Casma. Regional ANA offices do not have any published material on the process of the RBC development specifically for the Huarmay-Chicama watershed. Implementation of the new water law has been slow, at least among the

[54] These plans should include, according to the IPROGA/Muqui report, constructing water reservoirs, recuperating low-cost ancestral technology, and making use of—and investing in—the existing diversity of knowledge and strategies employed to adapt to changing environmental conditions.

[55] According to the report by Muqui and IPROGRA, greater involvement/autonomy by the RBC would include: the ability to annually program basin water availability according to existing and newly granted rights; power to deny certain water rights/uses; determining priority uses in the case of overlapping interests or rights; reinvesting surplus water; creating regulations regarding water licenses for provisional uses; early involvement in decisions regarding major and minor infrastructure projects when they are incompatible with the Plan de Gestión de Recursos Hídricos de Cuenca; and working to prevent conflicts.

highland watersheds. When I was preparing to end my fieldwork, the Ancash branch of ANA was just starting to hold community meetings along the Callejón where they planned to discuss the new water law and how it changes responsibilities and rights. When I went to the regional ANA offices, they had just set up a schedule for dissemination in the Callejón and were planning to meet with Siete Imperios in the next few months. In a focus group with older male participants, we discussed privatization at length the month before the law was passed and the participants echoed radio programming that discussed possibilities of water privatization. For example, one participant reported that "We aren't sure still what the law will say, but we have heard, people have commented that there will be privatization of water [under this law]. But we are always defending ourselves with strikes. We have already held a strike on the part of Ancash because we do not want water privatization" (Focus Group 1). Another participant of this focus group continued "with privatization there could be a war like between Iraq and the United States. Business people with money would exploit the poor people." "Or like Bolivia," said another, "where they kicked out all the foreigners [working on privatization efforts]."

Privatization Fears

Throughout South America, debates around and attempts to privatize water have touched off strikes, "wars," and serious political upheaval. Peru's neighboring countries of Bolivia and Chile have both had highly publicized struggles with the privatization of water, though with dramatically different outcomes. These struggles with privatization, and the homegrown suspicion of where government interests truly lay, reverberate through the Peruvian highlands. Privatization was touted as a cure-all by powerful transnational institutions under the basic assumption that privately run utilities can be more effective than the state at managing the resource.[56] In turn, this presumption is that privatization is more efficient is used as an argument for increased conservation, since more effective use can be equated to less overall use.[57] However, this shift to private companies requires a “reconfiguration of the hydrosocial contract between users and their environment” (Bakker 2003: 43). Instead of a right, water becomes a commodity, and instead of citizens, water users are merely consumers. Budds and McGranahan argue that neither public nor private institutions are able to adequately serve low-income populations without access to water and sanitation (2003). Barriers to access persist regardless of whether management is in public or private hands. This is not to say that private investment cannot or should not be part of a water governance system but that promotion of pure privatization is not justified in the case studies as a means to adequately improve the service (Bond 1997, Carbonel 2000, Foster et al. 2000, Bourbigot et al. 2001, Budds and McGranahan 2003).

Privatization in Neighboring Countries

Amid cries of corruption and pressure from transnational financial institutions, the Bolivian government began to privatize public services in 1999, following neoliberal policies that opened previously state-owned industries to private investment. As part of the privatization of water, the legislation eliminated guaranteed water distribution in rural areas and it prohibited the collection of water from previously constructed autonomous delivery systems and even rainwater harvesting (Assies 2003, Olivera 2004). The law took power away from local governments to

[56]Privatization as a term is used to reference a multitude of agreements and rarely refers to the complete transfer of rights for a service or resource. Generally, privatization refers to the increase of private sector involvements in the service of utilities, but it can also refer to the public-private partnerships (PPPs) where the state turns over certain responsibilities (and risks) to private partners through concessions but retains ownership of the assets in question (Bakker 2003, Budds and McGranahan 2003)

[57] The Dublin Statement on Water and Sustainable Development, known as the Dublin Principles, was adopted by the United Nations in 1992. The statement recognizes the increasing scarcity of water and outlines recommendations for action to reduce scarcity, including recognizing water as an economic good.

determine where and how water systems could be constructed and enforced a “dollarized” fee structure. Not only were Bolivians expected to pay rates based on US pricing structures (not the rise and fall of Bolivian currency) but the company contracted to take over delivery—*Aguas del Tunari*, a subsidiary of Bechtel—claimed that people were using more water than had been estimated prior to their contract. Thus, when the private company took over delivery, the price per cubic meter rose as well as the amount of water used. In response, peasant organizations, factory workers, and transportation unions called for demonstrations, blockades, and strikes. While these responses occurred nationally, Cochabamba became the focus of demonstrations due to the aggravated water scenario in the valley (Assies 2003).[58] From January to April 2000, 60,000 people participated in demonstrations that paralyzed the city on three separate occasions (Olivera 2004, Shultz 2008). The unnerved president of Bolivia sent in special security forces and suspended constitutional rights. The protests culminated in April 2000 when Bechtel fled the city, water distribution was returned to public control, and the water law was repealed (Shultz 2008).[59] What is now referred to as the Cochabamba Water Revolt is a popular example of local populations fighting back against exploitative privatization efforts and structural readjustment policies.

Chile, also influenced by neoliberal policies, had a decidedly different experience when its 1981 Water Code privatized rights, limited state administration, and created a free market in water rights (Bauer 1997).[60] While the adjustment has been publicized as something of a silver bullet internationally, upon closer inspection, its results have been uneven and its successes

[58] The once-lush Cochabamba became increasingly arid due to population booms for the fading silver mines coupled with deforestation and drought and chronic poverty; the infrastructure needed to supply water to the population was beyond what the state could afford (Shultz 2008).
[59] See Nickson and Vargas 2002, Assies 2003, Olivera 2004, Albro 2005, Shultz and Draper 2008 for a more in-depth discussion on the Bolivian water revolts.
[60] For more on water privatization in Chile, see Ríos and Quiroz 1995, Bauer 1997, Shirley 2002, Bakker 2003, Budds and McGranahan 2003.

exaggerated or incomplete. The "free" water markets are much more influenced by larger legal and institutional frameworks, political and economic conditions, and geography than one is led to believe (Bauer 1997). While the Chilean Code has been successful in balancing rights and encouraging more efficient water use within the commercial agricultural sector, it has been less effective "coordinating multiple water uses and relations among different economic sectors, resolving conflicts and balancing externalities (environmental and third-party impacts)" (Bauer 1997: 640). Following most critiques of privatization schemes, case studies in Chile show that large-scale farmers increasingly exert more control as a result of the Water Code, resulting in less access for peasant farmers (Budds 2004). Only new or formally traded rights were initially recorded, resulting in confusion regarding historical rights to water that were usually held by peasant farmers. The new Code was also environmentally questionable. Immediately following its enactment almost all surface rights had been allocated, which led to increasing interest in groundwater rights. Allocating groundwater was problematic because of the exhausted and quickly depleting aquifers, especially in the arid northern regions (Budds 2004). The privatization of water in Chile continues to be a polarizing debate and though it did not receive the type of international attention that Bolivia did, the country continues to struggle with the social and environmental repercussions of the 1981 Water Code.

Despite these problems, the Chilean Water Code has been heavily touted as something to follow. Peru and other neighboring countries have been seriously considering adapting the Code to their own scenarios even though it benefits commercial and industrial sectors over subsistence needs, as critics have claimed (Bauer 1997). In Bolivia, the groundwork for privatization was laid slowly through piecemeal legislation that eventually completely opened services to private investment. After many years of protesting the turn to privatization of water management in

Peru, many see the LRH as the next legal step in a pathway to privatization of water management (Trawick 2003).

Pathway to Privatization in Peru

Though a new water law was long overdue, the new legislation has led to fears of renewed interest in privatization among the population and, according to some these fears are not entirely unfounded (IPROGA and Red Muqui, no date; Urteaga 2009). Privatization fears are only exacerbated by the claim that the Congressional session where the new water law was approved (after 15 years of discussion) in March 2009 was "questionable for not following established procedures" (IPROGA and Red Muqui, no date: 4). By not following the appropriate legislative avenue to pass the new water law, the government invited accusations of corruption and pandering among those who were not in favor of the new legislation.

Although the 1993 Constitution of Peru declares renewable and nonrenewable resources alike as owned by the nation and *soberano en su aprovechamiento* (free for use), many are concerned that increased oversight of water management is paving the way for private interests in water concessions. The new water law nods toward recognizing native and *campesina* communities' rights to use water, but the question of profit-making, concessions, or ownership is left unaddressed directly:

> [The Law operates under a] principle of respect for the uses of water for *comunidades campesinas* and *comunidades nativas*. The State **respects** the customs of *comunidades campesinas* and *comunidades nativas*, as well as their **right to utilize** the waters that run through their land, as long as it does not oppose the Law. [The Law] promotes ancestral awareness and technologies of water (Ley de Recursos Hídricos, Ley Nº 29338, Preliminary Title, Art. 5, emphasis added).

The Peruvian Campesina Confederation (CCP) critiques the new law for setting up significant advantages for private sector water users at the expense of campesina communities (CCP 2009).

They claim that the law not only allows for but promotes water privatization and profit-making. An important phrase has been taken out from Article 2 of the 2009 water law—"management of water resources will be nonprofit"—which the CCP views as allowing for water concessions. Instead of the state overseeing water management through public administration and the promotion of social responsibility, CCP claims the state will hand over water management to private operators. These private operators will have "enormous advantages" according to the CCP, including: 1) water use tariffs will be proposed by private operators; 2) the 13-member board is the highest authority within ANA and will be heavily influenced by the private sector likely through the Ministries of Agriculture and Energy and Mines); 3) the state promotes the involvement of private sector participation in the construction and maintenance infrastructure as well as the operation and service provision; 4) the new law explicitly states the promotion of private investment in the sector; and 5) the CCP warns that the water sector infrastructure and projects will be implemented largely by the private sector, or when built with public funds, turned over to the private sector for management.

Fears about Water Privatization in Siete Imperios

Struggles between peasant communities and mining or other economic interests, backed by the state, have been well-publicized across South America and are often cited in the Peruvian highlands as reasons to be cautious with outsiders asking questions about water. While these detailed accusations or attributions to sources of privatization fears were not mirrored in Siete Imperios verbatim, there were a few research participants who mentioned privatization in the interviews and focus groups. For example, "We do not have enough water and now it is not only for increased population, now the government of Peru itself is making problems, it wants to privatize, it wants to sell, it wants to take. But we will not let this happen, we will fight privatization" (Interview 19). I was also denied access to community documents regarding water use and management based on fears that I would, directly or indirectly, contribute to the privatization effort by publicizing management activities. Though individuals saw me as only a silly woman asking about environmental changes and the future of water availability in the area, a year of living among them did not quell fears about my role in any government plan to privatize water. This lack of trust is widespread throughout the highlands and is a product of centuries of racism and marginalization (e.g., Thurner 1997, Larson 2004, Young and Lipton 2006). Gelles agrees, observing that "bureaucratic myopia is often compounded by a deep-seated racism" which is institutionalized through several systems, including water policies and irrigation bureaucracies (2000: 9).

Conflicts over Water

Demand for control, access and management of water resources has resulted in a series of conflicts, principally in rural areas of Peru. These conflicts show in part the importance of water to rural livelihoods, particularly as the resource becomes more scarce. The *Defensoría del Pueblo* monitors social conflicts occurring throughout Peru and the report from March 2009, when the new water law was passed, shows an increase of socio-environmental conflicts from 45 to 116 from the last year (Alegria 2009). While the monthly registered conflicts of *Defensoria del Pueblo* show only a small percentage of conflicts being over water, attributing the majority to mining disputes (see Figure 24 below), most of those conflicts categorized as environmental conflicts are in fact over water resources specifically (Urteaga 2009, Panfichi and Coronel 2010). Panfichi and Coronel (2010) note that these conflicts have four characteristics in common: 1)

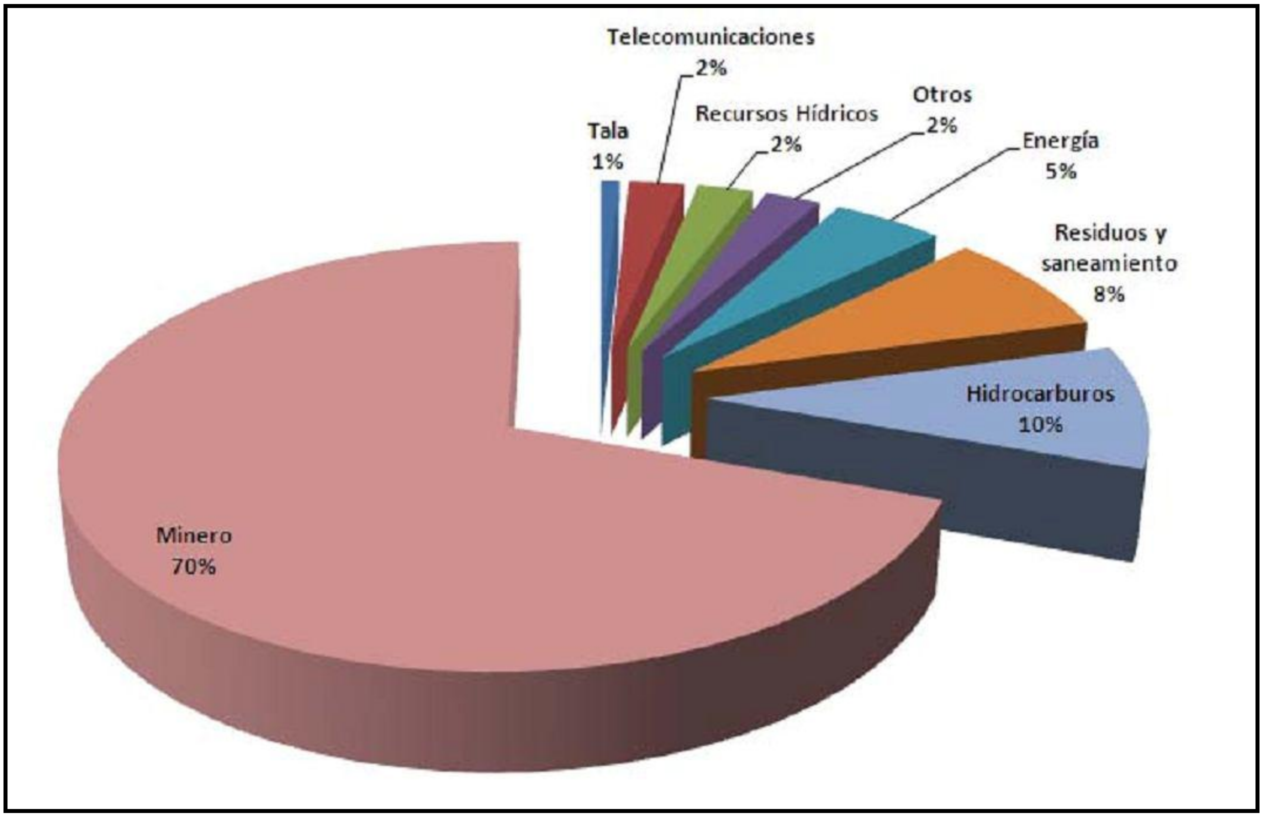

Figure 24 Types of socio-environmental conflicts. Defensoría del Pueblo 2009.

they are largely about contamination of water, 2) more than one entity is making claims against the existing scenario; 3) the claims are usually against mining or energy industries; and 4) these conflicts usually are long-term issues that evolve over time to include more than a single issue. Though there continues to be generally abundant water in the Cordillera Blanca, certain areas that find themselves with less available water, due to being downstream from water intakes orcanal improvement projects, are beginning to feel the strain of decreasing water availability. However, Urteaga claims that:

> The reason for these conflicts are not only physical, i.e., by resource depletion. Conflicts over water reveal a critique on the part of actors affected by the open position the State takes in favor of mining in some cases and, in others, agro- industrial sectors or water companies, at the expense of other productive activities by social actors usually *campesinos*, whose power is obviously reduced compared to their opponents. (2007: 51-73)

Conflicts in the Cordillera Blanca support this argument. Even considering the significant amount of water in the Cordillera Blanca, it is counted as one of the five regions with the most conflicts over water, likely because of the way it is managed and the power differentials behind such decisions (Panfichi and Coronel 2010).

Conflicts over water are unavoidable. Even when water flows are abundant, conflicts arise over the multiple uses and values of the resource. Though conflicts themselves are neither good or bad per se, the way in which these conflicts are resolved can engender negativity (Dukes 1996). As such, conflict has taken on a severely negative image in Peru. No doubt connected to the persistent resistance of highland communities in the days of nation-making, conflicts over resources in Peru have been painted as uneccesarily antagonistic (Panfichi and Coronel 2010). As many partisan campaigns would have you believe these conflicts are due to the fact that indigenous populations are backwards, anti-development rebels without a cause (Urteaga 2009). As part of neoliberal dispossession and the continued assault on indigenous livelihoods, former president Alan García published an editorial in the national paper claiming:

> There are artificial communities who have 200, 000 hectares on paper but only use 10,000 hectares for agricultural production while the others are idle property of a 'dead hand,' meanwhile its inhabitants live in extreme poverty waiting for the State to bring them all support instead of placing value on its hills and lands, renting them, trading them because if they are nonproductive for, they could be productive with a higher level of investment or the knowledge of a new buyer. (Garcia 2007: A4)

These new buyers are no doubt mining, hydroelectric or other commercial interests. Highly lucrative entities have far more rights over the land and water in Peru than "artificial" communities (Panfichi and Coronel 2010: 3).

Mining in the Cordillera Blanca

Extractive industries make up a powerful and far-reaching sector in Peru with legislative and political support. Environmentally, there is little protection against the effects of mining activities and often extractive concessions are awarded without any discussion of the waterways involved, which are highly susceptible to the byproducts of most mining activities. While national estimates of water used by mining activities is low (~5%), Bebbington and Williams (2008) argue that this number inaccurately portrays the scale of influence, as mines are typically found in headwaters of rivers and therefore any effects will travel downstream and affect all downstream water uses. The department of Ancash is one of the most prolific exporters of minerals in Peru. In the department of Ancash there are 573 *pequeños productos mineros* and 232 *productos mineros artesenales*, and several major mining operations, among them *Antimina* and *Pierina* in the Callejón (TMI and Urpichallay 2002, MINAM 2011).

The main concern regarding mining activities is the acidic drainage from tailings ponds or from transportation and transformation activities. Ore brought to the processing center is broken up and washed with acidic formulas to separate minerals from the remaining, less valuable rock. This process creates more surface area on the remaining rock. Increased surface areas means additional chemical reactions in ore that contains significant amounts of heavy metals in addition to the sought-after minerals.[61] At the end of the process, the remaining rock, in combination with the used acidic wash, is discharged into tailings ponds, which are simply storage areas for exhausted rock and chemical slush. Peru does not regulate these tailings ponds, so used mining chemicals leach into surrounding surface and groundwater. In the Cordillera Blanca there are some instances of tailings ponds being located directly on the banks of the Rio

[61] The Rio Santa of the Cordillera Blanca was reported by CONAM (cited in Bernex et al., 2004) as the third most polluted river for the heavy metals lead, iron, and manganese.

Figure 25 Tailings site on the banks of Rio Santa. Photograph by author.

Santa (see Figure 25 above). It is estimated that 13 billion m^3 of tailings effluents are released into Peruvian waterways (Bebbington and Williams 2008). According to the Ministry of Health, under the *Dirección General de Salud Ambiental* (DIGESA), between 1999 and 2000 the Rio Santa showed 17.5% of arsenic, 35.3% of lead, 82.4% fecal chloroforms *above* the standard limit of exposure levels (in Bernex et al. 2004). The risks associated with mining are not often well communicated to communities where mining activities are, or will take place, and once environmental changes are noticed, communities have little legal recourse. Often conflicts arise from this impasse.

There are no mines currently operating within Siete Imperios, but there are several small-scale mining operations in the nearby community of Vicos, where they have been struggling with water quality issues directly related to these mining activities. These struggles reflect the nationwide issue with mining effects on water quality. High above the community of Vicos there are three small artisanal mines (operated by a range of local, national and international interests) extracting zinc, lead, copper, silver, and gold: Toma la Mano, Arequipa, and Garrosa. These operations are low-tech and transport their ore to a processing center several kilometers south in Jangas.[62] Vicos and the mining companies have a contractual agreement to work cooperatively, though historically the relations between them are volatile due largely to issues of corruption and bribery with both parties (TMI and Urpichallay 2002). Community members were concerned about water quality, based on observed changes related to livestock and fields. However, these observations were not sufficient evidence for the mining companies to respond to or for legal action to be taken. In 1999 the community approached TMI and Urpichallay who initiated *Agua para Siempre*, a project to capacitate local leaders to test and monitor water quality so that they were able to better present their claim and negotiate with mine operators and departmental water authorities. Baseline water quality data were collected, and mirroring the Rio Santa, levels of zinc, lead, iron, and PH were found to be significantly above the maximum allowable amount in the Vicos waterways when compared to nearby valleys with significantly less mining activity (Tamblyn 1999, 2000). At the conclusion of this project, the local mines accepted and allowed the environmental monitoring on the premises, the Vicos community learned monitoring methods they can use for future negotiations with these mining businesses, and TMI and Urpichallay have incorporated environmental monitoring into their other development projects throughout the Callejón.

Who Controls Lake Parón?

One of the more publicized conflicts in the Cordillera Blanca is the struggle over Lake Parón. Lying above the heavily populated valley town of Caraz, Lake Parón has become the epicenter of disputes over environmental hazard management, hydroelectric power generation, tourism, and

[62] Since these operations exist within the boundaries of the park (they were established before the park itself), they are not able to process their ore on-site.

water-dependent livelihoods of nearby peasant communities. At the center of the dispute is the struggle for legal ownership of the water versus residents' rights to access and control the lake.

During the glacial lake inventory in the early 1950s, scientists and locals alike were very concerned about the potential for outburst flooding in Lake Parón due to the instability of the glaciers above the lake. These concerns led to lake security projects that partially drained or dammed the most precarious lakes. In Lake Parón government engineers secured the natural moraine with concrete structures and built drainage tunnels under the moraine dam. These drainage tunnels kept the water below a certain point by releasing ~1 meter per second, but they were not engineered for minute control over the level of the lake (Aiello 2009, Carey 2010).

The Peruvian government under Fujimori licensed Lake Parón waters for energy development in 1994 as part of structural reforms. Government-run Electroperu was privatized in 1996 and bought by Duke Energy in 1999. In 2007 Duke Energy announced it was planning to increase the release of water from the lake for hydroelectric generation. Local communities and municipalities were concerned about the increase in flow with regard to the structural integrity of irrigation systems and water quality. There was also concern that lowered lake levels would negatively affect tourism to the area, which had become a significant portion of the local economy since the development of road and path infrastructure during the security projects of the previous century. The mayor of Caraz successfully petitioned the local authorities to suspend the license in August 2007, but the company appealed the decision in Lima, and the petition was overturned since Duke Energy held a valid license (Aiello 2009).

Local government officials unsuccessfully attempted to intervene through legal frameworks, but by the end of 2008 the water levels of Lake Paron had dropped by 50%, which suggests that the water released per second was much higher than Duke had announced (Aiello

2009). Fearing for the future of the lake, the local *comunidad campesina* Cruz de Mayo forcefully took over operation of Duke Energy in July 2008. Relations deteriorated as Duke attempted to take legal action against the community while local officials argued for increased control over the company. As of April 2009, all parties have agreed to accept the decision of ANA which, under the LRH, is charged with creating a water use plan for the region. However, the plans have yet to develop and the standoff continues. This type of behavior on the part of governments and private interests is a recent manifestation of the centuries-long antagonism between highland rural communities and larger political powers, and it maintains the widespread and deep-seated mutual distrust between both parties.

Community versus Community

Just as conflicts exist between the state or extractive industries and communities, there is often conflict among the communities themselves over resources (Panfichi and Coronel 2010). Participants' responses to questions about existing or future disputes about water availability vary within Siete Imperios. Most jump directly to the "end of times" rhetoric, skipping over what will happen between now and the end. Several acknowledge the potential for conflict in the future, but only a few specifically cite existing disputes. Of these, the recent conflicts in nearby Carasbamba were most often mentioned.

The *centros poblados* Carasbamba, Chochapampa and Copa Chico to the north of Siete Imperios have been dealing with water conflicts for many years. A participant originally from Cochabamba, remembered five or ten people guarding the *compuertas* during the dry months of June and July to ensure the turns were observed: "they were stealing, fighting, hitting each other in each *conpuerta* (irrigation canal gate), between ten [people] they were fighting" (Interview

133). Those respondents familiar with the problems report that the issues of water availability in these communities is because the glaciers that fed their river had already disappeared leaving very little water in the river (Interview 2). In addition to the physical deficit, Cochapampa had secured funds to install an intake in the river above the other two communities, and pump the little water that remains directly to Cochapampa. As a result, Carasbamba and Copa Chico suffered from water shortages during the dry season which led them to block the Cochapampa intake in order to allow the water to again flow through the rivers and into their irrigation canals instead of being pumped away. However, when the intake was blocked, the community of Cochapampa was then completely without water for their needs. Conflict ensued between the three communities until regional officials were called in to help settle the dispute. With the help of the officials, the groups reached an accord to share the limited water that was available between the three communities.

The diversion of the river was the beginning of the conflict for Cochapampa, and Marcará had just completed a similar diversion for potable water in Condormarka. These events were particularly worrying to Siete Imperios since they share Condormkara River with Copa Chico, who were already struggling to find enough water for their needs. Reflecting on this conflict between Cochapampa and Copa Chico, another participant observed that “the same will happen here, no, between the upper and lower parts of the community” (Interview 2). Several participants noted that after the Marcará intake, there was less water in the Condormarka River. Copa Chico was very concerned with the Marcará diversion because they had no other significant water sources since the Carasbamba diversion. An informant who lives in Huecochec, the sector that borders Condormarka River and Copa Chico, reported that residents of Copa Chico diverted the remaining water from Condormarka for their use, when it should have been shared between Copa Chico and Siete Imperios: “it is our Condormarka [too] but they have taken it all, no water was left even for animals” (Interview 28). This change in access led Siete Imperios to extend the Allankay canal system to this sector to replace the water once used from Condormarka River for these families. While a solution was found to this series of events, such juggling will grow continually complex as glacial loss persists, further diversions are installed and water availability declines.

While Allankay continues to provide water to the community, many note that there is less water now in this canal system than before. As one community member recalls, “water used to be free and abundant” in Siete Imperios, but many of the research participants felt that there was no longer enough water in the canal system to continue open irrigation (Focus Group 1). In the last few years scheduled irrigation turns have become more standard, especially in those sectors of Siete Imperios that are in topographically difficult places for water to reach or those that are located farther down the mountain. Standardizing irrigation turns is common practice in the more arid southern regions of Peru (see Guillet 1992, Zimmerman 1996, Gelles 2000, Trawick 2003). This scheduling occurs in the dry season when crops are irrigated. In the most severe shortages or heat waves the standard allotments are not enough and families must request a second round of irrigation or return to open their fields for night irrigation. However, not all families went through official channels to increase their irrigation water. Though research participants were hesitant to discuss this, as they did not want to leave me with the impression that Peruvians were *ladrones* (thieves). As one participant explains, “In August and September it is obligatory because the schedule fills up so you have to rob to irrigate. You have to irrigate however you can when the schedule is full. Sometimes you take an hour or half hour of water each day, out of turn, just raise the *conpuerta* a little bit. Though this means there isn’t enough for the rest, you have to do whatever you can to get water" (Focus Group 1). As water levels continue to decline these actions could become more frequent and contentious, causing instability and friction among households in the community.

The ripple effects of border disputes in Cochapampa have already altered water allocation in Siete Imperios, and the community is preparing for future such issues with neighboring communities. A local official mentioned that the administration was considering changing community status allowances to show higher numbers for the district water allocation. Until recently, young adults have been admitted into the community as full *socios* and given a parcel of land to begin their adult life. However, in the past few years there has been very little land turned over for new *socios*, so the current generations of young adults are still living as *convivientes* because there is no land to complete the *socio* agreement. Considering the potential future availability of water, community officials are considering allowing *convivientes* to become full *socios* even without the requisite plot of land in order to increase the numbers of people officially living in the community. This strategy assumes that in the future access to water will be much more strictly regulated and will not be dependent on acreage of cultivated land, as in the past, but instead on the population of a given community. Also, it will further handicap already overproduced land, since multiple generations of families will have to farm together on their parents' plots instead of each having their own small plots. By shifting land entitlements for community *socios*, communities will be institutionalizing additional stress on agricultural production and water availability. Resources will be expected to serve higher population densities in an already fragile ecosystem, exacerbating the potential for disputes over water *and* land.

Conclusion

The organization of irrigation and agricultural systems around snowmelt has been practiced for many centuries (Gelles 2000). Great variation exists in water management systems across the Andes due to highly "complex interactions of technology and environment with social, economic and political organization" (Guillet 1992: 8). Nationally, the LRH attempts to address the complexities of water through national-level administration and regulation, though it is being critiqued for several reasons. These include not paying attention to ecological best practices for water management, ignoring decentralization efforts, and allowing private sector the upper hand at the expense of community autonomy. Regional plans are being developed alongside, though not necessarily incorporated with, the LRH to address the specifics of each watershed, but this process is slow.

The scarcity of water due to biophysical concerns regarding the local climate and the social and political contestations over ownership and access have led to water becoming "a central issue of social demand and political conflict" in the Andes (Jacobson and McNeish 2006: 7). This is certainly true of Peru in general and the Callejón de Huaylas in particular. Siete Imperios is a particularly interesting case study for such political scarcity as historically abundant water is becoming less available to highland populations due to constructed scarcity from various diversions (internal and external to the communities) and projected scarcity from glacial loss.[63] Due to external interests, communities are finding themselves with less of the resource to distribute among a growing population. This situation leads to shifts in the social

[63] There is a rich scholarly history of social organization and conflict around irrigation networks (see, for example, Steward 1955 and Wittfogel 1957 and the discussions that followed, i.e., Mitchell 1973, Lansing 1991, and Peruvian specific cases Guillet 1992, Mitchell and Guillet 1993, Gelles 2000, Trawick 2003, Oré 2005). In the case of the Peruvian scholars specifically, the significant distinction is that most of these case studies took place in areas had historically scarce water and carefully balanced irrigation schedules to effectively use the resource. In contrast, the Cordillera Blanca is experiencing a transition with regard to their water resources. This is an area with historically abundant water, where scarcity—constructed or projected—is a new phenomenon.

fabric of *comunidades campesinos* as well as increased potential for conflicts as water availability begins to decline like agricultural production, livestock health, and other subsistence strategies.

To further complicate matters, and perhaps to support claims for maintaining central control over water management, NGO and government literature from Peru often argues that:

> An adequate culture around water does not exist in the population, this is expressed in the little care given and inefficient use of the resource. This relates to the poor awareness of the fragility of the resource and the costs of treating it for human consumption; but also, with the little information released by the State about its cycles, the ecosystems that produce it, the amount available and the problems it presents. (IPROGRA 2008: 12)

However, I would argue that institutional structures imposed on communities through legal frameworks or economic interests has diluted or destroyed traditional or local culture that may have existed around water, as evidenced by historical cultivation techniques and rituals. Urteaga argues against this "lack of culture," saying instead that decreasing flows are a result of increasing environmental pressure on water resources and not necessarily an inability of communities to manage the resource (2009). Representing communites as ill equiped to manage water resources is part of a larger viewpoint that traditional people are ignorant and careless about their environment, and backward in their practices. These prejudices continue to influence representations of and engagements with indigenous communities and is a popular viewpoint among state-level agencies in Peru. Though usually utilized in conservation discourse, here the myth supports claims against appropriate water management in order to further disenfranchise highland communities.[64]

Water management negotiations between the state, economic interests, and the highland communities continue as they have for centuries, through a sort of centralized decentralization.

[64] Though powerful in this study, beurocratic myopia, the devaluation of indigenous values, and prejudice against these populations is not novel or unique to Peru (see, for example, Dove 1983, Lansing 1991, Scott 1999).

The LRH establishes institutions using hydrological scales to create the illusion of river basin oriented decision-making but in fact maintains centralized control over rights and access. The government recognizes the political and ecological importance of decentralizing water management to river basin units and does so in name; however, this decentralization is imperfect. Many elements of the LRH function to maintain centralized control over the resource legally, economically, and politically. The repercussions of this is business as usual for the relationship between highland communities and the national government, distrust and resistance, which allow and sometimes exacerbate localized conflicts over control and fears for future rights and access to the resource. This approach toward water management on the part of the state is not much of a departure from its general attitude toward highland populations. In the future, however, the (unstated) priority of economic interests over domestic use could prove dangerous as more water is diverted from river headwaters. The next chapter will build on this analysis to determine how these water negotiations influence the vulnerability and adaptive capacity of Siete Imperios and other highland communities.

CHAPTER 7

VULNERABILITY AND ADAPTIVE CAPACITY

If the global poor are to adapt to global change, it will be critical to focus on poor people, and not on poor countries as does the prevailing North-South dialog. The interests of the poor are not always the same as the interests of poor countries, since in the interest of "development," the poor may grow poorer.

Robert W. Kates

Introduction

In 2004, the Tyndall center for Climate Research counted Peru among the ten countries most vulnerable to the effects of climatic changes in its *New Indicators of Vulnerability and Adaptive Capacity*. The Tyndall assessment addresses the vulnerability of Peru based on the availability and management of water resources, variation in the global and micro climates, and changes in the composition of biodiversity. These factors will all significantly effect the agricultural sector and thereby the livelihoods of the majority of Peruvians. In light of the stress already being experienced, we must examine the elements of vulnerability for specific populations because "vulnerability, its elements of exposure, sensitivity and adaptive capacity, and their determinants are dynamic (they vary over time), they vary by type, they vary from stimulus to stimulus, and they are place- and system-specific" (Smit and Wandel 2006: 286). While national assessments of vulnerability are helpful on the global policy development scale, the priorities for reducing vulnerability change as the scale shifts from global to local systems.

Concepts of adaptation and vulnerability have emerged as generally accepted frameworks for assessing the ability of communities to respond to climate change, particularly for the purposes of identifying means that improve adaptive capacity for populations (Kelly and Adger 2000, Turner et al. 2003, Smit and Pilifosova 2003, Adger 2006, Smit and Wandel 2006). There are many ways in which adaptation and vulnerability are discussed in the literature. While all of these frameworks are fundamentally measuring similar dimensions, their relationship to one another shifts depending on the particular approach in question. While some frameworks view risk as an element of vulnerability, others view risk and vulnerability as two elements of a larger question.[65] However, throughout the literature a common concept is that the "vulnerability of any system (at any scale) is reflective of (or a function of) the exposure and sensitivity of that system to hazardous conditions and the ability or capacity of resilience of the system to cope, adapt or recover from the effects of those conditions" (Smit and Wandel 2006: 286).

There is potential for tension between the formalized matrices of vulnerability and adaptive capacity, and how these assessments compare with local perceptions of risk and potential for response. Though social vulnerability creates matrices in which cultural and social contexts are captured along with economic and environmental variables, these types of frameworks are still oriented towards quantitative reporting from census or other program data. The qualitative assessment that follows in this chapter adopts variables from a variety of matrices to reflect those concerns reported by community members when discussing how rapid environmental changes could influence their livelihoods, as evidenced by the frequency and intensity of their reporting. This assessment should be considered alongside the historical and political scenarisos presented in Chapters 3 and 6, which also influence the various elements of vulnerability and adapative capacity of a region or population to climate change stressors.

[65] Chapter 2 provides a review of the various ways that vulnerability, resilience, adaptation, and adaptive capacity have been developed and used across disciplines.

Vulnerability to Climate Change

It is difficult to disentangle vulnerability from adaptive capacity, as each depends on the other for definition. Most frameworks see exposure (to risk), sensitivity (to risk), and adaptive capacity as the elements for determining vulnerability (Gallopín 2006, Smit and Wandel 2006). "Exposure and sensitivity are almost inseparable properties of a system," both dependent on the interaction of the system of concern and the particular climate stimulus (Smit and Wandel 2006: 286). Luers (2005: 217) defines exposure as "the characteristics of forces that could stress the system (e.g., temperature) as much as magnitude and frequency" and sensitivity as "the degree to which a system will respond to an external disturbing force." Assessments of vulnerability or adaptive capacity must begin with a discussion of the risk or hazard in question. Risk is probabilistic in nature: in this case, the likelihood of an occurrence that will trigger events with an undesirable outcome (Smith 1996, Stenchion 1997, Downing et al. 2001, Brooks 2003, Jones and Boer 2003). Vulnerabilities shift depending on which hazard, or set of hazards, is threatening a population. Likewise, capacities to respond or adapt to risks associated with water availability will be different from those associated with another hazard like an economic crisis or an outbreak of cholera. The risk of focus for a given assessment will influence the priorities for action. This assessment is based on the likelihood that further temperature increases associated with climate change will exacerbate glacial loss, which will affect water availability for water-dependent highland communities.

The temporal aspect of these forces is a key element to the assessment of sensitivity and exposure. Stressful forces can be continual, like constant temperature increases, or episodic in the case of flooding. Of course, if occasional forces such as floods occur systematically over a long period of time this would affect the system in a similar way to a continuous force. In the event that a threshold can be defined for a system—a point at which the system is damaged or changes into another entirely—changes in sensitivity and exposure over time or with various forces will bring the system closer or farther away from the threshold. This assessment of Siete Imperios is concerned with the livelihoods of the families, given the projected changes in temperature that will affect both glacial meltwater and precipitation patterns. These water sources, as we saw in Chapter 4, are critical to the agropastoralist livelihoods of the families in Siete Imperios. Diurnal temperature fluctuations in the north-central highlands of Peru are more dramatic than seasonal temperature shifts. There is a few degree difference between wet and dry seasons, from November to May temperatures range from 20-25ºC, and during the dry season from May through September temperatures are slightly cooler, ranging from 10-12ºC. Though,

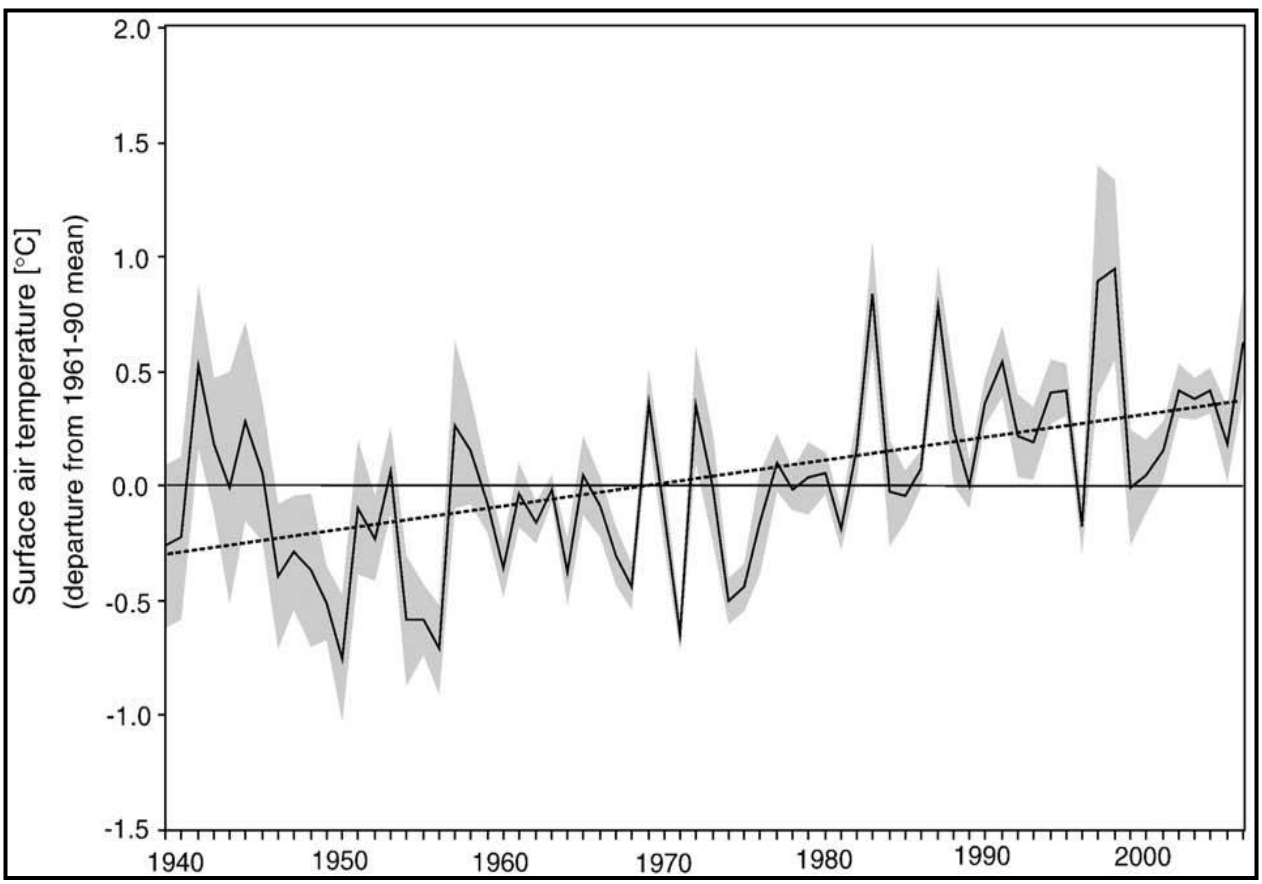

Figure 26 Annual Temperature Changes in Callejón de Huaylas, 1940-2006. Vuille et al. 2008.

as we see from Figure 26, there is a long-term warming trend of 0.10ºC per decade between 1939 and 2006 (Vuille 2008). Therefore, the community has a significant level of exposure to the consequences of temperature increases. Given the data on temperature for the region, I argue that the exposure of this force is continual, which significantly erodes the ability of the system to respond since it is in a constant state of increasing temperature (Luers 2006, Fussel 2007, Nelson et al. 2007).

The sensitivity of Siete Imperios to increasing temperatures is also high. This is partially because of the continual stress of temperature increases experienced by the community, but also because of the limited flexibility of the livelihood strategies of the community members. Livelihood systems in Siete Imperios are almost entirely based in subsistence agropastoralism; most families barely cultivate sufficient food for their family in a given year. While most families do participate in wage labor, these activities are supplemental and could not fully support the family. Only a few families within the community, if any, could shift in any significant degree from agropastoralism to a less temperature-sensitive strategy. Beyond the sensitivity to temperature increases alone, which cause significant stress to soils, crops, and animals, temperature increases also effect water sources for the region. Increased temperatures are linked causally with rapid glacial loss, increased evapotranspiration in rivers, canals, and agricultural fields, and can disrupt precipitation patterns. The risks posited by increasing temperature and its consequences is mediated by the various elements of vulnerability in Siete Imperios, discussed in this next section. The more vulnerable the community is, the more severe these risks become and vice versa.

Existing Vulnerabilities of Siete Imperios

In the following section I will explore social, economic, and ecological variables that influence the existing vulnerabilities of Siete Imperios.[66] Other than my research, data specific to Siete Imperios are not available. Unless otherwise indicated, statistical data discussed in this section are from the 2007 census for the district of Marcará, which encompasses the community of Siete Imperios. Aggregated provincial or district data are likely improved by the inclusion of urban areas, which are generally more educated, better connected to infrastructure and which have much more diversified income than their rural counterparts. Recognizing this fact, the 2007 census separates the urban and rural population for most indicators. The district of Marcará is mostly rural, with only 1,285 of its 8,634 inhabitants living in the district center. Of the total rural district population (7,349), 48% are men and 52% are women. This rural population includes Siete Imperios but also three other *comunidades campesina:* Vicos, Shumay, and Recuayhuanca. I will complement statistical or regional data with qualitative data from interviews, focus groups, and my own observations from Siete Imperios. In the following section each of these variables in Table 3, as evaluated by their proxies, will be discussed for Siete Imperios in order to make an assessment of the vulnerability of this particular community.

Table 3 Vulnerability Variables and Proxies

Variables	**Proxy**
Economic Wellbeing	Poverty classification
	Dependency ratio
	Livelihood diversification
	Interconnectivity
Health Status	Life expectancy
	Infant mortality
	Health initiatives

[66] This table has been adapted from various frameworks to reflect the variables I feel are most salient for an assessment of vulnerability for Siete Imperios, most notably Brooks et al. 2005 and Vincent 2007.

Education	Literacy rate
	Literacy ratio
	Spanish-Quechua speaking
	Secondary matriculation
Governance	Corruption
	Urbanization
	Service delivery
	Availability of funds
Resource Pressure	Population density
	Environmental stress
	Water resources
	Cultivated land per person

The *economic wellbeing* of Siete Imperios is defined here by its level of poverty, dependency ratio, livelihood diversification, and interconnectivity. In the province of Carhuaz over half of the population is living in extreme poverty, which is defined by the census as living on less than US$1 per day. Household income is not captured at the district level, but the majority of the households I worked with were living at or below this income level. Though most families have members of their household that participate in wage labor at some point in the year, this is often to cover deficits in the household budget. As a result income is immediately invested into agricultural inputs, house repairs, or set aside for annual school fees or community service dues. In the words of one interview participant, “those of us who live in the fields don’t have salaries. We plant in order to eat, and any extra we sell, but this money does not go towards savings, with this money we buy pesticides, we have to invest in fertilizer, and what is left is used for market purchases, nothing more” (Interview 19).

The dependency ratio (ratio of children and elderly to adults) is 86%. Traditionally, rural agropastoral communities have large families in order to expand their labor pool, but also because infant mortality is significant. These factors are combined with the reticence of the Catholic church to support family planning. However, recent campaigns by the ministry of health have discouraged large families in rural communities because there are high instances of malnourished children. This campaign includes family planning education and monthly monitoring of children under five. Occasionally in interviews, younger mothers would proudly say to me that their children were “overweight” for their age. Elder research participants often lamented their inability to work in interviews, but while some felt very well cared for by their family, others were barely getting by. The dependency ratio for Siete Imperios is very high. Though some residents feel that “the elders are younger than we are” due to the changes in diet and agricultural inputs, the ratio indicates a significant burden on the productive part of the population and therefore has a negative influence on the vulnerability of the community (Interview 19).

Livelihood strategies for households in Siete Imperios are largely subsistence-based agropastoral activities. Though the community has been developing various income-generating enterprises, and there are often seasonal wage labor opportunities for individuals, these activities do not suggest livelihood diversification. Communal or individual income-generating activities are supplemental to the agropastoral basis for household subsistence. The traditional, and most prominent, income-generating strategies are selling surplus harvest (usually potatoes or corn) to the market in Marcará or in Carhuaz, seeking out temporary employment through neighbors or municipal projects (like the installation of the sewage system that was completed during my fieldwork), or migrating to the coast for a few months to work as seasonal labor on the commercial farms. This particular strategy, circular migration, is most common among the younger men and women of the community. Traditionally, young men and women travel to the coast for a few summers of work in order to build funds with which to start their own family.

More recently, since the municipal government improved the roads, a few families in the community have invested in taxis or larger produce-moving trucks that help them earn money by bringing people up and back from the urban center of Marcará, which is the closest market. Various government agencies have also encouraged planting trees for watershed protection by providing seedlings and training. Because of these efforts, there are also both independent and communally owned plantations of eucalyptus or pine. Whether communal or independently owned, these plantations generate income through the sale of matured or harvested products. Eucalyptus trees are popular among the community as they mature quickly (can be harvested after 5-7 years) and their trunks send out shoots after being harvested that allow for subsequent harvests. In contrast, pine trees are slower growing and do not re-spawn, but they are a higher valued product. As plantations mature, the amount of wood available is advertised locally and the community, or individual, enters into a contract with the buyer. Part of this negotiation includes how much labor the community will supply in the harvest, though the buyer is responsible for transporting the harvested timber. In addition to plantations, the government has also encouraged communities to develop tourism companies to take advantage of the growing tourism industry in the Callejón. Siete Imperios was just starting its tourism committee when I arrived and not much advancement occurred during my fieldwork. I remain skeptical of such a venture being sustainable long-term. Though Siete Imperios does provide a convenient base camp to one of the more accessible glaciers, the nearby community of Vicos has been working in tourism for many years and has established themselves as the community of access for the Copa Glacier. Because of the rapid growth of the industry, there is steep competition for tourists and strict regulations for guides. However, a foreigner had bought land in Huecochec from a prior hacienda owner and was building a tourist lodge in the community during my fieldwork. While those community members living in proximity to the new lodge believe there will be some opportunity once it opens, the owner will probably rely on contacts from Huaráz, overrun with tourism companies and guides, for the tourist-oriented duties. Though he had been building the lodge since before I arrived, research participants report that he has not attended community meetings nor met with the president or any community officials to talk about his venture.

The measurement of interconnectivity explores relations among households in the community, external actors, and institutions to determine the breadth of the network on which a community can depend (Vincent 2007). Interconnectivity is relatively high in Siete Imperios; however, social and political changes in the district and the community could undermine the strength of this variable. The internal community relations are strong since families are usually related through blood or marriage. These relationships encourage helping one another during planting or harvesting, though this dynamic is shifting. Known traditionally as the *mit'a* or *minka*, when a family was ready to harvest, plant, weed, or any other labor-heavy field task, specific kin were invited to help in the harvest in exchange for a percentage of the total final harvest as well as a meal and perhaps even some beer once the work was finished for the day. When an individual or family participated in a *minka*, this also assured reciprocal participation when they required labor, thus reproducing interconnectivity. In should be noted however, that this "moral economy" is shifting and these types of payments are very rarely acceptable (Scott 1976). People now want to be paid in money for the time or effort they put into a harvest, in addition to a percentage of the final harvest (albeit a smaller one). As one focus group participant reported, "with their big soup plates they came before [to work], now everything is money, now you don't find [minka]" (Focus Group 7). This trend toward monetary compensation as opposed to reciprocity is causing traditional social networks that are based on sharing work and harvests, which help families and communities survive crop failures or other hardships, to become less available to those in need. While further income diversification is important for adaptive capacity, it should not come at the expense of risk-spreading processes like these traditional social networks.

The political interconnectivity within Siete Imperios is relatively strong since the numerous two-year term committees for services rotate through families in the community. Most household heads have at least served as a *vocal* at one point in their lifetime, which is an elected position that announces meetings and other committee activities. However, there is a perception, which follows on the geographical disparities discussed in Chapter 4, that most families that have held “major” offices (such as president or vice-president of the community or an important committee, like irrigation) live in and around Centro I and Centro II. These perceptions of inequality between the sectors can undermine the interconnectivity of the community.

External interconnectivity is less uniform, members of Siete Imperios remain largely marginalized. Some households have family members living in Huaráz or even Lima, others have connections in Marcará that facilitate their participation in district opportunities, but some families are not at all involved in external institutions. For example, one of the families with whom I frequently visited was related to the Mayor of Marcará and through this connection, the head of the household was employed by the district government to clean the intakes for their potable water twice daily. These external connections however, are tenuous. Some of those families with relatives living in Lima reported that they never heard from these relatives, which clearly nullifies any potential benefit from this connection. Connections with the current political administration in Marcará has been beneficial for Siete Imperios, but the next administration might favor a different community or be more focused on the urban development of the district.

Vincent (2005) suggests that interconnectivity limited to kin and friendship ties within the community leaves certain households more vulnerable than those who have networking social capital that expands geographically or socially outside of the community. The external connectivity of Siete Imperios is limited, and the internal connectivity is shifting with political and social changes. Overall this variable has a positive influence on the vulnerability of Siete Imperios, but there is potential for this variable to become a negative affect if the connectivity within the community continues to shift.

The *health status* of Siete Imperios is measured here by life expectancy, infant mortality, and participation in health initiatives. Unfortunately, life expectancy and infant mortality statistics are only available at the departmental scale. For Carhuaz, life expectancy averaged for men and women is 64.7 years and infant mortality is 22.8%. I have no reason to suspect the statistics for Siete Imperios are significantly different than these provincial numbers. As such, these indices do not strongly affect the vulnerability of Siete Imperios positively or negatively compared with other rural communities in the valley.

In addition to the statistical health proxies above, I provide here a qualitative description on access to and participation in health care in Siete Imperios. The existence of most of the health care initiatives discussed below suggests the poor status of health in Siete Imperios and it is unclear whether these initiatives will improve the status of the community. There is a health post in the plaza of Siete Imperios where a doctor, obstetrician, registered nurse, and an administrative assistant come each day of the week to treat the community. This health post staff were busy everyday from the moment they arrived in the community until they left in the later afternoon. The vast majority of community members being treated or waiting outside the *posta*, as it was locally know, were women and children. Through the Ancash Ministry of Health, the employees of the Siete Imperios health post were in the process of implementing the *Sistema de Vigilancia Comunal* (SIVICO). A participatory program which aimed to create a picture of the community's health by creating a map of those households with members at high risk for death or disease. Elected representatives from each sector of the community were to perform a health census within their sector along with a health post employee. At the time I concluded my fieldwork, only one sector had been partially censused because the health post employees and the community representative were unable to find time to carry out the SICIVO.

During my research period several national health initiatives were operating within the community. Two of the more popular and engrained health programs, Juntos and Caritas, are aimed at improving the conditions of the rural poor, particularly pregnant women and mothers of children under five. Juntos is a conditional cash transfer program initiated by the government in 2005. Its goal is to help poor families (those living on less than $1/day) educate and care for their children. The program provides monthly payments of S./100 (~US$30) to mothers and pregnant women on the conditions that they send their children to school at least 85% of the school year and that they participate in regular health and nutrition controls (Perova and Vakis 2009).

Caritas is a Catholic-based organization that began operating in Peru in 1955 (Caritas 2011). A Caritas program specific to Ancash, with support from the *Fondo Minero Antamina,* is *Ally Micuy*, which aims to improve the health and nutrition for pregnant women and children under 3 years of age.[67] This program improves the care and attention given to children by educating families to adopt new practices through group education sessions, one-on-one weekly sessions, monthly control for weight and height, vaccination, and de-worming sessions, blood analysis and iron supplementation. Nutritional workshops are also mandatory in which mothers are taught to cook a balanced, nutritional meal using local ingredients. A second element of the

[67] http://www.caritas.org.pe/si_allymicuy.htm, accessed August 2, 2011

Caritas *Ally Micuy* program is the "Family Plan for Improving the Household." In addition to encouraging *cocinas mejoradas*[68] (Figure 27), the Family Plan also supplies water filtration devices for each household in an effort to ward off contamination, helps families build shelving to hold utensils and other flatware, and to construct ecological refrigerators (see Figure 28).[69] Through this regional program, Caritas also works with the efforts of *Comunidades Saludables* to encourage healthy habits such as washing hands and brushing teeth. Finally, *Ally Micuy* encourages the consumption of *cuy* (guinea pig) as a very nutritional, local source of meat by giving each family a pair of *cuy* (male and female). The organization then helps the families to build an aboveground cage for the *cuy* (so they do not run freely around the kitchen as they were previously kept), and takes steps toward improving their feed.

The existence of these programs in Siete Imperios represents the position of most government and external actors that rural, peasant communities are unable to adequately feed themselves and their children. This position, that program officials repeat at each meeting, reinforces the idea that community members' position as poor and vulnerable is due to their own inadequacy and lack of ingenuity, and not the fault of programs or policies that undermine their historically successful livelihood strategies or strip them of land or resource security. I observed several workshops and visits by the health post employees, Caritas officers and Juntos representatives. During every visit, interactions between *campesina* women and government health workers reflected the identity politics and dynamics of power between populations throughout the Callejón. Adult women were chastised like children in their own homes for not

[68] All families in Siete Imperios cook with *leña*, or firewood, which is collected, bought from the communal eucalyptus plantations, or cultivated for domestic use in a portion of their agricultural fields. The *cocinas mejoradas* project aims to change the methods of cooking to reduce the amount of smoke inhalation by installing closed cooking stoves with chimneys instead of the traditional open fires in the kitchen.
[69] Ecological refrigerators are built of adobe with a wooden door and cooled by keeping the area moist using bowls of water or bottles of ice, if they can be obtained.

Figure 27 Open fire and closed cocina mejorada. Photograph by author.

Figure 28 Ecological Refrigerator. Photograph by author.

following program demands to the letter. In contrast, a workshop held by community representatives had a more egalitarian and pleasant, though effective, atmosphere. As it stands, access to medical attention in the community positively influences vulnerability within the community, but otherwise, health initiatives in the community may be having an overall negative effect on vulnerability by aggravating feelings of helplessness, inadequacy and entitlement.

Education in Siete Imperios is measured by literacy rate and ratio, native language spoken, and secondary matriculation data. Educational figures are not available for Siete Imperios specifically so I comment on how Marcará district data align with my observations in Siete Imperios for each of these proxies. The literacy rate for rural inhabitants of Marcará is 65%. This number is likely similar for Siete Imperios. Most elder residents were illiterate and many of those residents who came of age before the hacienda was disbanded reported that only hacienda children were educated while children of hacienda workers were taught to cook and sew instead of read and write. Younger generations are more likely to be literate, though there is a significant difference between the literacy rates of men versus women. In the district 78% of rural men and 53% of rural women are literate. This literacy ratio is likely similar for community members of Siete Imperios. The overall literacy rate is on par with regional rates. Though women are significantly less literate, it is likely that most households have one literate member.

The majority of the rural inhabitants of Marcará speak Quechua as their primary language and a small percentage speak Spanish as their primary language. For the rural inhabitants of Marcará, 87% report Quechua as their native language compared to only 13% that report Spanish. I suspect that the 13% that report speaking Spanish as their native language are either hacienda descendants or recent migrants to the area. In all interactions among community members of Siete Imperios Quechua was the primary language spoken. The only circumstances where Spanish was spoken (it was never purely Spanish because inevitably a member of the conversation would not speak Spanish) was when officials or other visitors were present. Quechua is spoken within the household, and children usually only learn Spanish once they go to school. However, I often observed that women would speak to baby girls purely in Quechua, but to baby boys in Spanish or with some Spanish words, even when the mother only spoke Quechua. I also observed that those who spoke only Quechua, did sometimes understand some Spanish. Quechua is an official language of the country, and there were many pamphlets and advertisements that were published in both Spanish and Quechua; however, Quechua literacy is reportedly much lower than Spanish literacy. Those who only speak Quechua are at a disadvantage in certain scenarios outside of their community activities; however, I do not believe this is a significant factor to the vulnerability of community.

Nationally, the primary matriculation rate for 6-11 year olds is 98.7% and secondary matriculation (12-16) is 91.5%, these figures are an average for both boys and girls. Primary matriculation for rural girls in Marcará (ages 6-11 years old) is 89% and for rural boys is 92%. Secondary matriculation for rural young women in Marcará (ages 12-16) is 65% and for rural young men in the district, 63% attend regularly. These matriculation figures are likely similar for Siete Imperios. Since 2003, Siete Imperios has improved its two-story, multi-building school near the plaza of Siete Imperios (see Figure 29). The school only offers primary classes (grades 1-5), but parents have been petitioning the school to offer secondary education as well. Currently, once children graduate from primary classes they have to attend school in neighboring Copa Chico (though it is not clear if the child needs to be a resident of or have a relative in Copa Chico to attend) or make the journey down to Marcará and back each day to attend the district

Figure 29 Parent meeting in the Siete Imperios school. Photograph by author.

high school, both time-consuming and expensive. As a result, not many children attend secondary school.

At the time of the census, 32% of rural inhabitants in Marcará reported having completed no education (20% of rural men, 43% women), 44% had completed primary school (48% men, 40% women), and 17% had completed secondary school (24% men, 10% women).[70] Only 78 rural inhabitants of Marcará had entered additional training institutions, and 68 people had graduated from training institutions, while 41 people reported having entered university, and 40 reported finishing. I only knew of a few families whose children continued their education past

[70] These numbers do not add up to 100 because of those censused 225 did not respond to questions on education.

secondary school. Of those that did, these were technical schools to become secretaries. For rural women seeking employment throughout the Callejón, the preferred employment had recently shifted from *empleada* (maid) to secretary which requires technical training.

The literacy of Siete Imperios does not meet the departmental average, particularly for women in the community. The primary language for most community members, especially women, is more likely to be Quechua. Secondary matriculation also falls below the national average, and again women are less likely than their male counterparts to complete secondary education. These proxy variables for education have a moderately negative influence on the vulnerability of Siete Imperios mostly due to the high illiteracy rates, especially among women.

Governance statistics are not available, but based on interviews, focus groups, participant observation and textual analysis of community records, I am able to give a picture of corruption, urbanization, effectiveness of service provision, and the availability of funds specific to Siete Imperios. While governmental corruption in Peru is perceived to be widespread, the community experiences fewer problems with this since decisions are expected to be made collectively in monthly assembly meetings and president of the community and his administration are up for election every two years. That said, the administration that was in office as I was finishing my fieldwork was being accused of corruption regarding the sale of communal eucalyptus and pine plantations. The administration is expected to vet prices for the sale of these plantations to the community through the monthly community-wide meeting. This administration not only neglected to hold community meetings regularly, it did not discuss the prices with the community prior to sale. The president and his administration were denounced when he handed out the payments for the plot, which were significantly less than was expected by the families. This type of questionable behavior on the part of authorities compromises communal management, like that in Siete Imperios, by perpetuating feelings of inequality among political sectors of the community.

The year I arrived in Siete Imperios, several infrastructure projects were being implemented simultaneously. The dirt road from Marcará up through Siete Imperios across the highlands and down towards Carhuaz was being improved by the district.[71] Prior to this improvement, the roads were nearly impassable by standard automobiles and only larger trucks would dare make the journey with loads of material or people. Typically when families needed to go to market in Marcará or Carhuaz, they would walk the nine kilometers down the mountain and back. The road was initially put in when these communities were established in the 1980s but the road beds had weathered badly. The improvement of the road increased the car traffic considerably, and toward the end of my fieldwork, several cars would make the trip to Copa Grande and back at various points in the day. The increase in traffic moving through the community allows community members greater ease of access to the valley markets, schools and services. In addition to the road improvements made, a potable water system was installed along with the backbone of a sanitation system.[72] Though the potable water system is said to have reached all the households in Siete Imperios this is not the case (see Chapter 4 for details).

For each service operating in the community—irrigation water, potable water, and electricity—there is a committee that is charged with its maintenance, and sometimes even a committee for maintenance in each sector of the community. If a service is not working, anyone from an affected household can inform the *vocal* (the official community representative for the service committee), who will inform the president of the service committee. The president then

[71] Road improvements were done by filling in dirt and using a heavy machine to stamp it down tightly. No paving was done.
[72] The individual house connections are said to be the responsibility of the households themselves. Regardless, the treatment center has yet to be planned or even sited.

issues an order for a *faena* to fix the problem. *Faenas* are rotating groups of *comuneros* that can be called upon at any time to provide obligatory communal labor for the various community services. As a full *socio*, or member of the community, each household is responsible for providing labor to the various tasks identified by the community administrations. My interviews turned up very few issues with daily service delivery.

In the event that the service is outside of their ability to fix manually, the committee negotiates with the service provider to restore access. During my tenure in Siete Imperios the electricity would often go out, and while the community members had little control over this service since it was provided by a company in the valley, they were generally abreast of the situation causing the outage and knew when power could be expected to return. Since the water for potable and canal systems is captured just above the community, if there is a blockage or problem with the water flow in either of these systems, those community members responsible for maintenance can reach the area of problem in a matter of hours to correct the delivery issue. Research participants showed no hesitation in informing their *vocal* (elected position that facilities communication between a service committee and community members) if there was a problem with the potable water or irrigation systems. There is a high degree of participation, effectiveness and transparency in service delivery. However, as discussed in Chapter 4, there are households or sectors without access to canals or potable water services. Some of these households attribute their lack of services to a prejudice on the part of community management for centralized regions. If left unaddressed, this could also undermine the cohesion of the community and thus exacerbate vulnerabilities.

Copa Grande, the five upper neighborhoods of Siete Imperios, has been encouraging its residents to urbanize in an effort to be counted as a higher level of administration giving them more political power in the district. Community members reported that if they succeeded, they would be able to elect a mayor and have access to funds from the district budget. In order to encourage urbanization, Copa Grande has given those *socios* living in the more distant sectors a small plot of land on which to build a house near the plaza. *Socios* would maintain their original agricultural plots for farming activities, but could build a second house on their new urbanized lots which have access to electricity, potable water, and sanitation. Those households established on the outskirts of the sectors like Centro II and Yanahuanca are less likely to have access to any of these services due to the costs of extending the service through the difficult terrain. Allowing these households to build near the plaza will increase the numbers the community is able to report as having access to such services. This effort will result in an actual population center as opposed to the more dispersed patterns in which people have settled until now. Infrastructure improvements would positively influence vulnerability if the increased diversions of declining meltwater were not taken into account. As it stands, further improvement and diversions of canal systems and potable water will severely affect the vulnerability of Siete Imperios by limiting their access to water.

Funds available for the development of community services are minimal. Upon entering as a full socio the person will pay a small fee to the community; services such as water and sanitation collect a small fee each month to maintain the infrastructure of those services, but otherwise community funds are collected based on the specific projects or enterprises undertaken. Larger infrastructure projects, such as potable water and sanitation systems, are financed by provincial or district monies that are earmarked for rural development. Though the perceptions of inequality present obstacles to the cooperation and transparency necessary to sustain communal management, and funds available for community development are minimal, governance in Siete Imperios has a positive influence on the vulnerability of the community.

Resource pressure is a significant factor for the area and will be measured by population density, environmental stress, the sustainability of water resources, and cultivated land per person. The population density for the district of Marcará is 54.8 (8,634 people in 157.49 km^2). According to the Ministry of Agriculture, Siete Imperios owns 13.3648 km^2 within the district of Marcará and the national census reports 1,145 people living in the community. This equates to a population density of 85.5 people per km^2, an extremely high figure. Many community members felt the increasing population was a problem for agricultural production and water availability. Throughout the Callejón de Huaylas, studies have shown significant environmental stress due mainly to decreases in vegetative cover and glacial loss (Byers 2000, Shoobridge 2005).

The effects of these stresses are felt in Siete Imperios through the declining soil productivity and concerns for water availability. As discussed in Chapters 1 and 4, the sustainability of water resources for the community is complex. Currently, there is abundant meltwater and seasonal rainfall to support two agricultural plantings; however, both of these sources are predicted to shift with climatic changes. Regardless of climatic changes to the hydrological regime, additional intake systems have tapped the rivers bordering Siete Imperios above the community, lowering the amount of water flowing through the community. Cultivated land per person is limited in Siete Imperios due to the rugged topography and altitude ceiling for certain crops; however, each family has at least two hectares of land in cultivation. When asked about environmental changes in the region, community members often reported on the decline in agricultural production (see Chapter 4). Yields are lower, pests and disease are on the rise and temperature and precipitation shifts are negatively affecting production. Respondents also attributed decreased yields to the chemical fertilizers that were introduced with the Agrarian Reform and are now heavily used. Decreased production has led to families leaving less land fallow, thus exacerbating the declining soil quality and further reducing production. Clearly, resource pressure has a very negative influence on the vulnerability assessment of Siete Imperios. The high population density, existing environmental stress, projected climatic factors and shifting agricultural practices pose significant threats to the ability of the community to sustain their agropastoral livelihood.

State of Vulnerability Considering Projected Climatic Changes

Based on the frameworks applied above, Siete Imperios is very vulnerable to the projected effects of climate change, though there are some mitigating variables. In this assessment, I am concerned with how these vulnerability variables positively or negatively influence adaptation capacity for the community. Below in Table 6, is a summary of the vulnerability assessment by variable and proxies based on the discussion above. For each of the proxy variables, I assigned a value—low, medium, high—that demonstrates the degree of influence that proxy has over the variable itself based on reporting from community members as well as my own observations.

Table 4 Vulnerability Assessment

Variables	**Proxy**	**Value**	**Assessment**
Economic Wellbeing	Poverty classification	High	Negative
	Dependency ratio	High	
	Livelihood diversification	Low-medium	
	Interconnectivity	Low-medium	
Health Status	Life expectancy	Medium	Neutral
	Infant mortality	Medium	
	Health initiatives	Medium	
Education	Literacy rate	Low	Negative
	Literacy ratio	Low	
	Spanish-Quechua speaking	Medium	
	Secondary matriculation	Medium	

Governance	Corruption	Low	Negative
	Urbanization	Medium	
	Service delivery	Medium	
	Availability of funds	Low	
Resource Pressure	Population density	High	Negative
	Environmental stress	High	
	Water resources	Medium	
	Cultivated land per person	High	

As each proxy was assigned a value, these values together determined whether the variable as a whole held a positive, neutral, or negative influence over the vulnerability of the community in light of rising temperatures and its consequences. The remainder of this section explains how the assigned value for each of the proxies influences the overall assessment for each variable.

Variables for economic wellbeing have a clearly negative influence on the community's vulnerability. There is a large degree of poverty, high dependency ratio, low livelihood diversification and low interconnectivity between the community and external networks. These factors combined significantly limit the flexibility of the community members of Siete Imperios in the face of shifting environmental factors that directly affect their agropastoral livelihoods.

Health indicators have an overall neutral effect on vulnerability for Siete Imperios. Life expectancy and infant mortality are close to average for the region, but the high degree of participation in the various health initiatives has the potential to hinder adaptive capacity by undermining resourcefulness on the part of families. Beyond the identity politics exhibited throughout the interactions between community members and health workers, some of these health programs give money, animals, or other materials to especially low income families. These "hand outs" are not viewed favorably by everyone in the community, some claiming it is too easy and therefore not utilized appropriately. For example, I was told some families buy cell phones with money intended for purchasing food supplies.

Educational variables fall largely along the same line as health indicators. Literacy rates and secondary matriculation are below average for the community, particularly for women. Lack of educational resources severely limit adaptive capacity for a population, particularly because the stigma attached to illiteracy and lack of education contributes to feelings of inadequacy on the part of community members, particularly in comparison to other sectors of society. The high percentage of the population that speak Quechua as their primary language need not be limiting, but this depends on the language preferences of the networks the community may be trying to access. This is no doubt a factor in the limited interconnectivity with external networks.

Governance indicators are generally positive, corruption is low within the community due to collective decision-making and accountability norms, and service delivery has been vastly improved with the recent introduction of potable water and electricity and offering households with urbanization options. Though the availability of funds for community development are severely limited which significantly limits government effectiveness, the real aggravating circumstances for governance are the potential longer-term affects of community development. First, the new services are differentially accessible depending on the sector, which creates or exacerbates inequality between the sectors. Secondly, increasing diversions of the glacial meltwater will decrease the amount of available water in each of the various systems, not to mention the amount of water lost to leakages and evapotranspiration. So in terms of vulnerability and adaptive capacity to temperature increases and the consequences, largely affecting water availability, overall governance variables have a negative influence.

Resource pressure variables are also clearly negative influences on the vulnerability of Siete Imperios to the consequences of climate change. The population density for Siete Imperios is extremely high and as such environmental stress is significant. Water resources are still sufficient, but threatened by projected and constructed scarcity. The land under cultivation in the community is overworked and therefore is losing its productivity. Though loss of productivity due to high population densities and shorter fallows has been argued to drive people to explore and adopt technologies or techniques that increase production (Boserup 1965), in this case, the high population density is couped with rapid environmental degradation associated with increasing temperatures, including declining water sources. These forces together cause a great deal of concern among the community members who felt there was little that could be done to counteract such multifaceted decline.

Adaptive Capacity

Adaptation is a part of human history; indeed, “adaptation is a continuous stream of activities, actions, decisions, and attitudes that inform decisions about all aspects of life and that reflect existing social norms and practices” (Nelson et al. 2007: 397). However, with the projected risks associated with climate change, many societies (if not all) will “require substantial adaptations and even transformations in social organization, resource use, and settlement” (Nelson et al. 2007: 396). Determinants of adaptive capacity shift depending on the hazard and population in question. However, Yohe and Tol have summarized a generalized framework for assessing the adaptive capacity of a population (see Table 5). Nearly all of these determinants have both micro- and macro-components to them, but for most, appropriate responses should be determined locally, perhaps from a set of responses put forth at a larger regional or national policy level.

Fundamentally, adaptive capacity is about governance. It seeks to gauge the power that actors and their social networks have to make and to implement management decisions. In order to make or consider such decisions, these networks rely in part on knowledge and experience gained through actively engaging with the ecosystem. In this case, decisions made by the community of Siete Imperios are influenced by both their experience living as agropastoralists in the region for many generations and by the larger governance networks in which they operate.

Adaptive Capacity in Siete Imperios

My analysis of adaptive capacity in Siete Imperios will be based on the framework put forth by Yohe and Tol (2002) extrapolated from Chapter 18 of the 2001 IPCC report, that encompases the main elements of adaptive capacity discussed by most adaptation scholars. Here, I stress economic resources, technology, information and skills, infrastructure, institutions, and equity as the major determinants of adaptive capacity. Using information gathered through community member interviews, focus groups, and archival research, I will address each determinant of adaptive capacity outlined in Table 5 below. As with vulnerability, adaptive capacity must be addressed in terms of a specific risk. In this case, I will consider how the historical and structural elements that have created the vulnerabilities discussed above for Siete Imperios will likely react when glacial loss and changes in precipitation patterns cause water availability to fall below a sustainable threshold for the community (as yet undefined).

Table 5 Determinants of Adaptive Capacity

Range of available technological options for adaptation
Availability and distribution of resources across the population
Critical institutions and decision-making authority
Human capital, including education and personal security
Social capital, including the definition of property rights
Access to risk spreading processes
Management ability and credibility of decision-makers
Perceieved attribution of the source of stress and the significance of exposure

The *range of adaptation options* available to highland communities in the face of climate change are still being developed on regional and national political stages.[73] Small-scale, local adaptations— mentioned only by a small subset of those interviewed—would be to harvest rainwater or to build a reservoir system.[74] Rainwater harvesting could be done relatively simply by households who feel the need most; however, as stated in Chapter 4, rainwater is felt to be polluted through field burning and mining activities so this is not viewed as an appealing option. Reservoir construction—a technology supported for use by archeological records (Herrera 2008)—would require significant investment on the part of district and regional governments but would not create too dramatic of a change to the rhythm of irrigation life in Siete Imperios as it is today. These reservoirs could be built near the current intake for irrigation water and distributed using the same system. Another adaptation option is a switch to rain-fed agriculture. Neighbors living in the Cordillera Negra live largely from rain-fed agriculture and this process too could be adopted for Siete Imperios. This would necessitate a shift in the agricultural system in terms of timing, crops, labor, and monetary input. However, at the time of the hacienda system, many households in Siete Imperios lived only from rain-fed agriculture, and several households still maintain some portion of their plots in purely rain-fed zones of Siete Imperios. The knowledge associated with this system could be recovered to some degree, although scientific and observational data suggest that rainfall patterns are becoming increasingly erratic. Of course, another response most often given by research participants was simply to accept changing water availability. I discuss this further as part of the last determinant: perception of risk.

[73] As of the conclusion of my fieldwork, options discussed at national meetings and in IPCC reports suggest building reservoirs, harvesting rainwater, introducing water markets, migration of affected populations or technological advances such as desalinization (IPCC 2007).
[74] As previously mentioned, the majority of responses felt the consequences of glacial loss could not be overcome.

As discussed above in the vulnerabilities section, the population of Siete Imperios does have access *to social and financial resources*, but the availability of these resources for non-subsistence ventures is minimal. Most community income goes toward paying the necessary fees for services and supplementing a declining harvest, and the community might be unwilling to divert the limited resources designed to address other issues toward a future uncertainty. Considering the infrastructure advances seen in the past three years were all funded by the distrct (improved roads, potable water and sanitation systems), it seems that Siete Imperios has a productive relationship with the district center of Marcará. However, this relationship could change depending on who is elected into office or the funds available to the district. During my tenure in Siete Imperios, the mayor of Marcará was a close relation to a family living in Centro II. While I am not sure the degree to which this relationship had bearing on funding choices for the district government, I do know that several short-term or part-time employment opportunities were given to relatives in Siete Imperios based on this connection. External resources for climate change education and adaptation programs exist in the Callejón, but as of my research, Siete Imperios has not been approached by any of these organizations. Many of these programs are in the pilot stages and only work with select communities or areas.[75]

Within the community, *critical institutions and decision-making authority* are clearly defined. While elected leaders have the authority to make decisions, these decisions are agreed upon by the community through discussion and voting in the monthly meetings. Institutions and authority within the community is collective and those institutions necessary for taking the proposed adaptive actions exist or can be adjusted to fit new irrigation patterns. For example, the irrigation committee is able to absorb some degree of decreasing availability by depending more on an irrigation schedule. However, the regional and departmental institutions and hierarchies

[75] Examples of NGOs working in the area include: CARE, World Vision, ITDG: Soluciones Practicas, and Oxfam.

regarding water management are less clearly arranged, particularly in regard to the “new” water law of 2009. Additionally, many of these institutions operate under biased management practices that critique “ancestral” practices for mismanaging or wasting water. In a document on managing water in the face of climate change, officials wrote:

> There is a careless use of water in the Cordillera Blanca and better management of this resource in the Cordillera Negra. It is important to institutionalize the management of water resources, because although there are irrigation organizations, these are based on ancient traditions linked to uses and customs, that are not always conducive to good distribution of irrigation water. Therefore, the problems include water management, agricultural management, and the knowledge and organization of the population. (Portocarrero 2008: 9)

Other examples of this bureaucratic blindness to the management practices and related concerns of highland communities are discussed at length in Chapters 3 and 5, but suffice to say it is significant and persistent. Other regional and national institutional hindrances to adaptive capacity include the separation of water management from climate change initiatives and the power differentials among water users within the Rio Santa watershed (see Chapter 5).

Human and social capital in terms of education and property rights is strong within Siete Imperios, though there are fissures in the facade. There is access to at least primary education within the community and fees are at least partially covered through community-wide financial ventures, though some families need their children to work and only permit part-time attendance. Property rights are somewhat complex and a cause for future concern. The land is titled to the community communally, who then determine the method and means of allocating land among its members. The ability of the community to award new *socios* with land is severely limited, a reality that could encourage young adults to move elsewhere, particularly in light of declining agriculture. This potential for migration will increase the dependency ratio but also decrease the total population, which would decrease the resource pressure via population density. As noted in previous chapters, some sectors of the community are more at risk for water-related vulnerabilities than others, so property allocation will become a larger issue. Extra-locally the level of education among the Peruvian scientific community working in climate change and hydrology is high and very diverse. Climatological studies, specifically hydrology and glaciology, have focused in the Callejón de Huaylas for many years as shown elsewhere in this dissertation. Local scientists are frequently approached by other countries with similar environments who have had less history in dealing with instability regarding glacial loss and glacial lake hazards.

Risk-spreading processes are historically common among highland communities. These processes mainly take the form of mutual obligations through extended family within the community and its immediate neighbors. Siete Imperios is no exception, but again, social changes reflected in the way reciprocal labor exchange is employed might be lessening the ability of these processes to actually reduce risk. If the risk we are focusing on here is that some households will have less irrigation water and therefore less available food for their families, it could potentially reach out to the extended families that live in areas that continue to have sufficient irrigation water. However, if this process is becoming more market-oriented (being paid for labor instead of expecting reciprocal assistance), it will no longer be risk-spreading but in fact increase risk. If families will need to access cash in order to hire enough labor to harvest their crops, they will either decrease their overall area of cultivation to decrease labor needs or they will increase their dependence on wage labor, or both. By decreasing their potential agricultural yields, they are increasing their exposure to risk because there would be a higher chance of their crop being hit by frost or other malady therefore leaving the family without sufficient food for the season. If they increased their dependence on wage labor they are decreasing the labor available to them for agricultural purposes, which will erode their self-sufficiency because they will have cultivated less.

The ability of decision-makers within the community to *manage information and determine authenticity* is a collective and transparent process. Monthly community-wide meetings serve as platforms for any issues or concerns on the part of *socios,* and decision-making with regard to any issue is undertaken during these meetings. From the perspective of the community, the processes of managing information and determining authenticity are responsive to community concerns, thus encouraging adaptive capacities. However, significant deterrents to adaptive responses in the highlands of Peru are external socio-economic or political forces that impede these collective and transparent communal processes (Young and Lipton 2005). Some development projects only address a subpopulation of the community, which is unsupportive or even antagonistic of the cooperative nature of the *campesina* community because it creates tension among a supposedly egalitarian community. Beyond specific antagonism, there is a long-standing mistrust on the part of communities towards outside authority. This mistrust is fed by the corruption and heavily skewed power dynamics throughout the country, particularly when dealing with land tenure and rights to water. Historically, the poor relationship between communities and external authorities, be they scientists or government representatives, could hinder the ability of the community to appreciate and appropriately utilize information from these sources. When I asked about any data or pictures specific for Siete Imperios in an interview with the director of INRENA (now the Glaciology and Hydrological Resources Unit under ANA), he recounted an encounter he had with Siete Imperios in 1997:

> We wanted to carry out some investigations [in Copa] because the Copa [Glacier] is a glacial mass with a very smooth slope compared to other glaciers where we install observation stations. Unfortunately, the people of the community refused the station because the people have their ideas and customs. They said that these apparatus were

> something that would guide the rainfall and were adamant that we withdraw the instruments, so we did. In Hualcán too, in this whole region, the communities did not permit us [to investigate]. North of Hualcán, in the Quebrada Ulta we had installed equipment to measure precipitation and it was destroyed by the community. Many times the people are not able to understand the goals of installing these instruments. It would benefit them because if we want to talk about development of agricultural or other subsistence based activities, these instruments have information about the glacier movements. (Personal communication, Marco Zapata, April 2009)

This illustrates the institutional prejudice on the part of government officials and the scientists working with them toward communities, the deep distrust on the part of the community, and the unwillingness of both parties to better understand the goals and motivations of the other. This monitoring station could have been extremely useful for scientists and also for the community itself, but there is also a significant possibility that it could have brought other interested parties into increasingly tense inter-community water allocation discussions.

The *perceived attribution of source and significance* is high in Siete Imperios. Both community members and the scientific community are well aware of the environmental changes and the future consequences of these changes. Even though the issues are recognized and feared, little or no action has been taken to adjust. Regional institutions have been quick to offer mitigating actions (e.g., banning burning and prohibiting littering) but slow to suggest adaptations other than small-scale individual-level shifts in agriculture. Community members are also at a loss for what actions might be best in the face of decreasing water availability. Some leaders and elders in the community claim that there is nothing to be done, while others argue that they do not have the knowledge or expertise needed to approach such problems. For example, when asked what can be done, respondents replied, "we don't know what to do" (Interview 21), "without water how we will live; we don't know, we have never seen it" (Interview 36), "not even God knows, for as much as we yell, who is going to augment the water" (Focus Group 6), and "yes, we are thinking, the community is thinking about this, but we cannot, we are not sufficient, this is the problem, we are thinking but we are not sufficient, this is our doubt" (Interview 116). In an interview with a community authority, I asked what could be done and he lamented the limitations he felt, "A reservior could be built. A government authority could think and decide this for us. We need people to support us, people that tell us the problems. We are *campesinos*, we are in our fields year after year. We cannot analyze, we are not students, we are illiterate" (Interview 19). Regardless, these perceptions are socially constructed and are clearly limiting.

Barriers to Resource Mobilizing for Adaptation

Given the determinants for adaptive capacity used as the matrix for this assessment, Siete Imperios has a high degree of adaptive capacity internally. The community is highly knowledgeable about the perceived risks of climate change, has transparent governance, high internal social capital and risk-spreading processes (though these are shifting), and a significant degree of self-sustainability. However, determinants dependent on a larger regional or national framework are in jeopardy. Adequate or appropriate adaptation options have yet to be explored in great detail, external resources available to the community are few and inconsistent, and the larger government processes are not participatory nor emancipatory. These low scores for these larger scaled determinants should not prevent community members from at least considering what actions might be necessary for future adaptations. However, as I have shown in Chapter 4, when asked what could be done about the glacier and future water shortages, the most common answer was death. Why do community members not believe they can act against these environmental changes?

Table 8 Adaptive Capacity Asssessment

Determinent	**Assessment**
Range of available technological options for adaptation	Low
Availability and distribution of resources	Low
Critical institutions and decision-making authority	Medium
Human capital including education and personal security	High
Social capital including the definition of property rights	High
Access to risk spreading processes	High
Management ability and credibility of decision-makers	Low/Medium
Perception of the source of stress and the significance of exposure	High

The most obvious possible reason people are not mobilizing resources for adaptation is that this study took place in a period where observations of change in the glacier had been going on for some time, but the infrastructure changes in the diverting of water from the intakes are just beginning to cause significant shifts in water availability for individual families. Another possibility is that with all the pressures on agropastoralists in highland Peru, future water concerns are just that, a concern for the future. Families are too occupied with preparing, planting, and harvesting their fields in order to survive the next season to put too much effort into longer-term planning. The lack of mobilization could also be influenced by the perspective that community members have no control over natural cycles. Almost all community members in Siete Imperios, who have witnessed glacial changes throughout their lifetime, believe glacial loss will bring about devastating and permanent change. Some members come by this view through religious doctrine, as shown in previous chapters, but others report this powerlessness in the face of glacial loss due to the sheer magnitude of what glacial loss will mean to the country. If all the water for Peru comes from these glaciers, how will we survive without them? Many interviews ended with participants exclaiming that nothing could be done about the receding glacier.

Another possibility is that community members view their knowledge as inadequate for such a task. Though knowledge production, application, and circulation is dynamic, the rapid changes being experienced by communities in the highlands of Peru leave residents reporting feeling as though they do not have the tools to adapt to the changing environment. Biophysical transformations will have “profound cultural and symbolic impacts” to those communities living where these changes are occurring (Adger et al. 2009). Cultural losses associated with these physical transformations are said to be “invisible in management decision-making, but could represent a loss of identity, loss of order in the world, and loss of knowledge” (Turner et al. 2008: 4). As shown in Chapter 5, older individuals in Siete Imperios reported having interacted with the glacier as they pastured animals at higher altitudes during their childhood and as a community during ceremonial holidays.[76] Visiting the glacier used to be a social activity undertaken by many, but it is now considered too far or too difficult for most to consider. Many research participants report that children now do not visit the glacier at all. The role this rapidly-retreating social space played in maintaining bonds between age groups or even community identity and solidarity is not taken into account during environmental decision-making or valuations of environmental changes (Oliver-Smith 1991, Gow 1995, Pretty 2007, Adger et al. 2009). Beyond the sense of loss reported for the social space associated with visiting the glacier that was expressed fairly uniformly across interviews, research participants reported that the relatively rapid environmental changes in the region made their traditional knowledge less relevant. While the scientific community is accustomed to, and indeed driven by, elements of uncertainty, those communities who survive based on their ability to produce and apply environmental knowledge find the dramatic and possibly irreversible changes disturbing.

Studies correlate market integration to loss of knowledge (Reyes-Garcia et al 2005, Godoy et al. 1998), but others cite cash agriculture, sedentism, and increased primary education

[76] Before HNP was established and banned burning activities within park boundaries, communities visited the glacier once a year to celebrate San Juan, during which community members burned pasture as an offering for the continued fertility of crops and animals.

requirements as factors involved in the erosion of traditional knowledge (Heckler 2000). Market integration for Siete Imperios has perhaps increased insofar as their roads have been recently improved, but the community has been integrating into the city markets for years due to their relative proximity to the valley. There is no doubt that increasing market integration plays a role in the loss or shift of environmental knowledge for the study community, but this is likely compounded by other losses. Older research participants in Siete Imperios reported that younger generations of the community do not value the knowledge associated with farming and animal husbandry practices that has been circulated in the community for generations:

> The people that came before, I tell you they knew these things much better. Now we are all a bit more simple. The older people from earlier times were normal, they ate natural food and were stronger. Now, we eat food full of venom and we are a bit more simple. Even our children are born weaker. (Interview 111)

Several research participants felt this lack of interest precipitated a loss of knowledge about how to sustainably manipulate the environment of Siete Imperios.

While I do not deny that any or all of these play a role in the seeming paralysis of Siete Imperios to address what they clearly view as an impending end, I propose an additional factor. Communities were granted sovereignty at a point when the Peruvian economy was rapidly deteriorating. Hacienda owners had been displaced due to the Agrarian Reform, and with them went seed supplies, animals, expensive agricultural inputs like fertilizer and pesticides, and equipment. Income from selling agricultural surplus was dedicated to repaying the agrarian debt and community members report seeking out external support for the purchase of necesssary agricultural supplies. Meanwhile the valley was full of technical experts and foreign aid oriented towards the rebuilding after the devastating earthquake and landslide of Yunguay. The availability of aid and influx of “experts” during the legal wrangling of newly established communities created an atmosphere of inadequacy among community members as to their own abilities to solve problems. Those few research participants who considered that there might be a solution to glacial loss and water availability (instead of straightforwardly predicting "the end") usually expressed feelings of inadequacy about contemplating what these solutions might look like. These respondents claimed we needed engineers, experts, and funding to determine what could be done.

The incorporation of multiple systems for environmental knowledge and even predictions does not need to be detabilizing (Roncoli et al. 2002). Farmers in Siete Imperios are clearly able to incorporate external expertise and knowledge into their own frameworks. Considering the effort and produce lost to changing patterns of rainfall and frosts, most residents of Siete Imperios are open to seeking out alternative sources of information, but are hestitant to entrust their harvests to external systems. The problem presented is that "some types of knowledge have a lot more ideological weight than others because of the power they signify and the resources they embody" (Roncoli et al. 2002: 421). This weight coupled with reported feelings of inadequacy in the face of increasing scarcity might overpower the historically rooted mistrust of the state or other external programs and allow communties to become further disenfranchised in the quest for adapation support.

Conclusion

In order to address my final research question, this chapter provides an assessment of vulnerability and adaptive capacity for Siete Imperios in the face of rising temperatures that lead to glacial loss and decreased availability of water. Not surprisingly, the vulnerability of people in Siete Imperios is significant due to their poverty levels, dependence on agriculture, and localized and regional resource pressure. Meanwhile, their capacity for adaptation is high since they have strong social networks and a clear understanding of the potential risks. However, the capacity for adaptation changes with economic, social, political, and institutional shifts. Larger scales of governance also have significant influence on the capacity of a given community to adapt (Smit and Pilifosova 2003, Yohe and Tol 2002, Smit and Wandel 2006, Adger et al. 2009). Individuals are influenced by community movements, community resources and decisions are reflective of larger regional networks, and regional management or capabilities are dependent on larger national financial and other decisions (Smit and Wandel 2006). It is important to remember that even if the community does in fact exhibit a high potential for adaptive capacity, it is still uncertain whether the community will draw on that capacity when the time comes (Vincent 2007). Though the potential capacity in Siete Imperios is high, this

> should not be romaticized at the expense of a realistic assessment of the challenges resource-poor farmers face in coping with climate variability and change. Adaptive strategies may entail hidden costs, not measurable in terms of yields and income, or evenly distributed among household members. Higher yields or profits may be attained at the expense of health and nutrition or by foregoing opportunities for education, leisure, and social life" (Roncoli 2006: 94).

Although the global discourse around "adaptation" and "mitigation" insist that these actions happen in a timely, cooperative, and egalitarian fashion across the world, history and pragmatism suggest otherwise (Orlove 2009). Indeed, throughout the course of my research, most community members in Siete Imperios deny any course of action will ultimately be successful in the face of disappearing glaciers. And in the long term, they might be right.

CHAPTER 8

CONCLUSION

Adaptability is not imitation. It means power of resistance and assimilation.

Mahatma Gandhi

Summary of Results

As the world continues to debate the appropriate responses to climatic changes, the effects of these changes are becoming more apparent within scientific and affected communities. The preceding chapters provide a glimpse into the current and projected challenges faced by a community experiencing rapid environmental changes. These changes are borne of global climatic processes driven by emissions far from their control, as well as more localized political struggles to control declining water sources. The principal consequence expected from climatic changes in arid highland landscapes of Peru is increasingly irregular water availability due to changing rainfall patterns and glacial retreat. Communities living in the region are acutely aware of the consequences of climatic changes, particularly glacial retreat, and feel overwhelmed by the implications of this potential loss for their water-dependent livelihoods. Meanwhile, projected water scarcity has led to increasingly complex political negotiations over control of the resource. These political negotiations result in constructed scarcity since increasing diversions meant to exert more control over meltwater decrease the available water across the various delivery systems. Both the projected and constructed scarcity exacerbates historical tensions between agropastoralist communities who are heavily dependent on seasonal glacial meltwater and government entities that prioritize economic interests. The complex physical and political environments surrounding water management are the main factors exacerbating the vulnerability of rural highland communities to climatic changes. Traditional communal governance of land and resources among rural highland communities in the Callejón de Huaylas are crucial to the adaptive capacities of these populations in the face of climatic changes; however, the underlying cooperation necessary for the maintenance of these structures can be compromised by inequalities and insecurities that result partially from ongoing environmental changes. In the following chapter I summarize the major findings for my research questions, discuss the theoretical contributions of this dissertation, and lay out directions for future research.

Environmental Change in Siete Imperios

My first research question aims to understand the connection between water availability and environmental changes. This research documented a clear understanding on the part of community members about glacial changes and the connectivity between glaciated peaks and river water levels, which in turn determines the water availability throughout the community. Scientifically, glacial loss, the ratio of glacial meltwater contribution to streamflow, declining glacial contributions, and changing patterns of rainfall are all well documented (see Chapter 1). Members of Siete Imperios do not have direct relationships with the scientific community in the Callejón de Huaylas, but are indirectly informed of these scientific accounts through radio programming and occasionally by newspaper coverage. However, interviews and focus groups with research participants in Siete Imperios show that most knowledge around glaciers and water sources develops from direct interaction and observation. As I have discussed, the community of Siete Imperios lies only kilometers from the edge of the Copa Glacier. Copa and other nearby peaks are visible from most parts of the community. All of the water sources in Siete Imperios are tied to the glacier in one way or another. While rivers, canals, and springs are directly connected to glacial meltwater, impending rainfall is often heralded by a change in the appearance of the glacier. Beyond connecting the various forms of water to the glacier, or perhaps as an element of this connection, members of Siete Imperios often commune with the glacial ice. In the past more than today, the glacier is a scene for social visits and as a source of ice for the community. While pasturing animals at higher altitudes and groups of children or women would visit the glacier to collect ice for making *raspadillas*, the Andean snow cone.

Siete Imperios is responsible for maintaining the network of canals that divert meltwater from the two rivers whose headwaters are at the base of the Copa Glacier. When Siete Imperios was established following the Agricultural Reform of 1969, the first act of community members was to improve and extend the rustic canal used by the hacienda before them. Their canal begins in the *pampa* above Siete Imperios just at the border of Huascarán National Park. Through this construction and routine maintenance of the canals, the connection of glacial meltwater and river flow could not be better understood by those living in Siete Imperios. Recently, as discussed in Chapter 4, a potable water system was constructed for Siete Imperios and the city of Marcará which taps these rivers at their headwaters and pumps the water underground to a series of pumps and pressure-breaks that allocate this water to the individual household pumps and household taps in Marcará. Participants in Siete Imperios observe that this system, while important both for the health of the community and its idea of development, also affects the amount of water in the meltwater-fed rivers and therefore in the canals that provide water for irrigation and livestock (and in some cases are still the source of water for families that do not have potable water taps). The changes in flow due to physical shifts and infrastructure improvements leave highland farmers applying traditional knowledge to systems not only changed by climatic variations but also disrupted by increased diversion of glacial meltwater.

Another notable source of knowledge about changing glaciers and available water is the Adventist church. Leaders of this church in the community teach about the science of climate change and the predicted effects to Siete Imperios and the region in general. However, the central tenet of this church is that this world is and will continue to be destroyed by the non-believers and there is nothing anyone can to do save it because it must be destroyed in order for God to create a new, better world for the believers. The Adventist church does have a significant following in the community, though most other members of Siete Imperios call the Adventists "liars" since they have wrongly predicted various dates for the end of the world. The inability to affect or reverse such significant environmental degradation found in Adventist teachings is echoed in Catholic messages and also in the elements of Andean cosmology, as referred to by research participants.

Negotiating for Control of a Resource

My second question required the analysis of interactions over water within the Callejón and between regional actors and national entities. This analysis began with the legal frameworks affecting water rights and management. The passage of the *Ley de Recursos Hídricos* (LRH) occurred during my fieldwork tenure after 15 years of debate. This law takes steps to recognize the plurality of uses and users within watersheds and to realign management from political boundaries to watersheds with nested management units. However, many feel that the LRH precedes, and permits, further privatization and the continuing paradoxical pattern of "centralized decentralization" and "water for all" with limited rights. Since this law was still being implemented as I left Peru, the full implications of how this law will affect Siete Imperios and the Callejón cannot be commented on here. The perceptions of various Peruvian scholars however, claim that the LRH is following Harvey's "accumulation by dispossession" model, where neoliberal governments ensure resources rights and access to economic interests, usually in the form of private investment, at the expense of citizen resource rights (Harvey 2003, 2007; Urteaga 2009, Panfichi and Coronel 2010). For these scholars, this motivation explains the empty language of "integrated, participative, and multi-sectoral management" when the law clearly maintains a high degree of centralized control with only nominal representations by sectors or citizen groups.

Given the trends towards privatization of water throughout Latin America in recent decades, Peruvian citizens have been in a relatively sustained vigilance regarding their own water rights. Fears of privatization have again been roused surrounding the passage of the LRH. Among residents of Siete Imperios, detailed privatization fears were not expressed in the majority of interviews, however, concern was evident within the community administration. I was denied access to community documents regarding water use and management based on fears that I would, directly or indirectly, contribute to privatization efforts by publicizing management activities. In addition to the administration's concerns, there were a handful of residents that mentioned specific concerns in interviews. These residents mentioned instances of recent or ongoing struggles for rights within the valley. The most often cited case was the struggle over control of irrigation water between two nearby communities where the conflict was resolved by implementing a pay per irrigated hectare system. Other residents cited the ongoing strike *campesina* communities are holding against Duke Energy over control of Lake Parón water levels; a case which is widely discussed on radio programs.

Conflicts like these among communities for access and between communities and other economic interests will be the exacerbated by climatic changes that decrease physical availability of water and the subsequent added pressure on communities, government and industry competing for more control over the declining resource. Instances of conflicts have risen since the introduction of the LRH. While most conflicts are subsumed under a general socio-environmental matrix, several Peruvian scholars have argued that nearly all of these are about water specifically. Conflicts over resources in Peru do not necessarily reflect a scarcity, but instead are the way marginalized groups vocalize their disapproval of the "open position the state takes in favor of mining in some cases and, in others, the agro-industrial sector or potable water businesses" (Urteaga 2007: 73). Safeguarding water rights for subsistence uses against corporate interests is a primary concern for communities in the Callejón, but unfortunately the LRH does little to ensure that the rights of highland communities will be held up against commercial interests in the resource. As it stands, the LRH has only created an organization to resolve conflicts at the national level. Due to the tendency toward centralized government in Peru, neither the political backing nor the funds are available to create watershed-level bodies that could hear and justly rule on disputes in the future. With the implementation of the LRH, communities like Siete Imperios will be increasingly marginalized from decision-making and planning for the allocation of and rights to water. Their rights to water for domestic and livelihood activities will not be prioritized against economic interests as the resource decreases.

Current political positioning, with the help of deep-seated historical memories, paint conflicts over resources, in a negative, sometimes overtly racist light. This is particularly the case when indigenous communities are involved. Partisan campaigns create the image that these conflicts are due to the backwards, anti-development, rebel-without-a-cause nature of indigenous peasants (Urteaga 2009). These concepts are often used by “authorities” to perpetuate existing systems of inequality while obscuring the structures of domination. For example, the former president plays a leading role in this image making, accusing communities of holding potentially productive land hostage from private investment while expecting government welfare. Highland communities are also represented by government representatives and environmental scientists as being bad resource managers, wasting water because of a lack of knowledge about the fragility or limits of the resource. These types of representations have harmful repercussions for the authority of community leadership within Siete Imperios and in district or regional negotiations, as well as negatively influencing the public perception of highland populations.

Vulnerability and Adaptive Capacity

Finally, I carried out an assessment of social vulnerability for Siete Imperios through a qualitative exploration of their exposure, sensitivity, and adaptive capacities to changing water availability as an element of climatic changes. For this assessment, temperature shifts are used as the proxy by which to measure vulnerability. Further temperature increases associated with climate change will exacerbate glacial loss, which will affect water availability for water-dependent highland communities whose main livelihood stems from agropastoralism. The community has significant exposure and high sensitivity to temperature increases and has experienced continual exposure to upward trending temperature fluctuations since at least 1940 (Vuille et al. 2008). This continual exposure exacerbates the existing sensitivity of Siete Imperios. The degree of existing sensitivity is due to the lack of flexibility within the livelihood systems of the community. While many households participate in market-centered activities and some even operate entrepreneurial enterprises, the majority of efforts in Siete Imperios go toward subsistence activities focused around agricultural fields and animal husbandry. These agropastoralist efforts are directly affected by temperature shifts.

Though the livelihood strategies of Siete Imperios determine its sensitivity to climatic changes, other factors influencing vulnerability are economic wellbeing, health, education, governance, and resource pressure. For the factors covering health, education and governance services the community has been taking steps to improve these services in the past decade. However, there continues to be different level of access among households and sectors within the community. Economic wellbeing, including the lack of livelihood flexibility discussed above, governance issues stemming from political marginalization, and environmental degradation due to resource pressure are factors that negatively influence the vulnerability of Siete Imperios. Arguably, these are the factors most connected with, and thus influenced by, larger scales of political and social engagement. Increased integration of politically marginalized groups into a centralized government system could exacerbate certain factors of vulnerability. If a society or system is marginal to the centralized government then that system is not as dependent on the state's knowledge or resources. Without depending on state's resources, which are coupled with limitations and restrictions, the inherent ingenuity of Andean systems has a much greater chance of creating a range of potential responses. This argument is central to the assessment of adaptive capacity for Siete Imperios, which can mediate vulnerabilities. Fundamentally, adaptive capacity is about governance and is gauged by the power that actors and their social networks have to make to implement management decisions. Adaptive capacity can be determined by the range of available adaptation options, access to resources, relevance of critical institutions and decision-making authorities, social capital, risk spreading processes, information management, and the perception of risk.

Though information regarding climatic changes is wide-spread and based largely on individual observation and experience, potential adaptations to these observed changes are less clearly recognized. Most community members do not feel there are options for long-term adaptation and those who do feel community resources are inadequate for such tasks. The availability of resources, from within the community or from external sources, for non-subsistence ventures is minimal. The productive relationship with the district center could change and initiatives and resources from external institutions (mostly NGOs) for adaptation are still in pilot stages and have yet to make recommendations for adaptation options or funding mechanisms. Community decision-making is participative and highly responsive; however, regional governance entities and NGOs exhibit a significant bias against communal management structures, critiquing them for the "careless management" of water. Because of this negative bias, the knowledge of communities is often discounted and not always viewed as a resource for adaptive strategies. Social capital and risk-spreading processes are institutionalized within the community, though the reciprocal nature of these systems is shifting to reflect greater market-integration. The consequences associated with glacial loss and related decreases in water availability are widely recognized by the community members of Siete Imperios, but when asked how they will respond, few respondents had an answer. Many individuals felt there is nothing that can be done about impending water problems because they are the result of natural phenomenon. Others felt overwhelmed by the changes due to religious or cosmological beliefs. A small group of interviewees felt there were potential answers; however, they did not feel as though the required expertise to implement a response to climatic changes existed within the community.

Conclusions of the Research

The community of Siete Imperios is undergoing unprecedented change socially, environmentally, and politically. Though members of Siete Imperios do indeed feel overwhelmed by the ongoing loss of their water source, physically and politically, I do not mean to imply or perpetuate the idea the people living in this community are merely passive entities without agency, ingenuity, entrepreneurship, or political savvy. While many external forces have influenced the organization and trajectory of highland communities in the Callejón de Huaylas, it would be wrong to presume these communities did not interact with these forces in an attempt to maintain authorship of their future. Indeed, people of the Andes are known for their effective and frequent use of strikes and protests to draw attention to perceived injustices and are able to create significant barriers, physically and politically, until they are heard. During my time in the Callejón, I lost count of how many strikes moved through the valley, each with a distinct tone. These changes are drawing the focus of farmers in Siete Imperios toward many possible futures. The seeds of these possible futures are present in newly implemented infrastructure projects, experiments with agroforestry, considerations of new migration patterns, public planning debates, casual conversations, and in the visibly changing landscape itself.

During my fieldwork I witnessed several ways in which the community was reorganizing itself in order to better manipulate the political frameworks in which it exists. Most significant of these, in my opinion, was the ongoing effort to change their demographic categorization in order to receive a general budget from the government, instead of funds designated for a specific project from the district budget. As the law stands, "in order to fulfill its functions and provide municipal services they are entitled to, the law provides that municipalities receive from towns, provincial and district municipalities, a percentage of its own resources and /or those transferred from the state;" however, this seems not to be the case in Siete Imperios (ONPE 2007: 11). The authorities in Siete Imperios were implementing a series of projects in order to be *considered* as a demographic unit that would be able to elect a mayor and have its own budget. These projects included installing electricity, potable water, implementing a sanitation system and establishing an urban *centro poblado.*[77] In order to establish the *centro poblado*, the community has divided the land just west of the main plaza into small plots just big enough for a house. One plot was then given to each household living outside of Centro I or Centro II, which as discussed in Chapter 4, are relatively close to the main plaza of Copa Grande.

Figure 30 Main road passing through newly urbanized area. Photograph by author.

[77] An urban *centro poblado* is where at least 100 houses are grouped together with streets and plazas (ONPE 2007).

Other than aiding Siete Imperios in being considered for its own budget from the central government, establishing this urban *centro poblado* serves several purposes for the community. By providing those families living farthest from Copa Grande plots in the newly urbanized area, these families are able to access electricity, potable water and sanitation systems that do not always reach into the topographically trickier sectors. This access is beneficial to families (although for some there is added labor of traveling between centralized housing and agricultural plots) but also the community is able to show that more of its membership has access to these services. By providing these households with additional plots, the community is also allowing families with many *convivientes* to move the *convivientes* into the urban plot (though they are still farming the same amount of land as urban plots do not have associated farm plots). This urbanization also allows the community to count additional households since previously *convivientes* were counted as part of their parent's household. As one community official explained, if they can increase their population, they can prove they need additional water shares when water becomes further controlled and more tightly managed like in nearby communities. If the community successfully obtains recognition by the government and a portion of district funds, this will provide necessary capital to invest in future water reservoirs or other projects deemed necessary by the community and thus provide a degree of autonomy from the engineers and experts who would otherwise control the special project funding.

Another significant reorganization within Siete Imperios is the conversion of several hectares of land into tree plantations with assistance from PRONAMACHCS.[78] PRONAMACHCS works with Siete Imperios to develop forestry management practices, build

[78] The establishment of communal plantations are financially and technically supported by the Ministry of Agriculture, through PRONAMACHCS, who encourage this style of reforestation an ongoing strategy for climate change mitigation (through carbon sequestration, water capture, and erosion reduction) and livelihood diversification of highland communities through the sale of matured trees (PRONAMACHCS 2007).

Figure 31 Government-funded nursery in Copa Grande. Photograph by author.

nurseries, and plant seedlings (Figure 31). The eucalyptus, pine, and fruit plantations are designed to be harvested upon maturation and sold as a way to support the community while providing watershed protection. These plantations are managed like canals and other communal resources, all households are expected to participate in the labor required for the plantations in exchange for a portion of the proceeds. The administrative committee is charged with advertising and negotiating sales of mature stands. This process has the potential for creating conflict if the community does not feel the president is being transparent in his dealings with the plantations. The few community records that I did have access to were almost entirely dedicated to the management of the various communal plantations all in various stages of maturation, particularly to the negotiations of price. Accusations of corruption were being levied against the current president as I was ending my fieldwork due to discrepancies between the expected and actual price of a particular strand of eucalyptus. In addition to farming or raising animals, families are also growing specialty crops exclusively for market, converting some of their household plots into trout hatcheries and small, individual tree plantations, and seeking local wage labor. Some of the more prosperous families are responding to the decreasing productivity in the fields by sending children to live in cities to work or even to continue their education. The continued success of the tree plantations and ongoing experimentation with market oriented strategies may help buffer households as agriculture yields and water availability further decline.[79]

Figure 32 Holes for seedlings in preparation of communal planting faena. Photograph by author.

[79] Some controversy exists over whether non-native eucalyptus trees are appropriate for the region as the extensive and fast-growing root systems of eucalyptus trees consume large quantities of water.

These projects are related to the environmental changes reported by Siete Imperios. Reorganization of community membership is said to help gain more political sway at the district level for future water management and tree plantations are meant to increase income diversity while providing erosion control and thereby improved ability to capture precipitation. That these efforts are focused on short- or medium-term outcomes illustrates the disconnect between short- and long-term conceptualizations on the consequences of climate change for community members of Siete Imperios. In the short-term, disruptions of water flow, problems with neighbors, and fears of privatization are the result of social or political negotiations. These short- and medium-term negotiations over resources have been a central element to highland life in the Callejón since before the Spanish conquest (see Chapter 3).

In contrast, the longer-term consequences of glacial loss are reported to be beyond the adaptive ability of the community, or any other entity. While the community clearly describes its agency with regard to ongoing water disputes or negotiations, for example, “we will fight,” the response to what is perceived as larger natural processes of glacial loss and environmental change is decidedly less clear. What explains the disconnect between the short- versus long-term changes in water availability? Longer-term changes related to glacial loss are conceptualized differently. While short-term availability issues are a result of political maneuverings, long-term decreases related to glacial loss are considered to be part of a larger natural or cosmological cycle in which humans have little, if any, agency.

Theoretical and Programmatic Contributions

This research contributes to ongoing scholarship within the theoretical trajectories that guided this dissertation both theoretically and programmatically.

Scaled Politics of Knowledge

Given the large degree of uncertainty surrounding how climatic change scenarios will unfold, and the difficulty ascertaining when and under what circumstances adaptation activities occur, this case study contributes insights toward both lacuna. The knowledge, perceptions and concerns around water availability and changing environmental conditions documented through my research ground scientific work on such changes throughout the Callejón. Though many scholars have shown the importance of local or indigenous knowledge for environmental planning (e.g., Lansing 1991, Zimmerer 1996, Olsson et al. 2004, Agrawal 2005, Ribot and Larson 2005), attempting to blend various forms of knowledge (i.e., scientific and non-scientific) has been met with resistance (e.g., Berkes 1999, Agrawal 1995a, 1995b). This is due more to power relationships, political agendas, and relations to (dependence upon) resources in question than the validity of the knowledge itself (Berkes 1999).[80]

Specific to this case study, blending scientific and local knowledge will require addressing deep-seated tensions between the entities expanding and managing scientific studies of climatic changes in the region and those communities who are experiencing these changes (see Chapter 3 for a discussion of how these tensions have evolved). One manifestation of these tensions can be found within NGO and government literature that often argues for a "lack of adequate culture" around water due to a "lack of care and inefficiency of use" and "poor awareness of the fragility of the resource" (IPROGRA 2008: 12). My research joins the response to these claims and assumptions that indigenous agropastroral communities "do not have an adequate culture" around water and must be educated how to sustainably care for water. Instead, I argue that that institutional structures imposed on communities through legal frameworks or by

[80] Agrawal (1995a) points out that even attempting to make a distinction between these approaches is pointless since even philosophers of science have not developed an appropriate criteria to defined science as opposed to nonscience.

economic interests has diluted or destroyed any traditional or local culture that may have existed around water. Further, community members in Siete Imperios are acutely aware of the fragility of water resources and are concerned about the increasing environmental pressure on water resources. Anthropological work is uniquely suited to show that there is a significant amount of awareness of change and concern for future management. This is an initial step in the Callejón de Huaylas for blending the various knowledge sources in order to better understand the nuances of localized climate change and to determine truly resonant adaptation strategies. Current scientific studies, while more thorough due to certain historical circumstances than other vulnerable mountain regions, are still unable to capture specific variations in the many microclimates of the Callejón, nor are they able to monitor all of the glaciated peaks. Communities living in the foothills of these glaciers, like Siete Imperios, routinely observe the weather and the glacier. Local observations on the part of communities throughout the Callejón could significantly improve regional data and therefore projections of climatic changes. This dissertation can show the knowledge residing in communities and the possibilities for future cooperation in a way that is approachable for scientists and government officials, who have long-standing prejudices to what they call “ancient customs” that they do not understand. In my own interactions with scientists and officials during my fieldwork, they were often surprised that communities were aware of glacial loss and especially that they connected it with future scarcity.

Apart from its emphasis on valuing multiple knowledge about climate change, my work also serves as a contemporary case study of Andean livelihoods at a time when they are not only being transformed by national and international conservation and development agendas (Bebbington 2000, Zimmerer 2006), but also rapid environmental changes linked to climate and the politics that accompany them (Bryant 1998, Young and Lipton 2006, Orlove 2009). A significant contribution of this dissertation is showing how environmental knowledge must be explored in consideration of the scaled political and social influences operating in a given region. The knowledge of ongoing changes and consequences reported by members of Siete Imperios is closely tied to the arena in which they are being expressed, or the audience they wish to reach. Short- and medium-term actions are aimed at regional government institutions and largely revolve around reorganizing the community structures to appear more in need or deserving of resources. Relative need plays a significant role in decisions regarding funding for service improvement, which in turn, as I have shown here, influences the availability of water for the district. Without attending to issues of scale, particularly hydrological scales, projects aiming at improving services for one area can exacerbate resource pressure for other areas. The government tendencies of restricting rights in the face of environmental degradation will exacerbate social inequalities among families and between community groups sharing a resource. Social inequalities within a community group will further compromise the faltering communal structure of the community, which is the strongest determinant of their adaptive capacity.

This research documented the current utilization of various scales of knowledge to understand and act on climate change. The true value of this research will come as it is able to be compared with similar questions among these communities in future years as the glaciers continue to recede and water becomes insufficient. How will the knowledge of glacier and water flow interactions have developed? What new actors will have arrived in the region and what motivations will they have? Will they be attempting to circulate new or different knowledge claims, seeking to negotiate water claims with communities or proposing adaptive activities? How will the range of accepted responses have changed?

Vulnerability as Legibility

Research centered on responding to climate change invokes a familiar critique among anthropologists. Vulnerability and adaptation are very much part of the dominant discourses surrounding the "crisis" of climate change. These concepts are utilized largely by national and international interests, which tend toward "institutional deafness," becoming less willing to accept knowledge claims or theories outside of dominant discourses as they gain momentum (Rappaport 1993: 300). There is significant concern, echoed by both scholars and communities, that such widespread institutional use of these discourses illustrates "the progressive envelopment of environmental movements within institutions of local, national, and global environmental surveillance and governance" (Brosius 1999a: 37). Projects of "legibility" have been undertaken by state-level institutions in Peru since before the Spanish arrived; Incan state institutions are indeed praised for such statecraft (Scott 1999, Wernke 2007). National projects associated with vulnerability assessments and adaptive planning have the potential effect of making the "vulnerable" communities more visible and in turn susceptible to exploitation by extra-local economic interests, interests that abound and are privileged by the neoliberal government of Peru.

Assessments of vulnerability and adaptation could easily be viewed as additional instruments of development discourse, which "has created an extremely efficient apparatus for producing knowledge about, and the exercise of power over, the Third World" (Escobar 1995: 9). Seemingly innocuous plans for reducing vulnerabilities to climate change and facilitating adaptation thus sometimes skillfully manipulate the discussion away from potentially political aspects or moral arguments surrounding such plans, and toward increasing the effectiveness of services through central management schemes (Brosius 1999a). State-influenced projects that aim to reduce vulnerability through poverty alleviation or increasing the availability of water "can end up performing extremely sensitive political operations involving the entrenchment and expansion of institutional state power almost invisibly, under cover of a neutral, technical mission to which no one can object" (Ferguson 1994: 256). This is particularly relevant for the delivery and management of water resources among the fears of privatization and distrust of centralized state control in Peru.

Beyond their work in state legibility projects, vulnerability assessments can fall into the old trap of viewing the vulnerable as passive (Tschakert 2007). Many assessments discuss vulnerability and the adaptive capacity of a group through external indicators without exploring the knowledge and adaptive capacity of the specific community at risk. Tschakert argues that vulnerability concepts create victim narratives for affected communities. This victimization tends to downplay accumulated experience, instead focusing on future climatic changes or extreme events that likely exceed the current adaptive range. The tangential roles assigned to farmers in most adaptation planning (if they are included in planning activities at all) reflect this bias. Tschakert argues for social vulnerability approaches that go beyond effect-driven sectoral adaptation research to embrace components such as well-being, livelihood resilience, self-protection, and social capital by focusing on adaptive capacity and resilience rather than passive vulnerable victims.

An element of this critique is whether vulnerability is as directly linked to marginality as many suggest. An argument could be made that if a society or system is marginal to the centralized government then it is not as dependent on their knowledge or their resources, and therefore has a greater range of responses available to them, which actually decreases their vulnerability to climatic changes. Many of these marginal communities have been operating largely outside the direct dependence on centralized government through several iterations of government and have almost necessarily developed a robust adaptive capacity for change; climate effects are only the latest in a long line of disturbances, “natural” or political. In the Callejón de Huaylas, most communities are just marginal enough to be ignored for any participatory planning but not isolated enough from programs or policies to operate outside of the consequences.

Future Directions for Research

The research presented here is a foundation for ongoing studies of perceptions and responses to climate change in highland Peru. The next phase of this project will expand the case study within the Callejón to include communities in the Cordillera Negra who are already experiencing water stress and additional communities along the Cordillera Blanca. Within these two groups, it would be useful to have communities like Siete Imperios that are not working closely with NGOs or government climate change initiatives as well as finding communities on either side that are collaborating with pilot projects on adaptation. This was initially proposed for the dissertation research, but was quickly recognized to be unrealistic given my time and resources. Future work could potentially be carried out over longer periods, with additional research assistants and resources. Including communities within the more remote and less studied Callejón de Conchucos, the valley to the east of the Cordillera Blanca would provide further depth to the variety of ways communities are being affected by climatic changes and how they view their adaptation options and capabilities. Including a variety of communities will also further illustrate how political and social context differentially influence the perception of risk and the range of responses considered for a population.

It will also be important to follow the implications of the most recent water laws among highland communities. Whether and how privatization fears develop and the degree of their validity will influence the positioning of highland communities with regard to regional and state control of the resource. How will regional and district governments engage with the national itineraries and regulations regarding water management? Will the continued expansion of services requiring additional diversions of the glacial meltwater pass the point at which they are viewed favorably by communities considering their affect on overall water availability?

Another aspect of future research would be to trace the “responsibility” for climate change among the various populations in Peru (e.g., affected indigenous communities, policy makers, scientists). My research is Siete Imperios showed that most community members blamed glacial loss and climatic changes on natural cycles or cosmological timelines. Others cited contamination by mines and cars and a few others blamed themselves because of certain agricultural practices. Who is to blame according to other populations and where might compensation come from? This is a theme I noted during participation in workshops and conferences on water and climate change in Lima attended by scholars, scientists and government officials that I was unable to further explore outside of Siete Imperios. Exploring perceptions of who is responsible for climate changes and consequences would uncover an intriguing blend of rights, victim narratives, and global posturing which ties closely to funding for adaptation and mitigation activities. The “responsibility problem” of climate change is closely tied to the “multiple impacts problem” (Orlove 2009: 30). Communities, organizations, and governments looking for pathways toward effective adaptation to glacial loss or for support from those responsible for the rising temperatures that trigger retreat are all asking the same question: where do we start?

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APPENDIX A

INTERVIEW GUIDE

Demographic Questions:

Are you padronado? Who lives here?

How old are you? How many children do you have? How old are they? Where are your kids?

Where were you born? Where were your parents born? Where do they live now?

How many years of school did you finish? Can you read and write?

How many hectares of chakra do you have? Where? Are they continuous?

What do you grow? Where do the seeds come from?

Do you grow food only to eat or also to sell?

What animals do you have? Where do you pasture them?

Do you have a biohuerta? What do you grow there? Where did those seeds/plants come from?

Do you or your family participate in any paid work? Where? When? How often?

Do you recieve Money from the community or the government? Juntos?

Do you know other regions of the valley, or Peru?

Do you go down to market? Which? When? For what purpose?

How do you get your news?

Are many people moving into Copa? Moving away? Why?

Political Questions:

How is the community organized? [sectors, leaders, work]

Do people live here/own land that are not comuneros? Who are they? How do they obtain land?

When did this happen? Before, ori s there still land to sell? Why is it not community land?

Is there communal work? What is it? How it is decided and carried out?

What projects are ongoing here?

How did Copa Grande/Siete Imperios start as a comunidad campesina?

How was life during the time of the hacienda? How many owners were there?

Is all the land communal? Can you sell comunal land to other people? Is there land here that is not community land? Whose is it?

Who controls irrigation water? Where do they live? When do they decide (each year/meetings or when necessary)?

How do they decide the rules? What are the rules? How do they decide who gets water?

Do you recieve irrigation water? When and how much?

Is it sufficient? Is there more or less water now for irrigation?

Are there problems (with families, other towns, Marcara)? If ther eare, what happens?

Do oficial from Marcara/Carhuaz/Ancash play a role in water management here?

Environment Questions:

Has the glacier changed? How? Why? What will happen? How do you know it is changing?

What did it look like when you were young?

Did you visit it regularly? Do you visit regularly now?

What time of year did you go/why at this time? Why did/do you visit? Why/how has this changed?

When did you begin to notice the changes?

What meaning does the glacier have? Do the glaciers mean something to you?

Does it make noise? More now than before? Different noises?

Are there different parts to the glacier?

What did your parents or grandparents say about the glacier?

Has the vegetation changed since the glacier has receded? Are there new or different trees/bushes growing?

How do you feel about how it looks now with less glacier?

When do you think the glacier recession will cause problems? 100 years, 50, 20, now?

Do you think they will disappear completely or they will be smaller?

What does this mean for future generations?

Do tourists come to visit this glacier? Does the glacier recession cause problems for tourism?

Do you think the change is part of the environment or is it caused my man?

How does pollution interact with the glacier? Does that pollution go into the water as well? Can you tell?

Is the glacier more dirty than before? Less white?

Do people here talk regularly about the changes in the glacier?

What do people say who come to visit Copa that lived here before? Do they notice or comment on the changes?

Were/are people afraid of the glaciers?

How does the weather change throughout a year?

Has the weather changed during your lifetime? Have teh rains changed? Frosts? Sun? Temperature?

How is the community changing? Agricultural system? Rainfall? Quantity of water? Population?

Are other aspects of life in Siete Imperios changing?

These changes, how are they affecting you in Copa Grande?

Water Questions:

How do you use water?

Where does the water you use come from?

From where did you get water before (potable water installation or canal improvement)?

Have you noticed changes in the water?

Does it taste different, have a different color, or more or less sediment?

Was there more water before? Is there more now? Why?

Who else uses this water? Above? Below?

What will you do when the water goes?

Will there be more fights among people in Copa or with the district when water goes?

What can people or organizations do about the lack of water?

What can Copa Grande do before the water goes?

How do communities survive in the Cordillera Negra where they don’t have glaciers?

When do you think we will see water problems? In 100 years, 50, 20, now?

APPENDIX B

INSTITUTIONAL INTERVIEW GUIDE

What is happening? What will happen?

Who is working on this? In Peru? South America? Globally?

How long have they been working here?

What is the plan for adaptation/mitigation?

Do you have any maps or reports you could share with me?

What are up the upstream/downstream users of water?

What institutions exist to govern access to water? How does water management work? Do the various institutions/levels of governance work well together?

How are disputes aired and/or addressed? At the community level? The district? The province? Region? National disputes?

What is the nationally legislated water management policy? Does it reach into comunidades campesinos? How? Is it accepted?

How do national and regional government work together regarding water?

Is water included in national climate change documents? How?

APPENDIX C:

DEMOGRAPHIC PROFILE OF INTERVIEWEES

Table C1: Age Distribution

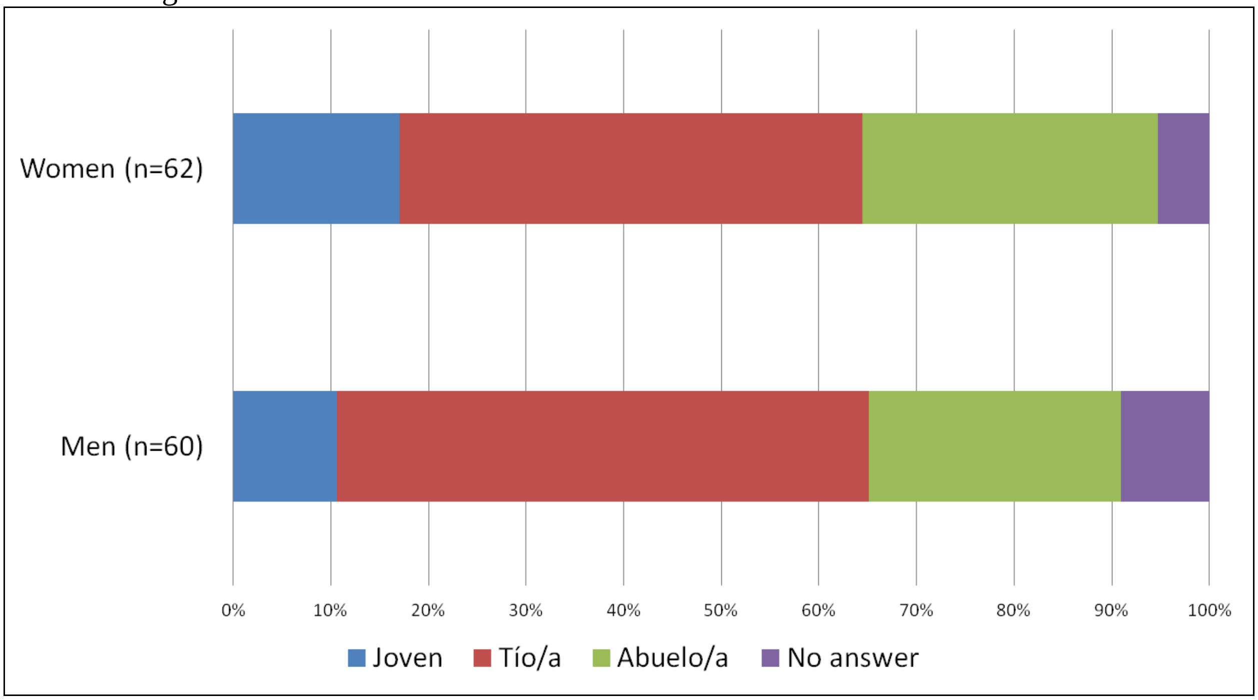

Table C2: Religious Affiliation

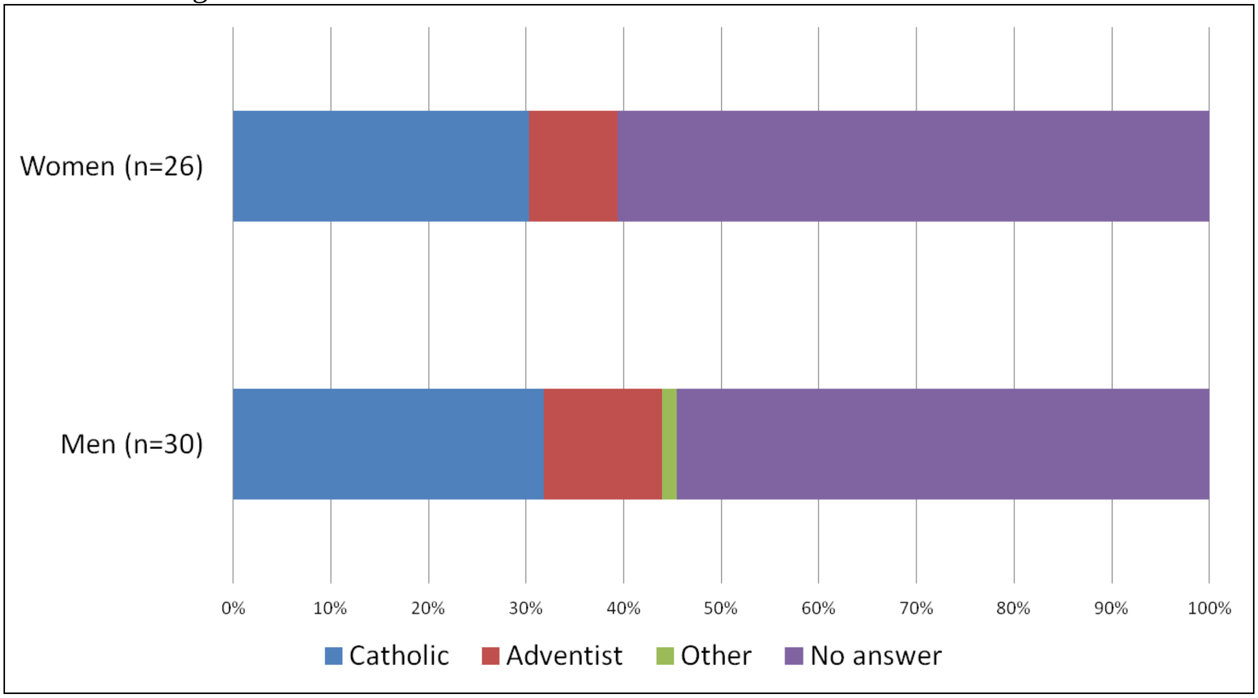

Table C3: Community Membership