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Perceptions of climate change and water governance vulnerability in the Aysén region of Chile

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PERCEPTIONS OF CLIMATE CHANGE AND WATER GOVERNANCE VULNERABILITY IN THE AYSÉN REGION, CHILE

By

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Abstract

While the majority of Chile's intact watersheds are located in the largely uninhabited southern Patagonia regions of the country, the majority of the Chilean population lives in the nation's parched central regions. In the face of recent trends in climatic change, including dramatic decreases in snowpack, diminishing glaciers, and shifts in precipitation cycles and seasons, mountain contributions to local watersheds are predicted to continue dwindling as aridification worsens around the world and throughout Chile. Problems associated with aridification are further complicated by Chile's water history, which has largely revolved around the nation's fresh water caches subject to private claims and ownership under Chile's privatized water market. This thesis presents an exploratory study of perceptions of climate change impacts that was conducted throughout five villages in the Aysén region of southern Chile. The study draws upon field observations and interviews with 30 agro-pastoralist respondents about their perceptions of climate change impacts in the region, with particular attention to the hydrologic cycle, and how those perceived changes and impacts are affecting their rural livelihoods. Additionally, this research explores what agro-pastoralists' experiences securing and soliciting water rights in Aysén have been, including perceptions of and suggestions for Chilean water law reform. A thematic analysis of respondents' narratives yielded themes of helplessness, fear, and perceived benefits. The resulting analysis explores the social and political aspects that are constraining local capacities to prevent, mitigate, and recover from the onset of intensifying climatic changes.

Keywords: Chile, climate change, water governance, vulnerability, agro-pastoralists, perceptions

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Dedication

Este tesis esta dedicado a toda la gente de Aysén, Chile.
Por su hospitilidad y generosidad durante mi tiempo en la region, tienan mi gratitud y amor.
This thesis is dedicated to the people of Aysen, Chile.
For your hospitality and generosity during my time in the region, you have my love and gratitude.

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CHAPTER 1:
INTRODUCTION

Chile has a distinctive physical geography with 4000 km of Pacific coastline to its west and the Andes Mountains as its eastern backbone. As a result of this unique combination of features, the climate throughout Chile varies intensely with geography and latitude; from one of the most arid deserts in the world in the north, to the temperate, glaciated regions of the south. These unique geographic features have resulted in a dispersed and dramatic fresh water distribution, including rivers with headwaters that can be found in the high Andes and flow downhill. These medium-sized basins are largely short and steep, with precipitation and river-flows that increase steadily from north to south (Bauer 2015). The Chilean territory's extreme distribution of fresh water is further complicated by the fact that upwards of 80 percent of the Chilean population lives in urban areas in the arid northern and central regions of the country (Hill 2013; Borzutzky and Madden 2011; Tecklin et al. 2011; Budds 2004).

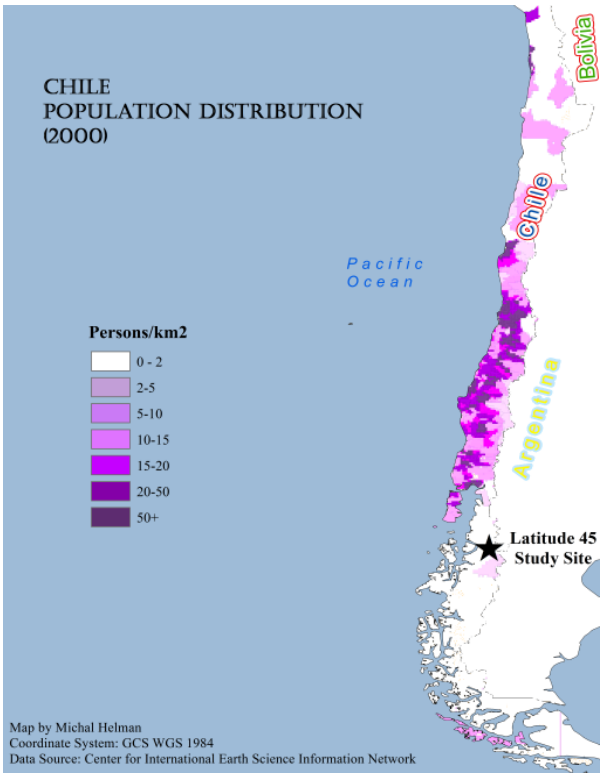

Figure 1. Chile's population distribution map (Map Source: M. Helman, 2015).

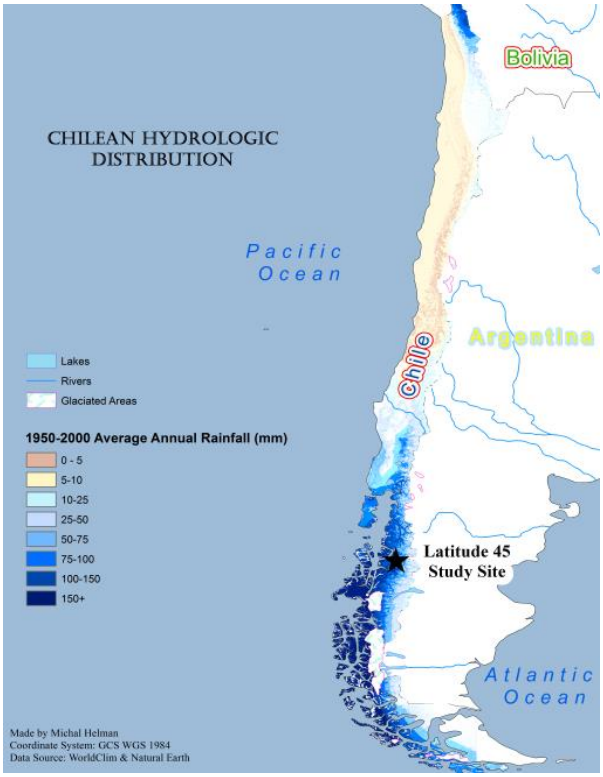

Figure 2. Chile's hydrologic distribution and intensity map (Map Source: M. Helman, 2015).

Climate change is bringing the matchless fragility of water resources into sharp focus, thereby, making water management critical for human livelihoods and all the Earth's diverse biota (Jennings et al. 2009). Poor administration and management of finite water resources is common and will likely continue to "aggravate shortages, increase social and economic disparities, and thereby make water issues a potential source of deadly local and international conflict" (Wiegandt 2008, 3). Chilean water issues have an additional layer of complexity due to the implementation of a national water code in which water is treated as a private commodity (not attached to the land on which it flows) in the free market. This system is likely to produce winners and losers as water resources are stressed by growth and climate change (COMEST 2010). Chilean water law allows for water rights to be bought, sold, and traded on the private market, which often conveys an advantage to those with greater economic and legal capabilities. In the face of continuing climatic instability, availability of water resources is predicted to dramatically decline (Bates et al. 2008; Kundzewicz and Döll 2009).

Anticipated and already occurring water scarcity calls for in-depth analysis of fresh water security and management throughout Chile (Roco et al. 2014; Hill 2013). If the complicated and tangled realities of water resource management are not well understood, it is likely that only those with financial, legal and political advantages, who are actively pursuing their personal interests, will be the victors in controlling the majority of Chilean water rights. The possibilities of water shortages and struggles with water resources must be acknowledged and confronted head on to enact meaningful and equitable reform. The purpose of this study is to provide insights to aid such reforms by conducting in-depth qualitative interviews on local perceptions of climate change and water governance.

Research Objectives

This study was conducted as a part of the Sensing America's Freshwater Ecosystem Risk from Climate Change (SAFER) project in collaboration with the Center for Patagonia Ecosystem Research (CIEP) and Universidad Austral de Chile. The SAFER project's hypothesis is that freshwater ecosystems are sensitive and sentient to the predicted changes in global and regional climates that will produce an alteration of the hydrological cycle. CIEP began monitoring and analyzing the watersheds in the region as early as 2008 and has continued expanding the project since that time. This research has contributed to the SAFER project by capturing local perspectives through interviews with agro-pastoralists in the region of Aysén to determine perceived changes in the availability of water resources, the impact of these changes on the livelihoods of agro-pastoralists, and what actions they might be taking in response to a changing water regime. In accordance with the overarching goals of the SAFER project, the primary research objectives of this study are:

- Identify agro-pastoralists' perceptions of climatic changes in Aysén, Chile
- Identify agro-pastoralists' perceptions of water governance in Aysén, Chile

This research was conducted in order to allow for open discussion with agro-pastoralists about their perceptions and experiences could be utilized in planning future management and adaptation strategies that are both technically and economically feasible as well as culturally acceptable. By fulfilling these objectives, this research increases understanding of the perceived effects of climate change on the local residents of Aysén, Chile. Moreover, conclusions from this study shed light on how water governance is perceived by the agro-pastoralists in this region. This study was accomplished using qualitative methods, primarily consisting of 30 semi-

structured in-depth interviews with agro-pastoralists, which were supported by field observations, and an extensive literature review of Chilean water policy.

Significance of Study

As will be seen in chapter two, agro-pastoralists in the Chilean Patagonia (*pobladores)* have reported seeing changes including: decreased water levels in local watersheds, notable changes in precipitation patterns (change in rainfall patterns and significant decrease in snowfall), substantial decreases in snowpack, a shift in seasons with a specific emphasis on shorter winters, and an increase in overall dryness year-round. Chapter three reveals that in Aysén the water code is weakly enforced and seems to be poorly understood by *pobladores*. The *pobladores* do not always have the rights to the water they use, leaving them feeling vulnerable to the increasingly unpredictable variables such as precipitation, stream flow, seasonal regularity, and land ownership. Vulnerability in the context of this research is defined in two ways for each of the two contexts being analyzed. In the frame of climate change vulnerability, the term is defined in its more colloquial and general sense of being susceptible to harm. In the context of water law, vulnerability is used here to mean "exclusion from and inequities in water governance" (Lynch 2012, 365). The latter definition was taken from a similar study conducted on vulnerabilities, competition and rights of water governance in Peru in the face of climate change. Thhis thesis contributes to the growing body of literature that finds that vulnerability is often greatest in impoverished communities that lack assets and/or abilities to adapt to the onset of dramatic climatic changes (Lynch 2012).

Thesis Organization

This chapter continues with a brief context of the history of the colonization of the Chilean Patagonia as well as an introduction to modern Chilean water law. **Chapter two** sets the

stage for the research with a brief overview of the history of colonization and development in the Aysén region, and includes a summary of the past 70 years of Chilean water law. This short chapter provides the historical context that is important for understanding the significance of the research presented in chapters three and four. The **third chapter** provides a brief overview of climate change and water availability with specific projections for Chile and the region of Aysén. Following this contextual material, I describe the methods and results from interviews conducted with the *pobladores'* on their perceptions of climate change within and surrounding the study area, hereafter referred to as the "Latitude 45 study site." The chapter concludes with thoughts about some of the potential indications from the study results. **Chapter four** consists of a description of the methods and results from research conducted on the experiences of *pobladores'* in soliciting water rights in the Latitude 45 study site, and their perceptions of Chilean water law. In **chapter five** I conclude with a brief summary, followed by a discussion section and recommendations for future research.

CHAPTER 2:

The History of the Colonization of Aysén & Chilean Water Governance

Climatic change affecting the people of Chile takes place within the context of a particular political and economic history. The economic model adopted by Chile in recent decades has been heavily based on the development of natural resources. Without considering the complexity and convergence of social, cultural and environmental variables, natural resources will be in scarcity and an appropriate and effective response will not be in place when it is needed most. Chile's economic model founded on increased development and extraction of natural resources has already begun to transpire into a problem of degraded lucrative ecosystems throughout Chile and as will be discussed in this chapter, throughout the region of Aysén (Gligo 2007). The following section provides a concise review of the relevant aspects of the history of colonization and development in the Aysén region followed by a summary of the past 65 years of Chilean water law history.

Patagonia Colonization and Culture

While there is a widely held perception that Patagonia is a pristine untouched wilderness, in actuality, Patagonia has a long history of human impacts. Humans have been present in this region for thousands of years. However, it was not until the late nineteenth and early twentieth century that human activity became a key player in the state of the Patagonian landscape. Although the Aysén region has the lowest population density in the country (0.8 inhabitants per km^2), the introduction of non-native species and intensive natural resources extraction have left a heavy mark on today's Chilean Patagonia. The changes can be seen most notably through the use of fire to create pastoral lands and subsequent overgrazing. These large-scale historical

landscape alterations have been integral in shaping the present state of the water regime in Patagonia today.

Fire

Beginning in 1870, British, Yugoslav and Spanish colonists arrived in the Chilean Patagonia where they proceeded to execute a large-scale genocide of the native Patagonian ethnic group. In addition to their massacre of the native people, the colonists went on to burn 3,120,000 hectares of native beech forests (Contreras 2007). In light of territorial conflicts with their neighbors to the east, Argentina and Chile agreed upon a slew of treaties between 1899 and 1901. As a result of these treaties and the threat of Argentina taking over uninhabited lands, the Chilean government decided to promote colonization, forestry, and agricultural activities within the Chilean Patagonia (Rodrigo and Oreggo 2007).

In 1928 the Chilean government initiated a movement titled the "Caja de Colonización" or the Agricultural Settlement Fund. This initiative promised free land to individuals who were willing to move to the Chilean Patagonia, clear forested land and convert it to productive inhabited land. The aim of the fund was to increase human presence and Chilean colonies in the region, as well as intensifying agricultural production and potential in the largely uninhabited and highly fertile land (Contreras 2007).

In 1937, Chile began to officially register the lands to colonists who came to settle the region, with the contingency that they clear at least 120 hectares of forest on their land. Many of the first settlers to take advantage of the land grab came from the Argentinean *pampas*[1], and fire was the land clearing method of choice (Contreras 2007). Thus, through the power of fire, the

[1] Lowland region of southeastern South America characterized by mild weather and mostly warm and dry conditions.

land of the Chilean Patagonia was colonized. This is the historical imprint which has largely determines Patagonia's current ecological situation.

Overgrazing

Since its colonization less than a hundred years ago, the steppe of Aysén has been subjected to severe overgrazing processes, with stocking rates exceeding three to four times the lands calculated carrying capacity (Rodrigo and Oreggo 2007). As bare earth becomes progressively more exposed, the problem of overgrazing in Aysén has led to further erosion, allowing an increased drag of soil particles by water and wind, thus slowly catalyzing the decomposition of this fragile ecosystem. Overgrazing has also negatively impacted other facets of the ecosystem such as the genetic diversity of flora and fauna and the fertility of the ecosystem.

Development practices used in the Aysén region in recent history have had many far-reaching and long-lasting environmental impacts, particularly on the hydrologic regime and soil composition of the region. These ecological modifications have facilitated the emergence of less thirsty and more tolerant invasive species and non-native organisms (e.g. *Pinus radiata, Pinus ponderosa, Pinus contorta,* and *Lupinus polyphyllus).* The aforementioned activities (i.e. deforestation, replanting of non-native trees, and overgrazing) have contributed to aridification and thereby reduced economic profitability in the Aysén region (Rodrigo and Oreggo 2007).

The above section summarizes of the modern history of colonization throughout Aysén, Chile and the implications of human settlement and unsustainable rapid development in the region (i.e. destruction of native ecosystem, decreased availability of natural resources, economic

depreciation). The following section delves into the compounding complexity of natural resource law in Chile, with a narrowed focus on water governance.

Modern Chilean Water Code History

With a chief interest in economic growth, the Chilean government has been encouraging the development of the country's natural resources, focusing particularly on the country's southern basins (Rodrigo and Oreggo 2007). The Chilean government initiated this trend by adopting neoliberal[2] policies towards natural resource management that allowed for development of the country's natural wealth in order to build the nation's economic capital. It was through these reforms, which can be traced back to 1951, when Chile's first water code was enacted, that modern Chilean water law was born.

The 1951 code is recognized for its focus on private rights to use of water that is publically owned and publically regulated. Carl Bauer, a leading researcher in Chilean water markets, remarks in his book, a *Siren Song: Chilean Water Law as a Model for International Reform,* the that the 1951 code is most similar to Chile's current water law model (with a few key differences) and compares Chile's initial 1951 water code to contemporary water rights law in the western United States (Bauer 2004). In the 1960's, under the leadership of the center-left reformist government of President Eduardo Frei, the Chilean government implemented a series of policy modifications. The modifications were promoted by then U.S. President John Kennedy under the influence of the Agrarian Reform Law of 1967. These reforms promoted the expropriation and redistribution of large land holdings from even larger private estates to cooperative and collective farms on the same estates (Valdés and Foster 2014). In the early

[2] Neoliberalization defined as a politically guided intensification of market rule and commodification (Harris and Roa-Garcia 2013).

1970's the left wing socialist Salvador Allende took over political power in Chile as the country's president. During his time in power, with the help of his political party the *Spanish Popular Unity Coalition*, Allende attempted to implement sweeping policies of nationalization and government control over the national economy. Allende was successful until 11 September 1973, when under the lead of General Augusto Pinochet the Chilean armed forces took over power in a military coup d'etat. General Pinochet stayed in power for almost two decades, during which time he set out to "radically transform Chilean society, politics, and economy, in the opposite direction from the Allende government" (Bauer 2015, 151). The military government of Pinochet had a vision to join neo-liberal economics with authoritarian politics, both of which were institutionalized in Chile's new Constitution of 1980 (Bauer 2015).

Following Pinochet's new 1980 Constitution came the implementation of Chile's 1981 national water code, in which water rights were converted into a private commodity that could be independently bought, sold, and traded, irrespective of the land over which the water flowed (Budds, 2004). Issues of water quality and environmental protection were grossly overlooked, "left out of the Water Code almost entirely" (Bauer 2013, 4). In his 2013 publication, Carl Bauer asks the broader question of whether or not a free market approach to water is compatible with long-term goals of integrated water management.[3] Bauer ultimately argues that "the Chilean experience shows that the answer is no" (Bauer 2013, 2). Policy oversights and the free market approach of Chile's water code have led to complicated challenges of how to best integrate

[3] Integrated Water Resource Management (IWRM) is defined by the Global Water Partnership (2009,.3) as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems."

sustainable water resource management to ensure that there will be clean water for future Chilean citizens, flora and fauna alike.

In 1988, under heavy international pressure to participate in an open election, Chile held an open vote for president during which the democratic political opposition won against the military government. The following year (in 1989) the opposition, known as the Concertación led by President Patricio Aylwin, was officially voted into government (Bauer 2015). When Pinochet left his position of command, the Chilean military agreed to transfer power to the Concertación so long as the Concertación committed to uphold free-market neoliberal policies, as outlined in the 1980 Constitution. Under these accepted restrictions, the Concertación spent the majority of their time in power trying to consolidate political democracy while keeping true to their agreement by promoting market-driven economic growth[4] (Bauer 2015).

To this day, with the exception of modifications from the 2005 legal reform, the 1981 Water Code is largely sustained to its original specifications. The Chilean court system deliberated the legal reform of the 1981 Water Code for approximately 13 years before finally passing it in 2005. The legal reform to the water code included requirements for improving water rights title information and record keeping by the Chilean national water management agency, the Dirección General de Aguas (DGA), while also strengthening the DGA's authority over granting future water rights. No dramatic or significant overhauling changes were made to the

[4] For a more detailed description of the political debate and Chilean water history from 1992 to 2004, see Budds (2004), Budds (2013) and Bauer (2004). For more information on the 2005 reform see Bauer (2013) and Bauer (2015) for an analysis of water management in Chile since the 2005 reform. Additional relevant resources: Borzutzky and Madden (2013), Tecklin et al. (2011), Hearne and Donoso (2005).

water code, and, rather than attempting to regulate or renovate the existing water law, those changes which were made aimed to improve the water market's current operating efficiency.

The most significant addition that was adopted in the 2005 reform was the introduction of "fees for non-use." These fees are charged to water rights holders for not utilizing their water right to the extent that was recorded in their initial water rights application. The rationale behind the "fee for non-use" charge is that it would act as a disincentive against the hoarding and monopoly of water rights, while also acting as an incentive to give up rights that are not being used so they can be solicited by other interested parties in the area[5] and encouraging productive use of fresh water resources. The "fee for non-use" charge was predominantly pushed in order to deal with hoarding of non-consumptive water rights (e.g. aquaculture and hydropower). Another notable issue with the 2005 reform is that the newly added modification to the 1981 Water Code did not apply to already existing water rights, which account for the vast majority. While this reform was enacted over ten years ago, none of the *pobladores'* whom I interviewed had ever been approached about their use or had even heard of the non-use fee, highlighting the lack of implementation of the newest reform.

While reflecting back on the 2005 reform, Humberto Peña and Pablo Jaeger[6] (the two individuals most responsible for pushing the 2005 reform through the hesitant Chilean National Congress) commented as follows:

> The changes of 2005 did not deal with the deficits that are evident and important today, such as the protection of the public interest after water rights have been

[5] The large majority of water rights in Chile are already solicited with no availability of new rights to be granted.
[6] Humberto Peña was head of the DGA for 12 years (1994-2006) and Pablo Jaeger was the DGA's chief lawyer for eight of those years (1995-2003) (Bauer 2015).

> granted; the aspects related to the functioning of the 'water market'; the sustainability of management of the resource in the medium and long terms in a changing hydrological context; and the issues of integrated water management in river basins (Jaeger and Peña, 2013, .7).

While the 2005 reform attempted to address some of the previous weaknesses of the Chilean Water Code (e.g. lack of DGA authority, no acknowledgement of minimum ecological flow needs) the changes made were modest at best and did not address some of the more fundamental shortcomings of existing Chilean water governance (e.g. no water conflict management protocol, lack of consensus on the "core principles of private property right" and "market forces"). In his final analysis of the nation's newest water law reform, Chilean water law expert Carl Bauer (2015) asserts that the reform ultimately did very little to improve the capacity for integrated water management .

Table 1 Summary of Chilean Water Code & Reform History (1951-2005) (Borzutzky and Madden 2011).

Water Code & Reform History in Chile (1951-2005)
1951 Water Code: Private water rights with strong government regulation
1967 Water Code: Free market in water rights with little government regulation
1981 Water Code: Water is public property that the state can grant private rights to and it is a resource governed by civil law.
2005 Water Reform: Non-use fee implemented, presidential power to revoke water rights, environmental sustainability and minimum flow requirements added, water users' gain official right to form local common interest organizations to manage community water use.

This section presented an overview of modern Chilean water history. In the subsequent section, I argue that Chile's modern economic model has resulted in an imbalanced distribution of undesirable impacts on the economically outranked rural populations of Aysén, Chile.

Inequitable Distribution of Resources and Responsibility

Two central features of Chile's economic growth are the high concentration of wealth and the vastly unequal distribution of income. Rapid economic growth is known to produce environmental and social impacts, known as externalities, which have fallen disproportionately on the poor. Pollution and loss of landscapes, landfills and industrial waste, fall mostly on the most vulnerable communities (Pandey and Bardsley 2015). The Chilean economic model unequally distributes "goods" and has led to unfairly distributed social and environmental impacts. This unfair distribution of negative impacts is also expressed territorially, with rural communities from away from city centers being marginalized politically (Budds 2013; Coleman 2012).

The cornerstone of the Chilean economy is the export of natural resources. The production occurs in the country's more rural mountainous and uninhabited regions, while the payoffs are concentrated in the capital (Santiago) or go to coffers of transnational corporations. The Metropolitan Region of Santiago (RMS) is the center of political, economic and social power in the country. The RMS contains greater than 40 percent of the Chilean population and 50 percent of the Chilean GDP, yet produces only 12 percent of the country's exports. In turn, the RMS produces 60 percent of trash and 50 percent concentrated vehicles. With the load capacity of the basin of the RMS exceeded, this current situation is unsustainable. However, Santiago continues to grow with an annual immigration of roughly 200 thousand people (Pizarro 2007).

By 2025, the population of Santiago is projected to increase by 30 percent, substantially increasing in economic activity and inevitably requiring more natural resources. The exchange is simple: as the basin of the RMS is saturated, Aysén provides cheap natural resources to Santiago, while Santiago exports the environmental impact of their consumption to Aysén. To supply the RMS, the citizens of Aysén, without receiving anything in return, would have to accept the irreversible destruction of unique ecosystems (Pizarro 2007).

This chapter covered the history of colonization and water law in Chile. This rich history spanning the past 100 years has provided a complicated context that has shaped the current water availability and water governance frame within which this study was carried out. The following chapter focuses on climate change projections for the Chilean Patagonia as well as results from a study conducted on the perceptions of *pobladores'* of changes in climate in Aysén, Chile.

CHAPTER 3:
POBLADORES' PERCEPTIONS OF CLIMATE CHANGE & RELATED IMPACTS

Climatic changes are having cascading impacts on freshwater systems all over the world. The effects of climate change on freshwater systems will have profound effect on biophysical and socio-economic systems alike. Water is indispensable in these systems for the simple reality that all forms of life rely directly on access to water. As the hydrologic cycle is presently changing and is predicted to continue changing, it will become critical in the coming decades for freshwater management issues to be handled in an especially mindful manner. One important element that informed water management policies should include is local perceptions of climate change on freshwater systems.

This chapter explores agro-pastoralists' perceptions of climate change and its impacts on their livelihoods in the Aysén region of Chile. In what follows I will briefly outline projections of climate change and impacts on the hydrologic cycle for Latin America and more specifically, Chile and the Aysén region. This will be followed by excerpts and analyses of interviews conducted with agro-pastoralists in Aysén, Chile. The chapter will conclude with a discussion of the implications of the major themes discovered in the interviews.

For this research project I used the method of triangulation, in which data from multiple sources and various research methods are used in the research process (Patton 2002; Woitas 2002). Analysis methods in this research consisted of a combination of a thorough analysis of the available and current literature on climate change research, ranging in focus from as broad as global projections and as narrowly as data available surrounding the Latitude 45 study site. While the literature review provided context, field observations and interviews uncovered rich and unique data that shaped this study's conclusions. The strength of this methodology is that

each data source is used to validate and corroborate findings from the other sources so "that the strengths of one approach compensate for the weaknesses of another approach" (Woitas 2002, 39).

Projections

Latin America

The United Nations Intergovernmental Panel on Climate Change (IPCC) predicts that any negative impacts of climate change on freshwater systems will significantly outweigh any benefits that have been predicted (Bates et al. 2008). Global projections include higher water temperatures and changes in extreme weather events, resulting in more intense floods and droughts, earlier melting and significant reductions in snowpack (Bates et al. 2008). As economic development and populations continue to rise along with changes in lifestyle and expanding water supply systems, these negative impacts are likely to be further exacerbated. These outcomes are anticipated to directly affect water quality by intensifying water pollution (Bates et al. 2008). In a more specific analysis of projected obstacles for Latin America, the IPCC predicts that "the number of people living in water-stressed watersheds is projected to reach 37–66 million by the 2020s." This will most impact low-income communities who do not possess the same access to the necessary resources to adapt to the onset of climate change as high-income communities (Bates et al. 2008).

Mountains are the source of the world's biggest rivers and home to the majority of water held in glacier reserves. For these reasons, the global population largely depends on mountains for fresh potable water. These areas also happen to be especially vulnerable due to their fragile ecosystems and increased incidence of natural disasters (Bates et al. 2008; Kundzewicz 2008; Beniston 2005; Keller et al. 2000). As the global climate continues to change, these

vulnerabilities are predicted to amplify (Bates et al; Kundzewicz 2008; Beniston 2005; Keller et al. 2000). These facts are particularly important for the Andean region of South America.

Most of the metropolitan cities of the Andes heavily depend on high-altitude water reserves such as glaciers and snowpack to supplement their fresh water reserves (Rangecroft et al., 2013). As glaciers continue to shrink and weather patterns become more erratic and extreme, these sources of water are likely to become even more stressed in the face of these continuing climatic changes. These changes will have cascading effects that will impact the rural communities that depend directly on steady and reliable fresh water sources to sustain their livelihoods. Socioeconomic variables will be central to the ability of communities to adapt to the effects of global warming, leaving rural communities amongst the most vulnerable social groups that will be affected the worst as they are the most ill-equipped to deal with the impacts of climate change" (Rangecroft et al. 2013, pp.854). As watersheds in the Andes become increasingly stressed, the need for long-term solutions with consideration to the livelihoods of people living in these regions will be necessary.

Chile

In conjunction with the Organization for Economic Cooperation and Development (OECD), the National Climate Change Office at the Chilean Ministry of Environment performed a focused analysis of Chile in 2012, identifying four central vulnerabilities that Chile is anticipated to face in the coming decades. The four climate projections were: (i) an increase in temperature throughout the entire country of between 1-4ºCby the end of the century, (ii) precipitation pattern shifts from north to south, (iii) dramatic glacial retreat, and (iv) decreased snowpack in high altitude mountain areas (Muck, 2012). While climate change projections contain uncertainties, Chile can expect significant impacts on the hydrologic cycles of the glacier-swathed, predominantly mountainous southern region.

These troubling projections are reflected in Chile's "National Climate Change Action Plan," published by Chile's National Climate Change Office at the Chilean Ministry of Environment (CONAMA). The report candidly acknowledged that not only will climate change have a dramatic impact on water resources through alterations in the water cycle but will also require considerable change in water control and management (Muck 2012). Additional stressors such as projections of steady population growth for Chile imply unavoidable increased pressure on anticipated decreases in water supply (Vorosmarty 2000). Water stress has already been documented in the densely populated northern and central regions of Chile (Roco et al. 2014; Muck 2012; Vicuña et al. 2011). The water stress experienced in the large urban areas of central Chile will most likely require accessing water from the country's freshwater-rich Patagonia region.

In their most recent national climate change action plan, the Chilean government explicitly acknowledges that:

> Knowledge about water systems is key to planning and managing priority sectors of our economy, such as agriculture, forestry, energy generation, population health and the development of infrastructure, among others. The growth of these sectors is influenced by potential adaptation options that could be made available in the future. Furthermore, an assessment of the impact of climate change on water resources will provide information for subsequent assessments of other sectors/systems. For this reason, maximum priority must be given to the matter of water resources in Chile. A detailed assessment must be made of the impacts of climate change on these resources and the adaptation measures necessary to address them have to be defined (Muck 2012, 42).

This excerpt unambiguously expresses the necessity for more in-depth assessments on the impacts of climate change on freshwater systems and the subsequent implications on anthropological systems.

Substantial changes in water resources, likely resulting from climate change have already been documented. Extreme weather events have occurred in Patagonia such as precipitation 58% above the baseline average during February of 2009 (Leidich, 2008). Furthermore, there is evidence that the ice mass in the Patagonia region has been decreasing over the last few decades, with both the northern and southern Patagonia glacial fields being gravely affected (Letteh 2014; Davies and Glasser 2012; Dyurgerov and Meier 2004; Lamy et al. 2004). Figure 3 below shows the dramatic decrease in cumulative mass balance of Patagonia's glaciers.

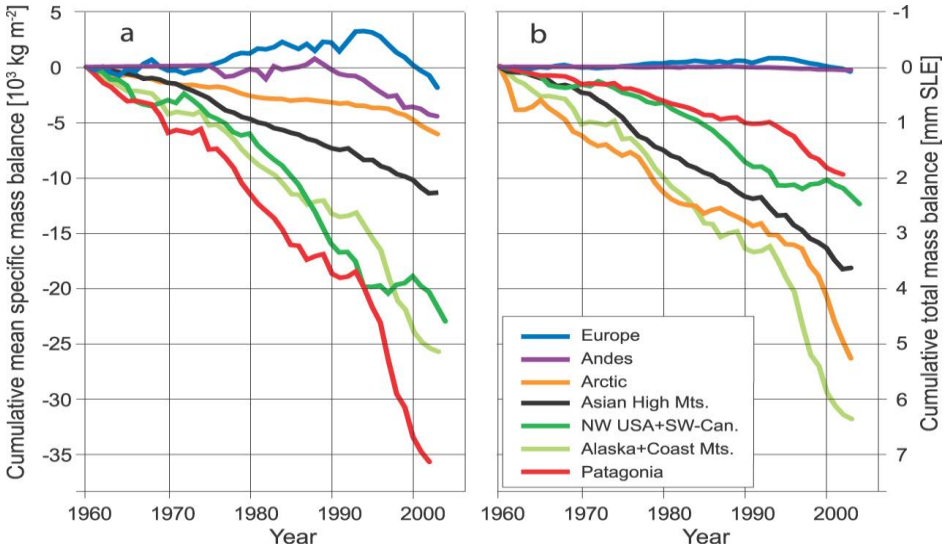

Figure 3 Cumulative mass balance for global glaciers (Source: IPCC 2007).

The hydrologic cycle is predicted to result in more bountiful and violent stream and river flows as glacier depletion quickens. However, once the glaciers have been depleted, the region is predicted to enter a period of extended drought (Ebi et al. 2007).

Turning to the Aysén region of Chile, the 2013 IPCC report claims that in the best-case scenario, average temperatures will rise by approximately 0.5 degree Celsius and that precipitation will decrease by approximately 10%. In the worst-case scenario, temperatures will

increase on average 2.5 degrees Celsius, with a slight increase in precipitation. It is projected that climate change will cause cascading effects in both highland and lowland environments. The anticipated effects include impacts on human livelihoods in ways such as widespread drought affecting agriculture, with studies showing that westerly flow have decreased in north central Patagonia over the past four decades (Garreaud 2013), increasing anecdotal reports of potable water shortages, flash floods, and a reduction in precipitation during all seasons throughout the southern Andes (IPCC 2013).

Addressing vulnerability in mountains is uniquely complicated given the complexity of mountains from an ecological, geographical, as well as a political standpoint. Vulnerability assessment studies are conducted using context-specific methods that attempt to assess the levels of vulnerability to human societies. A common framework applied in investigating the multi-dimensional nature of vulnerability is known as the "sustainable livelihoods framework" (Pandey and Jha 2012; Reid and Vogel 2006). The sustainable livelihoods framework aims to assess the local levels of vulnerability and adaptive capacity throughout global communities by analyzing the status of defined 'capital assets'—e.g. financial, social, physical, and natural (Pandey and Jha 2012). Analysis of the outcomes of the above vulnerability assessments has suggested that the most effective approach to helping the rural underserved communities to adapt to climate change is by pursuing more grassroots forms of aid that allow for adaptive capacities and flexible governance structures to materialize organically (Pandey and Jha 2012). Local people are most informed about their own site-specific needs and should therefore be central in leading any implementation efforts at a local level (Ostrom 2001; Wisner 2010). With this background information in mind I will turn to the analysis segment of this research study, beginning with a discussion of the methods used in the formation of this portion of the project.

Methods and Data Sources

The Latitude 45 study site in the Aysén region of Chile is approximately 80 x 30 km wide. The region in which the site is nested has historically had the highest recorded precipitation averages of the 12-macro regions of Chile. These high precipitation averages have resulted in historically high water levels in the region's multitude of watersheds (Andersen and Verner 2010). The Latitude 45 site was selected for this research project due to the region's many lakes and rivers as well as its mountainous terrain and ample glaciers. These features are critical contributors to watersheds and are known to be delicate sensors for climatic change (Rangercroft 2013; Vicuna 2011; Wilby 2010; Woodward 2010; Kundzewicz 2008; Bates et al. 2008; Beniston 2005; Buchler et al. 2004).

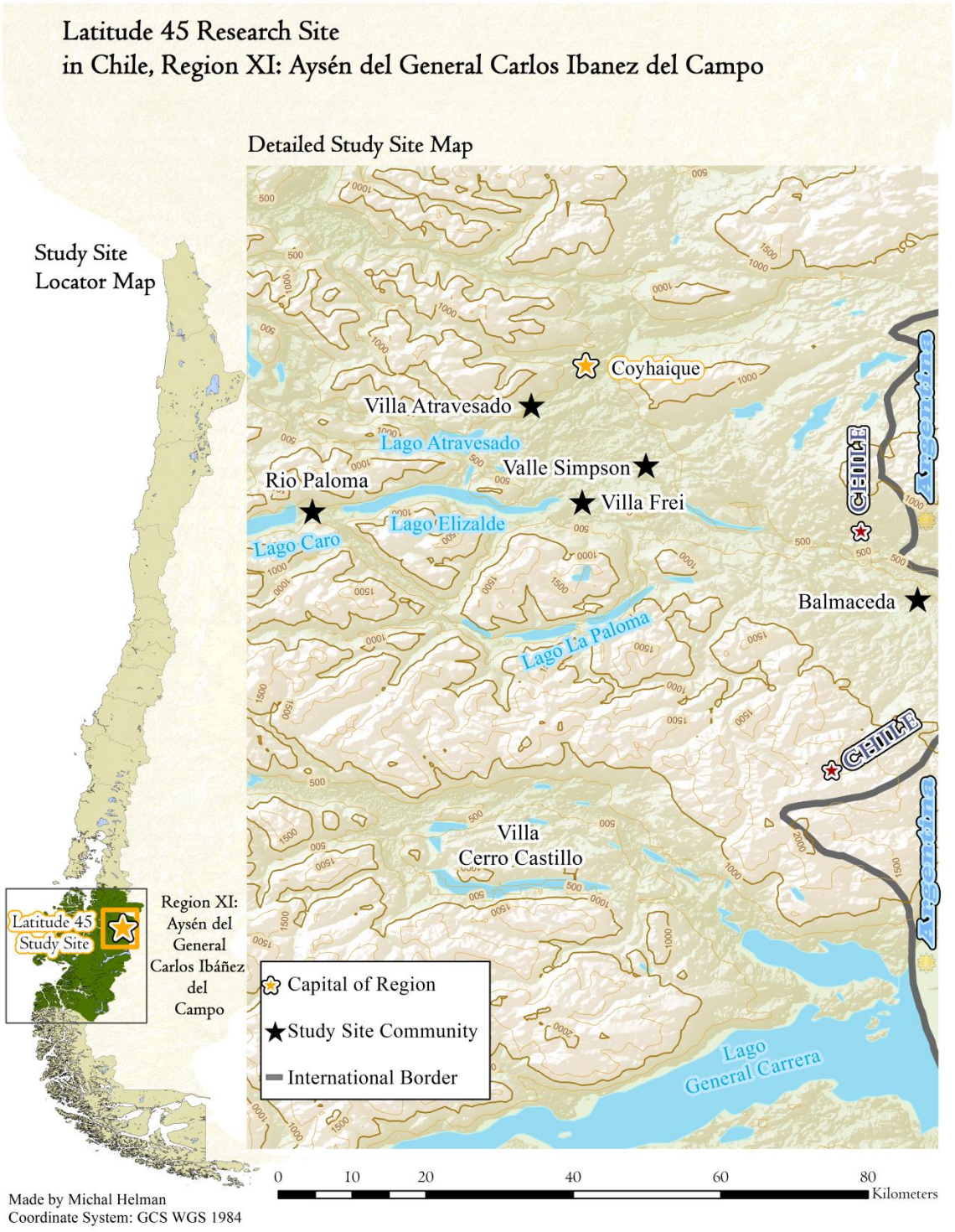

Figure 4 Latitude 45 study site map (Map Source: M. Helman 2015).

Of the residents in this region, approximately 99% are long-term residents who live a subsistence rural lifestyle (Astorga 2014). These agro-pastoralists predominantly raise livestock that they herd through mountains near glacial fields and through many watersheds; the most sensitive and indicative ecosystems of climate change (Beniston, 2005; Buchler et al. 2004). Due to the unique resource-dependent agro-pastoral communities found in this region the villages within the Latitude 45 research site were chosen for this study.

Semi-Structured In-Depth Interviews

For this research project I coded 30 in-depth, semi-structured interviews with *pobladores'* conducted in the Latitude 45 study site. The Interview Guide for the interviews with the *pobladores'* was designed with consideration of a preliminary, unpublished social science research survey conducted by collaborating SAFER researchers. The survey is entitled "Risk, Perception and Vulnerability to Climate Change in Wetland Dependent Coastal Communities in the Southern Cone of Latin America" from the International Development Research Centre (IDRC). Coding was done using NVivo software, which helped to organize the data based on similarities and differences of *pobladores'* perceptions. The study population for this research was comprised of Aysén agro-pastoralists who had lived in the region for at least 20 years. The semi-structured interview method was chosen for the flexibility needed for this style of exploratory research. The use of the purposive sampling technique helped restrict the likelihood of distorted responses due to ignorance, since each informant was selected on the condition of having sufficient experience in the region (Woitas 2002). The open-ended nature of semi-structured interviews allowed me for probing of respondents' answers into new topics of discussion to investigate burgeoning issues not included in the original interview guide. Additionally, in-depth semi structured interviews allowed me to identify nuances of attitudes and

behaviors that could be missed by using alternate, non-interactive research methods. Nuances from interactive investigation provide rich depth, detail and value to the overall quality of research gathered (Babbie 2013; Lofland et al. 2006). Just "'being there is a powerful technique for gaining insight into the nature of human affairs in all their rich complexity" (Babbie, 2013, 324), a technique which was foundationally utilized in my field research.

The agro-pastoralists in the Latitude 45 study sites were chosen as the sampling frame because of their dependence and familiarity with the region's freshwater and land (Agrawal 2010; Knapp and Fernandez-Gimenez 2009; Dewalt 1994). Research has shown that, when cross-referenced with recorded meteorological data, there is a direct and positive correlation between time in residence and land tenure and accuracy of by agro-pastoralists perceptions in assessing changes in precipitation patterns and temperature changes (Roco et al. 2014; Knapp and Fernandez-Gimenez 2009). Therefore in order to assign credibility to interviewee perceptions and experiences, a criterion was established that participants had to have been living in the region for a minimum of 20 years. Lastly, the sample population was systematically stratified by residence within the Latitude 45 study site in order to allow for analysis of perceptions and experiences throughout varied altitudes, climates and landscapes within the study site.

Once individuals who were to be interviewed were selected, I went to their houses and asked if they would be willing to participate in an interview for my thesis project. If they accepted, then we either scheduled a later date to conduct the interviews or more often (if they were free at the moment) I would conduct the interviews right then. Before each interview it was explained to every participant that the interviews were confidential and anonymous and would be

used for research purposes only.[7] Both the Interview Guide as well as the Verbal Confidentiality Agreement underwent the Institutional Review Board (IRB) process (please see the Appendix for confirmation of IRB approval).

Limitations

Since these interviews were conducted face to face, it should be acknowledged that my personal and physical participation as the field researcher for this project is a component and potential influencing factor in this study. Limitations of interview data based on perceptions include anxiety about being interviewed (particularly by an *extranjero*[8]), distorted responses due to outside influences, personal bias, and ignorance of the topic (Patton 2002, Woitas 2002). I had no previous connection or contact with respondents before this research study and it is possible that informants provided partial or incomplete responses due to the previously listed reasons.

In order to limit informant anxiety, I briefly explained to each respondent the purpose of my study and assured them of the confidentiality of their identities (please see the Appendix for the Confidentiality Agreement). While there is the possibility that respondents viewed me as a foreigner or outsider, it was my perception that I was not viewed as or considered a threat by respondents. My "outsider status may have also worked to my advantage because of the chance for the informants…to talk to an uninformed gringo about a topic of which they had a wealth of personal experience" (Woitas 2002, 40) on a subject that *pobladores'* may rarely receive a chance to discuss and perceptions and experiences that they have never been asked about.

[7] The Interview Guide and the Confidentiality Agreement both went through the IRB process. See Appendix for paperwork.
[8] While usually directly translated as being a foreigner from a different country, I came to learn that many of the *pobladores'* use the term to for an outsider or someone from outside the region.

Although I am an "*extranjero*" to the Chilean Patagonia, due to my personal background and upbringing in an Argentinean family, as well as my fluency in Argentinean Spanish, most of the *pobladores'* with whom I interacted, after some time and relationship building, took me in as one of their own guests often offering me a place to stay, a snack to eat, and insisting that I at least sit down and share some *yerba mate*[9]. In my experience conducting interviews with *pobladores'*, I found that they were not only willing to participate in the study but also often eager to have someone to talk to. This is in part owing to the fact that there are low population densities in this region; people go for days without seeing or talking to others outside of their immediate family.

Some individuals declined interviews with the explanation that they did not feel safe doing an interview with an *extranjero* (someone from outside the region) whom they did not know and for purposes they could not verify. Two interviews were thrown out owing to the incompleteness of responses.

Results

The data presented in the following section are from participants' responses coded from 30 in-depth semi-structured interviews with agro-pastoralists in the Latitude 45 study site. This portion of the study was conducted for exploratory purposes in order to better understand *pobladores'* perceptions of climatic changes and their impacts on the hydrologic cycle in Aysén. An additional goal of this study was to gain an understanding of the perceived impact that those changes are having on *pobladores'* livelihoods. The data presented here was coded as a part of

[9] *Yerba mate* is a traditional South American tea that is commonly consumed throughout South America and traditionally consumed out of a hollowed out gourd which is passed around and shared by several individuals.

this exploratory research in order to discover practices and perceptions amongst *pobladores'* in the region and are not intended to convey statistical significance for generalizability.

Demographics

Many of the *pobladores'* interviewed told stories of their fathers and grandfathers who settled the land. They referred me to talk to their brothers and nephews who lived down the road who also knew the region's mountains and rivers and lakes and could tell me about the changes they had observed. A common response to the preliminary question of "How long have you lived in the region?" was "Born and raised," with a total of 18 of the 30 respondents having lived in the same village all their lives and an average of 53.6 years in residence in their respective communities.

Table 2 Respondent Demographics

Community	**M_F Interviewed**	**Total Interviewed**	**Average Time Spent in Community**
Villa Lago Atravesado	5_2	7	57.5 years
Villa Frei	1_2	3	69.3 years
Valle Simpson	4_1	5	51 years
Rio Paloma	4_3	7	44.2 years
Balmaceda	5_3	8	51.6 years
Total	**20_10**	**30**	**53.6**

Pobladores' within the study site live a predominantly subsistence lifestyle working mostly in the cultivation of potatoes, hay, husbandry[10], and the procurement and sale of lumber. When asked how they would describe their work, *pobladores'* had responses such as:

> It is good. I work in agriculture, in what there is. With the sheep, the timber, with what there is. (i3)
>
> Mostly, with my animals here, the chickens and the greenhouse, those things. (i14)
>
> As a *poblador*. Doing work of a *poblador*. (i24)

For the rural people living in Aysén, this is the only way of life. Living as a *poblador*, doing work in "what there is." Working with the animals includes tending to the sheep and cows for men, while women are expected to care for the chickens, ducks, and "household" animals. Other typical work for the *poblador* men is collecting and selling lumber and hay, with the women tending to the small- scale subsistence greenhouse operations that can generally be found on *poblador* homesteads.

Perceptions of Change

The following paragraphs discuss the respondents' perceptions and observations of changes in the seasons, precipitation, wind, and the span of time during which *pobladores* began to notice the changes. The section is concluded with how *pobladores* perceptions of how these changes are affecting their livelihoods and ended with a brief conclusion of the results presented throughout the chapter.

[10] Predominantly sheep and some cattle.

Change in Seasons

Out of the 30 *pobladores'* interviewed 28 reported noticing a shift or change in the seasons. Throughout the interviews, the most frequently expressed perception of change in seasons was that of winters getting shorter, springs bringing more erratic weather, and summers becoming hotter and drier. *Pobladores''* perceptions included accounts such as:

> I have lived here my whole life, born and raised. The winters here are no longer winters for the little snow that there is… because also the summers are hotter..... Different than the sun that used to be…so it has changed a lot from the way it was. (i3)

> Here the seasons are very marked. Summer is summer and winter is winter… and more winter than summer. But I don't know how many years back now, that's not how it is anymore. (i11)

> The seasons, they have changed much…In years back it would begin to frost in the beginning of April and stay like that from then on…it would maybe stop freezing end of July. But for example, this year it didn't frost almost at all. (i30)

Changes in Precipitation

All interview participants mentioned perceptions of some sort of significant and noticeable precipitation change. All *pobladores'* interviewed mentioned change in snowfall patterns and 28 out of 30 expressed perceptions of change in rainfall.

Decreasing Snowfall

When asked if any precipitation changes have been noted during the *pobladores''* time in residence, *pobladores'* relayed that they had perceived a notable decrease in snowfall over the years. Examples of some common responses include:

> Lots! Lots….during my time, yes. Years before 40, 50 years ago…It used to snow a lot…but the past few years, well, not so much anymore…There is no snow on the mountain tops. (i10)

> Well, okay…for example in the years around 1955, I can remember that there would be at least two meters of snow that would fall. It would easily reach up to here (indicates level of snow) just imagine that….but no, things have changed

> dramatically…It's less. Much less. Which is not to say it's not cold. It's been cold. But less snow…Yeah…dramatic…like I said...it's the snow, it comes and it goes quick…. (i13)

Respondents' accounts on this matter were filled with passionate conviction and vivid anecdotes of the harsh winters from their youth.

Change in Rainfall

The majority of *pobladores'* reported seeing a decrease in snowfall, with a concomitant shift of earlier rainfall with less overall precipitation throughout the seasons. Responses included excerpts such as:

> Now it rains more. There is more rain than snow. (i18)
>
> The spring is more rainy, and there is no more snow in winter. (i22)
>
> It doesn't rain like it used to. But when is rain it rains for days. But it doesn't rain like before. But now not water or snow falls much. The years are getting drier. (i5)

In the final excerpt the *poblador* also mentions a perception of aridification. This was a common perception that was repeated throughout the interviews. *Pobladores'* largely linked decreases in precipitation with stronger winds leading to significant drying of the landscape.

Change in Wind

Of the 30 interviews analyzed, 24 mentioned a significant increase in wind. Responses included accounts such as:

> Before it was different. Not like today. There was less wind. The days were more calm. And now it is very windy and it dries everything up…last year we had three months of wind. It dries up all the grass for example and it all dies. I never saw that before. (i4)
>
> Here there was never wind before. Now these years the wind doesn't stop. Before you never noticed, there was never wind. [Yells to his deaf father-in-law who is

> visiting] Isn't that right that there was never wind here?! But now these last years, lots of wind. Lots of wind. Doesn't let people fish. (i30)
>
> I think that every time, every year they are going to get worse…I think they are permanent, yes. Each year is worse than the last. Now come the wind storms that used to come just in November and no more, but not anymore. Now they come three, six months pure wind…so yes, I think it is just going to keep getting worse. (i2)

Not only do these excerpts reveal the strong consensus about the increase in winds, expressions such as the above perception that the climatic changes are "just going to keep getting worse" depict the negative perspective that some of the *pobladores'* associate with their perceptions of climatic changes.

Timing of Change

Out of the 30 respondents interviewed, 20 provided an estimate of when they began to note significant and dramatic change in the local climate patterns. The range of time reported by respondents was 5 to 20 years with a mean of 10.6 years and a mode of 10 years of noticeable change. Fourteen out of the 20 respondents reported seeing noticeable changes within the past 10-15 years. As respondents put it:

> [About] 10- 15 years that I began to note it. Every time, less snow, less snow. (i22)
>
> About 10 years back began the changes. (i18)
>
> Not so many years, 10 years. 10 years that I started to notice it more. (i7)

The consensus amongst the majority of respondents about when changes began strengthens the power of this perception.

Changes Affecting Livelihoods

While *poblador* respondents unanimously agreed that climate change was occurring in the region, there was not a consensus amongst respondents about the implications of those

changes. Some *pobladores'* responded that the erratic weather and changing seasons have made their agricultural work challenging

> …it seems like the seasons are moving. They change in little time. What we have observed this year was they there was no fruit. Because the flowers froze. Because there was frost in the spring. And that affected everything. So there was little fruit, and we didn't have apples, no cherries, all because of the frost. Nothing of fruit. (i26)

While other *pobladores'* whose livelihoods depend more on husbandry complained of climate change affecting their livelihoods because

> It affects the animals…because there was no grass last year. The grass was 50% more valuable than it usually is…Anyone who had grass sold it for the value of gold. And the quality of the soil is also deteriorating. And it affects the vegetation. It is not like before. (i4)

> There isn't enough water and so the animals no longer have what they need. And now the animals have started to die. And the grass doesn't grow. If there isn't water the grass doesn't grow. (i8)

However, not all accounts of recent climatic changes were negative. Below is an excerpt in which one *poblador* expressed a positive perspective of the changes:

> Every day things are getting better. There is more sun now. We can work more now. Before during winter in November I'd have to stop working. (i22)

This *poblador*, along with several others, communicated that their perceptions of change have resulted in things "getting better." They are experiencing generally milder winters and a longer growing season, which was described by these respondents to be a benefit to their overall livelihoods. The contrast in these two outlooks and outcomes is important to recognize because there was not a consensus amongst *pobladores'* interview about weather climate change was impacting negatively or positively. In some instances both. While for the Chilean *pobladores'* interviewed the issue of climate change is a topic of concern, it is also recognized as part of a larger "natural" process over which they have no control. When asked if there was anything else

they wanted to add to the topics we had discussed one *poblador* responded in this way:

> Okay well…climate change I can't really say anything because it's the weather and all that, and it's happening naturally, and we can't do anything about that. But the water rights, well I don't know, people come from other regions and get the water rights, and it has nothing to do with them. Now mostly other people have the water rights, and in reality it's not the people that should have them. But okay, well, that's the way it is. I don't find it good. The water law. Because the water is natural, and it shouldn't be like that. But that's just my way of thinking. It shouldn't be like that. Because in the end, its unjust. Because the water is natural. (i8)

While climate change cannot be controlled, *pobladores'* did express that they felt that a more equitable water policy does need to be set in place so that *pobladores'* are better able to deal with the climatic changes out of their control.

Conclusion

The interview data indicates a strong awareness among this group of *pobladores'* of the impacts that the changing climate are having on their livelihoods. With the onset of histrionic climatic changes, further studies will be necessary to the articulation and implementation of effective adaptation efforts. This research is vital for some of the aforementioned and following reasons. Mountains, arguably the most fragile environments on Earth, are rich repositories of biodiversity and water, which provide ecosystem goods and services to communities at many large and overlapping spatial scales. In addition to being fragile, an increasing number of natural and managed systems are already more susceptible to climatic extremes than to changes in mean climate (Beniston, 2005). Climate change impacts will be vast and affect all biota, the less quick to adapt and less resource-secure more so than the quicker and more prepared. One of the theories about why humans have been able to survive on Earth for so long is our ability to problem solve and co-operate to make tremendous advancements as a species possible. By

pursuing a sturdy climate change strategy that covers various lucrative aspects throughout multiple scales future adaptations are most likely to succeed.

CHAPTER 4:
POBLADORES' PERCEPTIONS OF VULNERABILITY

There is nothing more to do without water. We would all die. Nothing operates without water in this world. …. I think we're going to have to fight for water in the coming years… (i7)

In the face of continuing climatic instability and an ongoing rise in the global population, natural resources such as water are becoming increasingly stressed. As Lynch notes, "many of those vulnerable in the face of climate change are neither destitute nor lacking capabilities; rather their livelihoods and lifeways are intimately tied to environments threatened by natural phenomena, economic activities that produce hydrologic change, and governance structures that fail to promote equitable distributions of water resources" (Lynch 2012, 365). As water commodities become continuously more scarce, clarity and diligence in water governance is essential. Understanding the concerns of stakeholders about water governance as they relate to vulnerability should be central to decisions on the management of water resources.

Chapter three discussed *pobladores'* perceptions of climate change and how it was affecting their lives. This chapter focuses on vulnerability concerns related to water governance. This will be done through an exploratory study of subsistence agro-pastoralists (*pobladores'*) extraction and uses of fresh water in the Aysén region of Chile. I also examine their experiences soliciting water rights in Chile's privatized water market. As in chapter two, this research was founded on in-depth semi structured interviews. Interviews with *pobladores'* were supplemented with interviews with the chief of the Aysén branch of the Dirección General de Aguas (DGA), the Aysén DGA lawyer, an environmental lawyer working in Aysén, and an official from the

Aysén branch of Chile's environmental protection agency write out full official name in Spanish (CONAMA).

The chapter begins with a brief introduction to water privatization followed by a more in-depth overview and analysis of the history of water law in Chile. Following the context portion of the chapter, the study methods and data results are presented. The chapter concludes with an assessment as to some of the potential implications of Chile's water market and predictions on the direction in which the country's water law may be headed.

Context

The privatization of water provides the context for considering vulnerability, water governance and water ethics in Chile. In a 2006 essay published by the World Bank titled, "Universal Access in the Water and Sanitation Sector," the authors highlighted the fact that a majority of privatized water rights in the global south are owned by corporations in the global north (author names, date). This is a phenomenon that does not occur in wealthy developed countries that generally own their own water rights. Furthermore, "the poor pay higher unit costs than the better off, even though the volumes consumed are smaller" [paying] up to "ten times more per litre" (Mattoo et al. 2006, 104). In the XI region of Chile there is only one private company, Aguas Patagonia de Aysén, which deals in potable water distribution. Out of the region's estimated population of 91,492, Aguas Patagonia delivers potable water to approximately 74,968 of those habitants. Due to the remote location of the communities throughout Aysén, region XI has among the highest costs of water per m^3 in the country. High rates have accordingly resulted in Aysén being the region which provides the highest subsidy for water services (7322 CLP/month/family compared to national average of 4088

CLP/month/family[11]) in Chile to 9,159 of the recipients of potable water in region XI (approximately 12% of customers) (Chilean Superintendence of Sanitary Services 2006).

The privatized water system in Chile has created a complicated water governance framework. As will be illustrated, the privatization of water rights and the complexity of the water code are key factors in considering *pobladores'* perceptions of vulnerability to water stresses. These vulnerability concerns are clearly expressed in the interviews discussed later in this chapter. The next section will begin this discussion by reviewing the methods used in this qualitative study on *pobladores'* interactions with and perceptions of water governance in Aysén, Chile.

Methods and Data Sources

Semi-Structured In-depth Interviews

Semi-structured in-depth interviews allowed me to explore *pobladores''* extraction of water, their experiences soliciting water rights, and their perceptions of water law in Chile and its management in the region. Community perceptions provide a unique and comprehensive perspective of how the day-to-day has changed over decades and what the implications of these changes may be in the long term (Knapp and Fernandez-Gimenez, 2009). This method of qualitative field research allowed for comprehensive engagement and investigative inquiry most appropriate for the research question at hand within the rural population and cultural context inlayed in this study (Creswell, 2009).

Respondents in the *pobladores'* sample population were chosen through a multi-step process involving a review of the ownership registry held by the DGA, an analysis of ranch sites

[11] At the 2006 exchange rate of $1 US Dollar to $708.66 Chilean Peso.

using satellite imagery from GoogleEarth ®, and lastly through in-field investigation to find citizens who had lived in the region sufficient time to be included in the study. In the field investigation stage, interviewees were selected through chain sampling methods and tapered to the limits of the given study using purposive and stratified sampling criterion.

In accordance with the methods stated in chapter two, stratified sampling was used to ensure variations in the sample population, while purposive sampling allowed for selection of respondents deemed most representative of the population being studied (Babbie 2013). In purposive sampling the researcher 'bias' of the selection process becomes its strength by sampling the most knowledgeable and thereby most appropriate "information-rich" subjects who are able to best elucidate the issues being explored (Woitas 2002). By analyzing data from "information-rich" respondents, research yields in-depth understanding rather than empirical generalizations (Woitas 2002; Patton 2002).

As specified in chapter two, interviewees were selected based on the following criteria:

- Livelihood (ranching)
- Residency in the region for 20+ years
- Ownership and management of their own land

While the results in chapter three are connected to the data and analysis presented here, the Interview Guide portion of the research presented in this chapter was designed with consideration for data from a preliminary, unpublished social science research survey conducted by collaborating SAFER researchers entitled "Land Ownership, water resource law and management and basic demographics."

Key Informant Interviews

In addition to the interviews with local *pobladores'*, interviews were also conducted with the chief of the Aysén DGA branch, the lawyer of the Aysén DGA branch, a Chilean environmental rights lawyer and a brief interview with a representative at Coyhaique's CONAMA branch. Key informant interviews were conducted for background and context purposes and did not have accompanying pre-formatted official interview guides, nor were these interviews analyzed to the same rigor as the in-depth semi-structured interviews with *pobladores'*. These interviews were only included in this study to provide a more holistic framework with which to conduct the data analysis process.

Limitations

Apart from the limitations discussed in chapter two, other limitations unique to this portion of the study included not being granted permission to record my interview with the DGA head, leading to the potential loss of information that could have been useful and added richness to the rest of the data collected. Additionally, the interview with the DGA lawyer was on the record and limited to the responses of a government official representing the DGA. Being on the record may have influenced the responses received about how the DGA and the water solicitation process operate. The interview included a lot of "well, hypothetically this is how that's supposed to work" with a brief recognition of the disparity between the water law and the reality of how things operate and exist on the ground.

Results

The data presented in the following section are from 30 in-depth, semi-structured interviews with *pobladores'* in the Latitude 45 study site about their vulnerability concerns related to Chilean water governance. The data presented here was analyzed in order to discover

and represent practices, attitudes and experiences amongst *pobladores'* in the region and are not intended to convey statistical significance.

Expressions of Concern and Vulnerability

Among the *pobladores'* interviewed, there was a clear and vigorously communicated appreciation for and reliance on fresh water, as well as an undertone of pride in the region's wealth of watersheds. However, nearly all respondents also reported concerns of personal vulnerability under the current water law. As stated in chapter one, vulnerability in the context of this research is defined as "exclusion from and inequities in water governance" (Lynch 2012, 365). While the sentiment was wide spread amongst respondents, one *poblador* articulated the attitude especially well:

> There is a lot of water in this region but soon the rest of the world will need water. It is not a problem for the region or Chile necessarily, but the world… We need to start protecting better for the future. Because in the future we won't have enough, and it is getting less…I think we're going to have to fight for water in the coming years…So yeah, we'll see the battle…and it's already beginning.(i7)

Pobladores' communicated an unmistakable recognition that water means everything for their livelihoods, and more broadly the survival of the larger interconnected ago-ecosystems. When asked how he interacts with water on a day-to-day basis one *poblador* without a second thought replied:

> For everything. Without water you can't do anything. Water for drinking, for the plants…The important thing is that without water there is nothing. There is no grass, there are no animals, and everything is lost. (i1)

When asked the same question one of the *pobladores'* more stanchly connected water to its economic value:

> I use it for everything. For drinking, for consuming. Because you need it for everything. The plants, for everything that needs it…with the changes everything is changing. Without snow there is no water, once the water goes it is gone…and then there is drought and the poor people are left without anything…without rights, without work. (i3)

As highlighted in this excerpt, livelihood success for the *pobladores'* is inextricably tied to their access to fresh water. The importance of water and direct dependence on water noted here ties back directly to *pobladores'* sense of vulnerability, especially if supply and access to water are restricted or denied.

While in many of the interviews there was a clear connection made by *pobladores'* between the need for water and their livelihoods, many of the *pobladores'* also articulated a recognition and gratitude of the role that water plays in the much larger scheme of our shared planet. When asked how they interact with water on a day-to-day basis, some *pobladores'* relayed the following accounts:

> In every way, because you have to make food. You have to wash yourself, you have to irrigate. I think that the most important thing to have is the water. Because if you don't have electricity, fine you go to bed earlier. But if you don't have water…you have don't have anything. If I don't have water…I couldn't water the greenhouse and I wouldn't have sustenance. And I fought for these issues because I know the importance of water. It has always a problem. And I fought my whole life for the issues of water because I know what it means not to have good water…We all have the same rights to the water. And before no one left garbage or anything. With that we have luck. Down here they treat the watersheds with respect. (i6)

> There are regions that don't have water but here there is more. We need to start protecting it more, for the future. Because in the future we will not have enough, and it is getting less. The water is for drinking. Without water…There is nothing more to do without water. We would all die. Nothing operates without water in this world…I believe that yeah, with the years we'll see the battle. (i7)

In the above excerpts there is a discernable communitarian ethic and global consciousness that recognizes the many values that water has, not just to the *pobladores'* or Chilenos, but its value to the world. The ecological ethic that *pobladores'* have is one of the central cruxes of the

current incompatibility between formal water governance throughout Aysén as well as the clash between *pobladores'* and "*extranjeros.*" I will further discuss this intimation later in the chapter in the Concerns about Water Governance and Vulnerability and *Extranjero* Wealth Advantage sections.

Water Extraction and Use

Pobladores' primary purposes for extracting water were for personal consumption and for their livelihoods as agriculturalists. The majority of respondents reported their predominant uses for water as being for drinking, cooking, bathing, and for irrigating their greenhouses and crops of hay and fields of grass; fodder which *pobladores'* rely on for feeding their livestock. In accordance with the forested and mountainous residential setting of the *pobladores'* interviewed, the majority of respondents reported their principle water sources as the stream or river adjacent to their primary house[12].

The water extraction methods reported by respondents include, directly from a local watershed- sometimes just with a hose and the use of gravity and sometimes with a pump or from a stream-fed well (n=25).

The water that flows in the streams is largely glacial and permanent snowpack fed with little between the source and the extraction location of the *pobladores'*. Most of the flowing watersheds are considered by the *pobladores'* to be very clean. When asked from where their potable water is extracted, one *poblador* responded:

[12] It is not uncommon for a *poblador* to have a couple of different houses. Often the majority of them are small structures throughout their vast land lots that act as shelters during their often long journeys through the mountains and forests. It is also relatively common for a *poblador* to have an additional house in the city for their wife and children to live in during the academic year while the children are in school.

> We get our water from a *vertiente*[13]. I collect water from the *vertiente* and from there comes the water through a hose. And we drink it like that no more. We just take it out from here. Use it in its natural form… I grew up on the ranch. And we always just used and drank the water in its natural form. Without filtering it or anything. Here the water is very clean. There was always good clean water running consistently here. So I always drink it with confidence. There is nothing that contaminates it. (i4)

While the water in rural Patagonia is relatively clean in its "natural form" relative to unfiltered water in other parts of the world, it is worth noting that the majority of *pobladores'* described also their cattle and sheep drinking from the rivers and streams

> We have a *vertiente* here. So we don't need a well or anything. There is a *vertiente* there and we just stick a hose in and it brings us water. And the animals have a stream that they drink where they get their water from. (i5)

However there was an important awareness by the *pobladores'* interviewed that care needs to be taken so that their animals aren't directly responsible for the contamination of their local water sources.

> We used to have a stream that came, and it was beautiful. The water came very clear, but some animals came and contaminated the water. (i27)

As articulated in the above excerpt, a number of the *pobladores'* expressed a distinct understanding of the lucrative and inextricably intertwined relationship between downstream water quality and upstream practices.

In some of the larger and more organized communities in the Aysén region (e.g. Valle Simpson, Villa Frei, Villa Lago Atravesado) a few respondents (n=3) reported getting their water from the community's potable water committee. The potable water committees are ordinarily comprised of active community members who solicit large water rights on behalf of the

[13] A *vertiente* is a cascading watershed that comes flowing down a steep slope. Might be described as being something between a stream and a waterfall and is usually seasonal.

community. These community members assume the responsibility of extracting, often times treating (with chlorine), and delivering (via direct pipelines) potable water to the houses of their fellow community members. Alternately, in more metropolitan cities (e.g. Coyhaique, Balmaceda) private water companies (e.g. Agua Patagonia) hold water rights and have constructed infrastructure for extracting, treating, and delivering potable water at a national quality standard.

Solicitation of Water Rights

When probed about the legal rights of the water that they extract for use, many *pobladores'* relayed information that was inaccurate or misinformed. When asked if water rights had to be solicited for the water being extracted, one *poblador* responded:

> Yes, you have to ask for water rights. Before no, before you didn't have to. But everything is changing. They came to buy the water, buy the water rights. The laws are changing and you have to pay for the water now. (i18)

While the perception amongst many *pobladores'* is that the law is just now changing, water rights have been privatized in Chile on and off since 1951 and have been registered since 1981. This shift in perception at this point in time is likely due to an increase in development and outsider interest and investment in the region, which has likely increase awareness of the need for water rights. It was not uncommon to hear amongst *pobladores'* that they felt the need to secure water rights to protect themselves against losing their livelihoods for lack of access to fresh water.

> The way that foreign people are coming in, I don't like it. And sure now everyone has to go and solicit water, from here from there, just to feel at ease, figuring out how much water is coming, liters per second. No, I am not in agreement with that. (i26)

In the above excerpt this poblador pointed out that he has noted members of the community increasingly trying to procure water rights "just to feel at ease," highlighting the increasing sentiments of concern and vulnerability associated with not having legal rights to a nearby fresh water source.

While some *pobladores'* communicated that they either had a water right or were in the process of being granted water rights, when I would go back and verify these claims with the national water registry, I found that a number of *pobladores'* had reported a status of their water solicitation that was completely incongruous with the reality of their legal water right. When asked if she had to get water rights for the water she reported getting from the stream, one respondent replied

> I went to go solicit them the year before last. But before that we didn't have the water rights. (i22)

When probed further about her experience soliciting water rights I discovered that while this *poblador* had begun the process of soliciting water rights, she had never completely gone through with the solicitation and thereby still did not have legal rights to the water she was extracting from the stream. Rights that could very well, legally belong to someone else.

During another set of interviews with a group of *pobladores'* who lived relatively close together within the Lago Atravesado site, all three respondents reported that a foreign wealthy man had recently bought some of the land at the top of the hill and the water rights to the two lakes at the site along with the property. The respondents condemned the man for having bought up the water rights and cut them off access to the watershed where they recounted memories of when they used to go to those high altitude lakes to wash clothes and bathe on hot summer days.

> There is a man up here who owns land with two big lakes but he doesn't let anyone else access the water. It needs to public. The rivers and lakes are all of ours. They belong to us all. (i1)

When I followed up on the claims that the man at the top of the hill owned the water rights to those two lakes, I discovered that he in fact did not have the rights. He had submitted a solicitation to the rights but had not been granted them by the DGA due to insufficient demonstration of need or prospect of potential use. During a meeting with the DGA's Aysén lawyer, another noteworthy nuance in the Chilean water code was divulged to me: Chilean law has maintained that even if private rights can be given to water extraction or use, the actual watersheds are national public space. That is to say that even if someone owns rights to a lake on their property they legally have to grant others access to that watershed and use it as they wish (swim, wash clothes, etc…) so long as they are not extracting any of the water (1981 Water Code). This is a feature of the Chilean water law that was not widely known by the *pobladores'* in this research study, as demonstrated by the above excerpt in which a *poblador* states that access to a public watershed can be restricted by its extractive rights holder.

Further, *pobladores'* interviewed were found to be uninformed on the protocol for soliciting rights and whether or not they even have legal rights to the water they use. In one instance, when discussing water rights for a well a *poblador* had installed on his property, the *poblador* told me that he did not solicit the water rights "because it is a well." Legally, wells have a separate solicitation process, but nonetheless have a solicitation of rights and registration of use protocol of their own (laws of groundwater extraction are laid out in Title VI of the 1981 *Codigo de Agua).* The main takeaway here is that the Chilean *pobladores',* across the respondent pool, were not well informed on the law and their rights.

Disregard for Law

Many *pobladores'* were candid about their disregard for Chilean water law. When asked if he had to solicit the rights to the water he uses, one *poblador* openly responded:

> No one really monitors or anything... We just stick the hose in and take the water out. (i5)

The Chilean water code is complicated and exists in theory more so than in practice. Information about the water code is not widely available and it largely not well enforced. The Chilean lawyers and DGA staff I interviewed readily admitted that there are shortcomings in the current water code. During my interview with the DGA lawyer he confided in me that

> The truth is that this region is rather extensive and the reality is that until last year there was only one person who was in charge of supervising the water rights, now there are two people. So the man power we have isn't enough to implement the level of supervision that we would like to have. We just can't... Because we can't supervise everything. It's impossible, simply impossible. (DGA Lawyer)

Not only is there not enough manpower to implement the system but, as he delved into the details of water solicitation, the DGA lawyer conceded that

> We're talking in theory here because in reality the people just take the water anyhow. We're clear on that right? In theory if these people don't have water rights they should buy the water rights. (DGA Lawyer)

If lawyers who have dedicated their lives to studying water law think it is an inapt governance system, then why would *pobladores'* who have chosen to live in the remote forested mountains of Aysén be up to date or care about the structures imposed by government officials in city centers hundreds of miles away. It is likely that the knowledge of the *pobladores'* about the water law in Chile is minimal, as the policies of the city centers have yet to impact their day to day lives. Further, there is presently little incentive for them dedicate time and resources to

educating themselves in the topic. Two *pobladores'* interviewed said the following about water rights:

> M: And the water rights? How do they work?
> Something like, everyone comes and takes what they need.
> M: But do you have to ask permission or you just come and take it?
> You have to ask for it. It is a process. Usually one person has the water rights and it is very complicated to change that. (i1)

> Yes, you are supposed to solicit water rights. Before people didn't worry about things like that, but now you do have to. (i17)

As featured in the above excerpts, many of the *pobladores'* only recently began soliciting water rights, while they previously extracted water from wherever they were able, whenever they needed it. As suggested by the DGA lawyer, many *pobladores'* still continue to extract and use water from wherever and however they see fit.

Concerns about Water Governance

As discussed in chapter two, climate change is altering the water regime in this region of Chile. As also discussed in chapter two, this research revealed that within the Latitude 45 study site *pobladores'* are perceiving climate change to be affecting their livelihoods by slowly drying out their local watersheds and changing local precipitation cycles and seasons. When the DGA lawyer was asked about *pobladores'* perceptions of climate change, he responded:

> Yeah that (climate change) is happening more. Much more. The truth is that, if you compare us to the rest of the country we are very privileged. But if you just look at this region, how it was 10-20 years back, there is much less water in the rivers. And we have to confront it in the best way, which still has to be recognized and implemented.

In the last line of the excerpt the DGA lawyer clearly expresses that the current system is not the "best way" to manage water rights in light of contemporary changes in the hydrologic cycle.

Compounding their concerns regarding their vulnerability to climatic changes, the *pobladores'* feel that the Chilean government and foreign entities are taking advantage and manipulating water resources for private profit, whereas the *pobladores'* feel water resources are a public good to which they are entitled. 29 out of 30 *pobladores'* interviewed expressed dissatisfaction with current Chilean water law. When asked about their perceptions of water governance in Chile, *pobladores'* articulated some of the following sentiments:

> Strange. Why should I have to be soliciting water that is in my own *campo*[14]. Why now do I have to be the owner of the rights of these waters? (i22)
>
> The people who live here, the *pobladores'* should have the water rights. Rights to the rivers to the streams to everything. (i20)
>
> I don't think it should be that way because the people here colonized the land. They came here when there was nothing. So how are you going to tell them that the water isn't theirs. The water that runs through their own land. The people that have lived here their whole lives. It isn't right. Not for the people who have lived here their whole lives. (i16)
>
> The people down here have it all wrong because they're paying for their water. To have to pay the state to have security in your water right? No, that's just wrong. They built their *campos* with the strength and help of their fathers, since they were young. And now they all have their own land. And then the government comes down here and starts charging for the water that's on the *pobladores'* own *campos*. They don't let a man live. In that the government is bad. (i30)

As illustrated in the above excerpts, *pobladores'* by and large expressed dissatisfaction and bewilderment with the current water laws. These sentiments were starkly highlighted in the phrases such as "it isn't right" and that the water law is "just wrong…They don't let a man live." The *pobladores'* are articulating strong sentiments that the current system is unjust. Using the previously defined meaning of vulnerability, as exclusion and inequity in water governance, these excerpts display a clear sense of vulnerability under the current Chilean water law.

[14] A ranch or farm.

Injustices

Pursuing the themes of social inequity and vulnerability, 16 out of the 30 respondents interviewed specifically mentioned that they perceived injustices in the current Chilean water law and management of water rights in the Aysén region. When asked what they thought about the water rights in Chile, the majority of respondents touched on the theme of injustice throughout their remarks. Along with a variety of other inferences that the distribution of water rights was unfair, they repeatedly used the words "unjust" and "not just" as highlighted in the following excerpts:

> Okay, well, that you have to pay for water rights seems unjust to me, because the water is everyone's. (i17)

> Well, water rights, they shouldn't be privatized. Because now if I make a well, here on my own property, someone else can come and solicit the rights and they aren't mine they are someone else's. The water shouldn't be privatized. Because without water we can't live. And now anyone can come and buy the water rights from your land. It is not just. It is not just. (i14)

It is evident in the above quotes that there is an especially strong sense of injustice in regards to the current water governance, particularly with the privatization of water. As water scarcity becomes an increasingly pertinent issue, the *pobladores'* expressed that they believe water rights need to be redistributed more equitably. One respondent succinctly noted:

> There is little water. That is the problem. We no longer have enough water. And only the rich buy large tracts with watersheds, lakes and they then own the water for themselves. And it is bad. The government needs to come in with a hard hand and redistribute the water rights. The ones who have more get more and they keep squishing the poor. And so the poor keeps having less and less until they are forced to sell what they have because they can't live anymore. And then those with the money end up with more. It is bad, and that's how it is. One can have water right there on their own land but if the owner is another than they sell it back to the people that live on that land. (i1)

The perception of inequitable water distribution was not just an issue for *pobladores'* because it was perceived to be discriminating, but as can be seen in the above and following quotes,

unequal distribution of water rights in a scarce resource market can leave those "who need it" with "less and less until they are forced to sell what they have because they can't live anymore." This is a strong statement of concern among a community that feels vulnerable to being "squashed" by the "rich":

> No, no, it doesn't seem good to me. Here all the water rights are bought up. I think the law and the legal rights need to be respected, but they also need to be given to those who need it, and that isn't always done. (i12)

In these interviews there is a sentiment that water is a common public good that needs to be shared with all and distributed relative to need. With a general consensus that water rights need to be given "to those who need it." As one individual put it:

> The water should be for everyone. Because, because it is not good that they come and solicit your water and then you are left with no water. Never had we solicited water and neither had we ever prohibited anyone from coming to our lake. To come to bathe in our lake, what have you. Because no, it isn't right. We all have the same rights to the water. No one left garbage or anything. With that we have luck. People here, historically, have treated the watersheds with respect. (i6)

Most of the *pobladores'* interviewed voiced that they do not feel that they have adequate legal access to the watersheds on which their livelihoods depend, leading to a perception of vulnerability. While their sense of a just distribution of water resources is not clearly expressed (i.e. how does one determine need to ensure equitable distribution), the take away from respondents was that the current system is unjust and needs to be changed.

Vulnerability and *Extranjero* Wealth Advantage

Further contributing to this sense of vulnerability, a majority of the *pobladores'* (n=18) mentioned a sharp and noticeable increase in the numbers of *extranjeros* that have come to the region in the past decade. *Pobladores'* expressed that while generally they do not have definitively negative feelings towards *extranjeros* themselves, they do have the negative perception that *extranjeros* are disregarding local customs and buying up the all of the local

resources. Like many of the respondents, one *poblador* expressed frustration as he explained that,

> It is not like it used to be. They have to fix the management of water. *Extranjeros* came and now they own our water. The Chileans, no, we don't have rights anymore. We own nothing. The majority are international owners. Those that live here no longer have anything. And no, it just won't do. (i1)

When asked what they thought would be a better alternative to the current water policy, one respondent replied:

> That they let us work in peace and people from outside don't come and try to take it from us. (i26)

Pobladores' would tell me anecdotes about foreigners and foreign companies coming to Patagonia, extracting large quantities of water from pristine watersheds, bottling it and then exporting it and selling the bottled water abroad. When asked their overall perceptions of the *extranjeros* taking advantage of current water laws, respondents replied with perceptions such as:

> It is bad, bad. For example, the water rights, they sell them to people who have money. Like those aquaculture guys down the street. They have a lot of the water rights for here. Who knows how many liters per second. And the rest is owned by Senor X, why? Because he has the bills. He has the bills to pay for the rights. All the water in this region is all already accounted for. Here the majority of the water owners are Endesa. They are Spanish. We live here and we barely have much involvement in the water rights of the region. (i4)

> *Extranjeros* come and buy up rights and then charge very high prices. Much higher than what should be charged…the people who live here, they are the ones who need to be guaranteed rights. Otherwise the people of this land just keep getting poorer, everything being taken out of their pockets by *extranjeros* and taken elsewhere. Nothing stays here any longer. And the people here, they are the ones who pay the most. They people live here and work the land, and then they have to pay such high prices? It shouldn't be that way. It should be cheaper. (i2)

> I don't know, people come from other regions and get the water rights, and it has nothing to do with them. Now mostly other people have the water rights, and in reality they are not the people that should have them. (i8)

In addition to the more general themes of injustices in the water laws discussed in the previous section, the above sentiments highlight the perceptions of wrongdoing by wealthy *extranjeros* who are seen as buying all the water rights and then charging high prices, thereby excluding locals from the access they need to the watersheds that supports their livelihoods. Throughout *pobladores'* responses there is a distinguishable perception of vulnerability by way of rights being distributed to those who have the money and knowledge base to acquire legal water rights, when some *pobladores'* think that they (the foreigners) "are not the people that should have them" (the water rights). The *pobladores'* perceive this inequitable distribution to have made them vulnerable by "having everything being taken out of their pockets" by wealthy foreigners. As one *poblador* stated, while the pobladores' colonized and now inhabit the remote region of Aysén, they "barely have much involvement in the water rights of the region."

Positive Opinions

It is important to note that there was one *poblador* of the 30 interviewed who had a positive outlook on the *extranjero* presence. In addition, a couple *pobladores'* that they had received some increase in business from the increased presence of *extranjeros*. One respondent indicated:

> A lot of people down here are against them (HidroAysén)…but I think they just don't understand…This region has the most water of all the regions in Chile…and those guy…HidroAysén. They want to come here build dams…but we too will benefit. We'll get better roads out of it…cheaper energy for sure, that's a given. Because the energy is something we need too. They'll build us schools and we'll get jobs….I think this is something that we need to support. We'll be the ones who also grow rich from this business….(i13)

This *poblador* expressed an interest in development for its potential benefits to the wellbeing of his community and future generations.

Pobladores's Recommendations

One of the phrases repeated most throughout the interviews was a longing for a freer Patagonia focused on simple and traditional community based values. *Pobladores'* made some of the following suggestions in regards to Chilean water governance:

> I think they should be free. Because they were free before, and now with all the regulations they are making it impossible for the *pobladores'* to live. With everything that we have to pay for we don't own practically anything anymore. (i19)

> It should be like it was before. That everyone has rights to the streams, the lakes, the *vertientes*. Because imagine today, they sold the rights to the water that is on my land. And that *vertiente* is his…It doesn't seem to me a good idea, the idea that they had. Because for the little guys it is bad. To make a solicitation of water is expensive. Imagine, not everyone can pay for that. With everything you have to do, between the tests and the paper work and the verification and measurements and everything that one has to do it comes to be expensive. It should be like before. That the water belonged to all the Chileans. That you would take water out for your animals or what have you from any place. And someone from somewhere else couldn't come and take away your water rights just because you have a nice stream. (i6)

The above excerpts emphasize *pobladores'* plea for better management of resources as the numbers of *extranjeros*, who have different values from locals, are moving in and "monopolizing" these resources. This appeal is aggregated with the assertion that water should be free to those who need it and should not be privatized or contingent on the ability to pay for a water right. One respondent suggested that it is the responsibility of the government to protect the rights of the *pobladores'*, stating:

> They need to come and supervise the supervision of water. I think they have to come and monitor the water better. One person comes and gets the water rights and stays with those water rights for themselves. The same person stays with the same water rights and no. It doesn't work. They have to redistribute and give water rights to other owners. (i2)

When asked how they felt water governance in Chile could be improved the response was:

> I'm not totally sure, but the law shouldn't be like this. It should be restricted more. And those that need the water rights to give it to them. (i4)

In these two excerpts there is a recurring mention of a foreign hand intervening in the problems in current water governance. When asked about how water conflicts are managed the Aysén DGA lawyer stated:

> We don't do that. The only thing we do is that those who are involved in these communities have the water right for the amount they are using. We keep a registry of groups that are using the water. But the actual distribution within the community we leave to the groups themselves. We just don't have the manpower. In situations that are very concrete and straightforward sometimes we get involved. But even then it's complicated because we don't have the numbers to deal with all of these issues. For example right now we have a community in Chile Chico which is operating very poorly and they asked us if we could help them by intervening but we had to tell them that it is impossible. We can't have a representative there full time. It's impossible. And what's more the people don't participate much so it doesn't make sense for us to commit our limited resources… so it's complicated.

The lack of manpower and legal authority of the DGA is at the crux of the water governance issue in Chile. The rate of water related conflicts is going to rise as more communities find their local watershed to be drying out. And although *pobladores'* are reaching out to the DGA, there is no official organization in place to address the *pobladores'* concerns.

For the Future

Above all else, there was a discernable concord amongst the *pobladores'* that the water in Aysén needs to be recognized and protected for its quality and abundance. In the following excerpt one *poblador* astutely commented:

> If we don't protect nature it affects the whole world…the water, we see it getting lower and more contaminated but we don't take care of it. We throw plastic into the rivers, garbage, cigarettes… but it is our nature, and we don't take care of it. Our society no longer takes care of the Earth. And we are the ones who need to be taking care of it, taking care of it for ourselves…for each other, for the future. (i14)

It is marked from this representative excerpt that *pobladores'* are not only concerned about their own access to water, but it is equally important that there be a high value associated with treating the natural environment with mindfulness and respect, and "we are the ones who need to be taking care of it." *Pobladores'* in Aysén view themselves as stewards of this land; not just for themselves, or for their fellow community members, but for all future generations to come. Throughout the interviews there was a clear demand amongst respondents that there not only needs to be inter-generational equitable distribution of water, but intra-generational consideration as well. This distinction and inclusivity of equity is a direct reflection of the deep-rooted values of justice and honor that the *poblador* respondents in Aysén live by. The sense of personal vulnerability and injustice communicated by the *pobladores'* can be directly tied to the mismatch between *pobladores'* ethical values and the reality of current water governance and distribution in Aysén, Chile.

Conclusion

Amongst *pobladores'* interviewed there was an incontrovertible desire for change in Chilean water governance. In addition to *pobladores'* perceptions, both the environmental rights lawyer, and the lawyer for the Aysén DGA made statements recognizing the impracticality of current water law in Chile.

> What we need is a constitutional reform- if there is reform then you can regulate a bad situation. You would be saying that these people, constitutionally, never had a right to privatize something that is common. You'd be validating an international treaty through the constitution. Because the people who have the majority of water rights are also involved in the mines and hydroelectricity, the things that drive the Chilean economy, for this to happen practically for this to function, there would have to be certain agreements made... But these types of negotiations don't happen quickly, so it will likely go slowly, starting with sanctions, new applications, and then they start to understand that they can't give something like water a major market value - that it's a free market but an ethical one.

A better solution for water governance is extremely unclear, and ushering the Chilean water market from the private to the public sector would have unpredictable, cascading implications.

There is an undeniable need to be more environmentally prudent and conscience of the reality that our shared natural resources are limited. A little bit of forethought in management practices pre-implementation can go a long way post-implementation. This is especially pertinent in the face of increased privatization and anthropogenic management of natural resources around the globe.

This chapter highlighted the perceptions of vulnerability and concerns of *pobladores'* in the Latitude 45 site in relation to water governance in Aysén. Additionally it portrayed the widespread sense of dissatisfaction with modern Chilean water law and management amongst *pobladores'* interviewed. These issues will only become further exacerbated by the onset of dramatic climatic changes. In the following chapter I conclude with a summary of the study results presented throughout this paper and close with recommendations for future research.

CHAPTER 5
CONCLUSION

This research project was organized to explore local perceptions of climate change and to analyze the factors that contribute to freshwater vulnerability for *pobladores'* in Aysén, Chile. The issues presented here demonstrate the inextricable connections between environmental and socioeconomic matters.

In chapter two, I presented a study conducted on the perceptions of *pobladores'* on the issue of climate change. The study generated accounts of changing weather, climate, and physical environment. Respondent descriptions included reports of erratic weather and consequently unpredictable ecological implications, most notably on fresh water resources. The resulting thematic analysis determined that perceptions of climatic change spurred feelings of fear and helplessness in respondents. Perceived benefits arose as well, reflecting positive aspects and opportunities emerging from the changing environmental conditions. Accounts about the dramatic change in the ecology of the region over recent decades were expressed in connection with concerns expressed by *pobladores'* in relation to their rights under current Chilean water laws.

Results from interviews about the concerns and experiences of the *pobladores'* in regards to Chilean water governance were presented in chapter three. Analysis of the data indicated widespread concern and vulnerability amongst *pobladores'* regarding their water security, while interviews suggested a lack of comprehension amongst respondents of current water law. While *pobladores'* expressed a desire for change in the current water law there was not a clear consensus amongst respondents on specifics of how water governance should be altered. Suggestions ranged from converting water to a non-privatized resource that is free to all

and managed by the government, to keeping water rights privatized but giving locals more control over management. In addition to the *pobladores'*, two Chilean lawyers were interviewed for the portion of the study presented in chapter three and concurred that the current water governance system in Chile is not working and needs to be changed. The convergence of perceived climatic changes along with *pobladores'* dissatisfaction with the current water law calls for a reassessment of national Chilean water policy.

Discussion

It is critical to highlight the importance of the specific methodology utilized in this study. Semi-structured interviews were the most pragmatic interview method for this research. The open-ended nature of semi-structured interviews allowed me to probe respondents' answers into new topics of discussion and investigate issues not previously considered an included in my original interview guide. Additionally in-depth, semi-structured interviews allow the researcher to "recognize…nuances of attitudes and behavior that might escape researchers using other methods" (Babbie 2013, 296), nuances which provide rich depth, detail and value to the overall quality of the research. In particular, field research that incorporates direct observations reveals subtleties that might otherwise not be apparent in a quantitative study.

The above described methods were chosen for their distinctive adaptability in the field, allowing for inductive exploratory research, while remaining within the structured confines of a systematic approach to population representation within a circumscribed research population- a "small-scale society" which is challenging to access and difficult to study in a non-face-to-face setting (Babbie 2013; Creswell 2009).

Future Research

Further research is necessary to better understand the impact of current Chilean water law

on the water availability vulnerabilities as well as *pobladores'* vulnerabilities in the Chilean Patagonia. Additionally, monitoring of the environment, with a particular focus on hydrographic and meteorological data will help to corroborate *pobladores'* perceptions and increase understanding of what future changes might entail. These research objectives, along with continued community engagement are the crux of sensible and equitable future water governance decisions in Chile.

Conclusion

Water is a fundamental necessity for life. It is always in demand and thus the supply is in a perpetually constant flux. As global climate change continues to distort the ecosystems we once believed we could control and predict, I believe that we will see the water crisis become increasingly pervasive and severe. Notably, a significantly large majority of our fresh water comes directly from mountains, predominantly isolated marginalized regions. It is thus imperative that a concrete universal water ethic and international policies be realized as issues water scarcity become more pronounced and severe.

In a report entitled *The Ethical Implications of Global Climate Change* published by UNESCO (2010, .32) and compiled by the World Commission on the Ethics of Scientific Knowledge and Technology, the issues of "intergenerational equity" are discussed "with respect to the long-range consequences of climate change." This report ultimately determines that it is "ethically imperative to consider with care how to weigh future costs and benefits and to devote serious attention to assessing them" (COMEST 2010, .32) The COMEST team appropriately point out that ethics should not be viewed as "something added on top of other issues related to climate change, but rather a constitutive part of all of the reasonably justifiable responses to the challenges of climate change" (COMEST 2010, #?). COMEST appeals to the most basic human

emotional heartstrings: to do what is right, at the very least, for a fellow human being. COMEST (2010, 38) declared in its 2010 report the following:

> It can be stated unequivocally that climate change cannot be dealt with adequately and properly if the ethical dimensions discussed in this report are not highlighted, well understood, and taken into account in decisions about responses. The purpose of this report was therefore not to make climate change a (new) theme of ethics, but rather to make ethics a core and necessary element of any debate about climate change and its challenges.

Climate change is having impacts on current world citizens and will undoubtedly carry intergenerational impacts as well. In order to ensure the protection of the most vulnerable members of society, it is necessary to identify who those groups are and to aid in implementing support systems before hazards become reality. It is therefore crucial that, when making future decision on natural resources, that the Chilean government considers the perspective held by many *pobladores'* that the public has communal rights to the nations natural resources and, as such, the interests of all members of society who are affected by the decision should be taken into account. This sort of democratic criterion would reduce elitist decisions from being made about commonly owned resources.

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Appendix

Interview Guide

Preliminary/Background Information

How long have you been living in the region?

Probes: What brought you to the region?

Where did you move from?

How would you describe your work/involvement in the local community?

Use and Observations

In which ways do you use and interact with water in your day-to-day life?

Can you describe a typical day and how you use and interact with water throughout the day?

How does this routine change through the changing seasons?

What changes have you observed in the local watersheds during your time living in the region?

What factors do you think have contributed to these changes?

Do you think these changes are temporary or permanent?

What kinds of changes in precipitation patterns have you observed?

Probes: How have these changes altered or impacted your use and interaction with water?

What factors do you think have contributed to these changes?

Do you think these changes are temporary or permanent?

Extraction

What is your primary source for irrigation and potable water?

Solicitation

Did you have to solicit rights to that water?

Probe: Can you walk me through the process of soliciting the water rights?

Management

How is water managed in this region?

What do you think is being done well with the water management?

What do you think could be done better with the water management?

Participation

How much control do you have in the management of local water resources?

Would you like to have more/less? Why?

Wrap Up

Is there anything else you would like to say about water?

Do you think there is anything I should be asking about these topics that I'm not already asking?

Is there anyone else you recommend I talk to?

Would it be okay if I let them know you recommended that I talk to them?

Participant Verbal Consent Script

Verbal Consent Script

Thank you for agreeing to participate in this study. Your participation is expectedto take about 45 minutes. During this time you will be asked a few open-ended questions about your experience living in the region.

If you're at any point feel uncomfortable for any reason and would like to stop participating, that is okay, please just let me know and we will stop the interview. Should you choose to participate in the interview, your data will be securely stored and coded, so your responses will remain confidential.

If you have any questions, just ask me. Then, if you agree with the content of this verbal consent, state your name and that you consent.

IRB Approval

UNIVERSITY OF MONTANA

INSTITUTIONAL REVIEW BOARD
for the Protection of Human Subjects in Research
FWA 00000078
Research & Creative Scholarship
University Hall 116
University of Montana
Missoula, MT 59812
Phone 406-243-6672 | Fax 406-243-6330

Date: October 21, 2014

To: Michal Helman, Forestry and Conservation
Noel Dane Scott, Forestry and Conservation

From: Paula A. Baker, IRB Chair and Manager

RE: IRB #198-14: "Rancher Observations of Changes in Precipitation Patterns, Fresh Water Ecosystem Health, and Potable Water Management in Lago Paloma, Chile"

Your IRB proposal cited above has been **approved** under the **Exempt** category of review by the Institutional Review Board in accordance with the Code of Federal Regulations, Part 46, section 101. The specific paragraph which applies to your research is:

X (b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

University of Montana IRB policy does not require you to file an annual Continuation Report for exempt studies as there is no expiration date on the approval. However, you are required to notify the IRB of the following:

Amendments: Any changes to the originally-approved protocol must be reviewed and approved by the IRB ***before*** being made (unless extremely minor). Requests must be submitted using Form RA-110.

Unanticipated or Adverse Events: You are required to timely notify the IRB if any unanticipated or adverse events occur during the study, if you experience an increased risk to the participants, or if you have participants withdraw from the study or register complaints about the study. Use Form RA-111.

Please contact the IRB office with any questions at (406) 243-6672 or email irb@umontana.edu.

Form RA-108
(Rev. 08/14)

VP RESEARCH & DEV. OCT 17 2014 THE UNIV. OF MONTANA

THE UNIVERSITY OF MONTANA-MISSOULA
Institutional Review Board (IRB)
for the Protection of Human Subjects in Research
CHECKLIST / APPLICATION

IRB Protocol No.: 198-14

At the University of Montana (UM), the Institutional Review Board (IRB) is the institutional review body responsible for oversight of all research activities involving human subjects outlined in the U.S. Department of Health and Human Services' Office of Human Research Protection and the National Institutes of Health, Inclusion of Children Policy Implementation.

Instructions: A separate application form must be submitted for each project. IRB proposals are approved for no longer than one year and must be continued annually (unless Exempt). Faculty and students may email the completed form as a Word document to *IRB@umontana.edu*. or submit a hardcopy to the Office of the Vice President for Research & Creative Scholarship, University Hall 116. Student applications must be accompanied by email authorization by the supervising faculty member or a signed hard copy. *All fields must be completed. If an item does not apply to this project, write in: n/a.* Questions? Call the IRB office at 243-6672.

1. Administrative Information

Project Title: Rancher Observations of Changes in Precipitation Patterns, Fresh Water Ecosystem Health, and Potable Water Management in Lago Paloma, Chile.	
Principal Investigator: Michal Helman	UM Position: Student
Department: College of Forestry and Conservation	Office location: MLIB 461
Work Phone:	Cell Phone: 734-834-6485

2. Human Subjects Protection Training

(All researchers, including faculty supervisors for student projects, must have completed a self-study course on protection of human research subjects ***within the last three years*** *and be able to supply the "Certificate(s) of Completion" upon request. If you need to add rows for more people, use the Additional Researchers Addendum.*

All Research Team Members (list yourself first)	**PI**	**CO-PI**	**Faculty Supervisor**	**Research Assistant**	**DATE COMPLETED Human Subjects Protection Course**
Name: Michal Helman Email: michal.helman@umontana.edu	☒	☐	☐	☐	9/17/2014
Name: Noel Dane Scott Email:	☐	☐	☒	☐	
Name: Email:	☐	☐	☐	☐	
Name: Email:	☐	☐	☐	☐	

3. Project Funding

(If federally funded, you must submit a copy of the abstract or Statement of Work.)

Is grant application currently under review at a grant funding agency? ☐Yes *(If yes, cite sponsor on ICF if applicable)* ☒No		Has grant proposal received approval and funding? ☐Yes *(If yes, cite sponsor on ICF if applicable)* ☒No		
Agency	Grant No.	Start Date	End Date	PI on grant

For UM-IRB Use Only

IRB Determination:

Note to PI: Non-exempt studies are approved for one year only. Use any attached IRB-approved forms (signed/dated) as "masters" when preparing copies. If continuing beyond the expiration date, a continuation report must be submitted. Notify the IRB if any significant changes or unanticipated events occur. When the study is completed, a closure report must be submitted. Failure to follow these directions constitutes non-compliance with UM policy.

___ Not Human Subjects Research
X Approved by Exempt Review, Category # 2 *(see memo)*
___ Approved by Expedited Review, Category #___ *(see* **Note to PI***)*
___ Full IRB Determination
___ Approved *(see* **Note to PI***)*
___ Conditional Approval *(see memo)* - IRB Chair Signature/Date: _____
___ Conditions Met *(see* **Note to PI***)*
___ Resubmit Proposal *(see memo)*
___ Disapproved *(see memo)*

Risk Level: Minimal

Final Approval by IRB Chair/Manager: Rachel A Bates Date: 10/21/2014 Expires: N/A

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