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Water Resource Change and Management: Implications of Climate Change and Water Resource Management for Pastoral Herders in Bayan Ulgii

Rachel Ryan
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Water Resource Change and Management:
Implications of Climate Change and Water Resource Management for Pastoral Herders in Bayan Ulgii

Ryan, Rachel
Academic Director: Sanjaasuren, Ulziijargal.
Project Advisor: Bayasgalan, Onon
University of Denver
International Studies and Strategic Communications
Mongolia, Bayan Ulgii

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Abstract

Mongolia is the 8th most vulnerable country in the world to climate change. The water regime of Mongolia is therefore experiencing intensive change with significant effects in the availability, distribution, and security of water resources. The implications of this change are exacerbated when aligned with poor water resource management, an issue that is prevalent as water regime change challenges current water management systems. These implications specifically affect the vulnerable rural population of Mongolian herders who maintain the practice of nomadic pastoralism. In the western province of Bayan Ulgii, the change in the numerous glaciers and other water resources that are the foundation of the livelihood of nomadic herders is significant. Thus, this study explores the implications of climate change on water resources and nomadic herders in Bayan Ulgii. In addition, this study explores the current Mongolian water management system at a local level and herder perceptions and interactions with this management. In doing so, this study assesses the current water management system and its ability to address herder vulnerabilities to changing water resources. Through interviews and observations in Ulgii aimag center, Altai soum, Altansugts soum, and Ulaanbaatar with 16 herders and 8 specialists, the significant effect of climate change on water resources is understood. Moreover, these changes pose challenges to herders’ livelihoods in regards to water supply and livestock health, fodder and pastureland health, and flooding disasters. Due to a lack of local capacity in implementing and participating in water management activity decision-making, these current challenges and water resource changes will further exacerbate herder vulnerability to climate change.
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Terminology

White Dzud: A severe winter in which high snowfall inhibits livestock from accessing grass.
Aimag: Administrative unit of Mongolian, also known as a province. There are 21 provinces in Mongolia.
Soum: A second level administrative unit of Mongolia and a subdivision of an aimag.
Bag: A third level administrative unit of Mongolia and subdivision of soum. Often, there are several bags that make up a soum.
Small governor: Leader of bag administrative unit.
Bayan Ulgii aimag: Western province of Mongolia.
Altai soum: Soum of Bayan Ulgii. Altai soum has five bags.
Altansugts soum: Soum of Bayan Ulgii
Ulaanbaatar: Capital of Mongolia in which almost half of the Mongolian population resides.

Abbreviations

ICDD International Center for Development and Decent Work
IWRM Integrated Water Resource Management
MARCC-2014 Mongolian Second Assessment Report on Climate Change
NGO Non-governmental Organization
OECD Organization for Economic Co-operation and Development
RWSS Rural Water Supply and Sanitation
Introduction

Mongolia is a land of extremes, of sand and desert, of grassland and of forests, and of a province in the far Western corner that is defined by jutting snow capped peaks, vast and numerous glaciers, and winding rivers. This Western Mongolian province is Bayan Ulgii. It is home to a population of nomadic herders and eagle hunters interspersed throughout the glaciers, mountain ranges, rivers, and lakes. Yet there is a change occurring to these waters and to these herders, climate change. As the climate changes, the water regime also intensifies, causing gradual yet significant changes in the availability and distribution of water resources and supply. The implications of this change are significant, especially in western Mongolia where the high elevation and inland location contributes to the intensive experience of climate change (Khovd Buyant River Basin Council, 2012, p. 11). Thus, in Bayan Ulgii, precipitation, river flow, glacier, and snowmelt are changing. The implications are significant for all province inhabitants but most significantly for one of the most climate change vulnerable populations, nomadic herders. The pastoralist livelihoods are directly reliant on their livestock and the resources in which sustain the livestock. Water is therefore a necessity, but a necessity that is changing in availability and distribution.

The academic world is increasingly recognizing the implications of this change, not only on water resources but also on water management systems. Climate change, as explained by the Organization for Economic Co-operation and Development (OECD), aggravates and exacerbates existing issues and complicates “future planning, management, and investment in water infrastructure” (2013, p. 13). Water trends and issues are no longer static, but instead dynamic and unreliable. Thus, climate change and water resource change implications cannot be understood without an understanding of the current water management system in place. A report on The Implications of Projected Climate Change for Freshwater Resources and their Management (2008) states, “that billions of people in water stressed areas will be adversely affected by climate change” (p. 6). However, the report continues by saying that the actual number of people impacted depends on the ability of water management to adapt (2008, p. 6). Thus, it is necessary to understand and assess the ability of water management systems to be receptive and observant of climate change and water resource change. As the impacts of climate change increase and become more costly and significant, effective mitigation and adaptation techniques will be needed. This necessitates a water management infrastructure that can meet these demands.

As a relatively young country to democratic and decentralized management of resources, there are still barriers to water resource management at a local level in Mongolia.
Therefore, the implications of growing change in water resources are significant. This study is thus defined by four different aims: **Aim I** To explore the implications of climate change on water resources in Bayan Ulgii; **Aim II** To explore implications of water resource change on pastoral herders in Bayan Ulgii; **Aim III** To explore the current water management system at a local level and herder perceptions and interactions with this management; **Aim IV** To assess the water management system and its ability to address herder vulnerabilities to changing water resources. The study will thus analyze current and future data trends regarding climate change with a narrow focus on the region of Bayan Ulgii. This case study location has a variety of water resources, including glaciers, and thus provides a full understanding of how climate change affects water resources. In addition, the current water management system and possible weaknesses of such a system will be explored through literature. Interviews with herders will provide an understanding of perceived water resource change and management. These interviews will also provide the perception of water resource management at a local, rural level. Interviews with specialists such as Ulgii government officials and environmental specialists will provide a holistic understanding of water resource change and water resource management. Through this exploration and assessment, an overall analysis of water resource change and water resource management will be provided in respects to vulnerability of Bayan Ulgii herders.

**Mongolia and Bayan Ulgii Demographic and Geography:**

Mongolia is a large, landlocked country between Russia and China, located on the North Central Asian Plateau. This study focuses on the most western province of Mongolia, Bayan Ulgii. Bayan Ulgii is located in the Khar-Lake Khovd River basin, basin number 28 as defined by the *Integrated Water Management Plan: Mongolia 2013* (p. 57). Of Mongolia’s relatively small population of 2.96 million people, 149.1 thousand persons live in the Khar-Lake Khovd river basin, 26.6 million living in soums and 66.4 million living in rural settings (Ministry of Environment and Green Development, 2013, p. 57).

In Mongolia, total freshwater resources consist of lakes, which store 500 km$^3$ of water and glaciers in which 19.4 km$^3$ per year contribute to Mongolia’s freshwater resources (Ministry of Environment and Green Development of Mongolia, 2014, p. 109). In Bayan Ulgii, the total cubic kilometers of surface water is 2.39. Of this surface water, only 0.29 km$^3$ are available (*Strengthening Integrated Water Resources in Mongolia* and the Ministry of Environment and Green Development, 2012, p. 23). According to the Mongolian Second Assessment Report on Climate Change (MARCC-2-14), only 6.2 percent of surface water is
contained in rivers and 4.4 percent of resources derive from direct runoff from rainfall and snowmelt (p.109). Though a small percent, rivers and runoff are major sources of water supply for rural populations.

The Khar-Lake Khovd River basin and therefore Bayan Ulgii is located in the Internal Drainage Basin. The rivers and water discharge thus flow from the Altai Mountains, located in the western section of Bayan Ulgii (Batima, 2006, p. 24). According to the Integrated Water Management National Assessment Report Volume 1 (2012), the density of the river network is concentrated upstream in areas such as the Altai Mountains, Khetii, and Khangai mountain regions (p. 20). In addition, the Khar-Lake Khovd river basin holds 96 percent of glaciers recorded in Mongolia (Khovd Buyant River Basin Council, 2011, p. 3). The Altai Mountain range, as well as the Khanai, Khuvsgul, and Great Kyangan mountain ranges produce 70 percent of surface water (Withanachchi et al., 2014, p. 8).

The population specifically targeted in this research is herders practicing nomadic pastoralism. Nomadic pastoralism is a traditional practice in Mongolia in which livestock herding is a main source of income and livelihood. They move at least four times a year in order to access pasturelands for grazing and other natural resources. Nomadic and semi nomadic pastoralism herders’ food, water, and income are highly dependent on the availability and maintenance of the natural resources and landscapes in which they live. In Mongolia, livestock herding contributes to 20.6 percent of the GNP and provides 40 percent of Mongolian employment (Usukh, Binswanger-Mkhize, Himmelsbach & Schuler, 2010, p. 10). However, recent trends as provided by Mongolian Society for Range Management (2010), reflect that half of the rural population is living in poverty (Usukh, Binswanger-
Mkhize, Himmelsbach, & Schuler, 2010, p. 10). According to Mongolia Human Development Report (2011), the lowest GDP per capita in 2010 was in Bayan Ulgii, an aimag that is both remote and contains a population that lives in a majority of rural areas, practicing nomadic herding (p. 46). Thus, the herders of Bayan Ulgii are some of the most vulnerable populations in Mongolia to changes in resources. Demographically, a majority of the inhabitants of the Bayan Ulgii province are Kazakh, descendants of the large movement of refugees to Mongolia almost a century ago. Because of this Kazakh descent and the rising tourism in the area, eagle hunting has become a popular tradition for herders in the province. Eagle hunting is practiced in the free time of a herder for sport and tradition.

**Climate change: Global water resource change and implications:**

According to UN Water, water is the “primary medium through which climate change influences Earth’s ecosystems and thus the livelihood and well being of societies” (UN Water, 2014). By 2050, it is projected that the global area experiencing water stress will double (Dhakal, Silwal, & Khanal, 2010, p. 7). This stress derives from climate change’s implications on water resources and therefore populations. These implications extend from “agricultural productivity, malnutrition, human health and sanitation” to increased stress on infrastructure and agricultural land (Dhakal, Silwal, & Khanal, 2010, p. 7). The implications of a changing hydrosphere and cyrosphere paralleled by increasing populations and population movements necessitates an understanding of how water resources are changing and what the implications of these changes are.

An OECD report on water and climate change took a survey of 34 countries to understand climate change effects on water resources and adaptation policies. The extent that water and water management influenced the 34 countries was apparent in other sectors such as energy, agriculture, infrastructure, biodiversity, and health (2013, p. 14). This therefore expresses the importance and far reaching impact water resource change has on current global populations. The survey concluded that almost all countries project increasing water risks due to climate change such as extreme events, water shortage, water quality, and water supply and sanitation (OECD, 2013, p. 14). In addition, global climate change affects shifting precipitation patterns, changing rainy seasons, and the timing and amount of melt water (p. 13). As a warmer atmosphere speeds up the water cycle, it will result in intensified precipitation and evapotranspiration changes (OECD, 2013, p. 23). Moreover, OECD (2013) explained that this accelerated water cycle results in a growing uncertainty regarding the availability and distribution of water resources (p. 33). The understanding of climate change
on water resources expressed in the OECD report will be the foundation for a further analysis of climate change implications on Mongolia in the following section.

**Climate Change in Bayan Ulgii: Water Resource Change and Implications:**

Mongolia is one of the most vulnerable countries in the world to climate change due to both the vulnerable ecosystem and the dependency of nomadic and pastoral communities’ on the availability of natural resources. As confirmed in above findings, water resources are acutely affected by climate change and therefore reflect past, current, and projected change. As described in a report on the implications of climate change on water resources and management, “Changes in the distribution of river flows and groundwater recharge over space and time are determined by changes in temperature, evaporation, and crucially, precipitation (Kundzewixz et. al., 2008 ,p. 3). In this study, the understanding of climate change and water resource change will analyze air temperature, precipitation and evaporation, glacier and snow cover, and freshwater water sources. The changes in these main contributors of water supply for herders will thus be analyzed. As such, this section will analyze current and relevant studies on the changes to water resources in Mongolia due to climate change. Human induced issues, such as water sanitation, will not be analyzed though the implications of climate change on water resources will exacerbate these current issues.

**Air Temperature**

According to 48 Mongolian meteorological stations, the air temperature and land surface in Mongolia has increased by 2.07 degrees Celsius, an increase that is felt more intensively in mountainous regions such as Bayan Ulgii (Ministry of Environment and Green Development of Mongolia, 2014, p 69). In addition, the projected temperature increase from 2016 to 2035 during the winter ranges from 2.1 to 2.3 C and during the summer from 2.1 to 2.2 Celsius. In the western region of Mongolia, the increase in temperature in the summer has the possibility of increasing by 5 to 5.5 degrees Celsius in the summer (Ministry of Environment and Green Development of Mongolia, 2014, p 77).

**Precipitation**

As expressed in MARCC-2014, climate change has a significant effect on the hydrologic cycle, therefore increasing precipitation and evaporation (p. 23). This general trend is looked at in a more narrow focus in relation to the western region in which Bayan Ulgii is located. MARCC-2014 states that by the end of the century, the summer
precipitation will be decreased by 5 to 10 percent while the winter precipitation will increase by 55 to 75 percent. Overall, in Mongolia it is likely that there will be an increase in precipitation during the winter, while the summer will experience a short term decrease in precipitation but a possible slight increase in the long term (Mongolia Human Development Report, 2011, p. 33). In addition to the general trend of increase in precipitation, MARCC-2014 projects an increase in an increase of volume of rain during the growing season (p. 77). A significant implication of this growing trend is the effect of intense waterfall on land and increased erosion, in some cases resulting in 500 to 600 tons of lost soil (Ministry of Environment and Green Development of Mongolia, 2014, p 134). In the last 10 years, soil erosion has increased in northern areas of Mongolia due to the increase intensive rainfall. This situation is present in the Altai Mountains, a high mountainous region in which water intensity and erosion are present (Ministry of Environment and Green Development of Mongolia, 2014, p 134).

Evaporation

MARCC-2014 projects that alongside precipitation a major concern is the increase in evaporation, which in Altai, Bayan Ulgii will increase by 2.64 in 2020, 22.70 in 2050, and 62.19 in 2080. (p. 92). In high mountain areas, the past 60 years have reflected an increase of evaporation of 10.2 to 15% and future evaporation from open surface water is projected in high mountain areas to increase 2.5 times (Ministry of Environment and Green Development of Mongolia, 2014, p 116). By 2050, this significant increase in evaporation could exceed the increase in precipitation by six to ten percent (Ministry of Environment and Green Development of Mongolia, 2014, p 112).

Cryosphere: Glaciers, Permafrost, and Snow cover

A reason for the focus on Bayan Ulgii aimag is the amount of glaciers that are located in the province. In total, there are 580 glaciers in Mongolia, 96 percent of these glaciers are located in the Khar-Lake Khovd River Basin (Khar-Lake Khovd Basin Council, 2011, p. 6). Since 1940, these glaciers have melted by 30 percent. The Potanin Glacier in Bayan Ulgii has melted 15.5 meters in the last 12 years (Ministry of Environment and Green Development of Mongolia, 2014, p. 64). In addition, the Tsambagarav glacier, a flat top glacier located in Bayan Ulgii, experiences more intense retreating due to its flat top structure. The effects of this increase in glacier melt were expressed in the changes of the Kharkhiraa River, a river in the western region of Mongolia. MARCC-2014 report stated that the annual discharge of the
river is expected to decrease slightly from 2011 to 2030 and significantly between 2046 and 2065 (76.9%) (Ministry of Environment and Green Development of Mongolia, p. 124). Thus, as glaciers melt due to warming, there will be a short term increase in river flows but a long term decline following the disappearance of glaciers (Kundzewicz et. al, 2008, p. 5). These glaciers sustain the lives of herders and residents of the province. Thus, the change in glacier size and melt is significant.

In addition to change in precipitation, there have been noticeable changes specifically regarding snowfall and snow cover. In a MARCC-2009 Report, it was found that the total coverage area of snow will decrease in Mongolia (p. 60). Snow cover, continued in the MARCC-2009 Report, is important both to the Mongolian ecosystem and herder livelihoods. It provides insulation and protection for deep soil, is a water source for herders and their livestock, and provides melt water for rivers in the spring (Ministry of Environment, Nature, and Tourism, 2009, p. 58). If there is too much snowfall, however, it is called white dzud, which negatively affects food availability and production for herders. On the contrary, black dzud in which there are low levels of snowfall and snow cover, results in a lack of drinking water for herders and livestock (Ministry of Environment, Nature, and Tourism 2009, p. 58).

**Surface Water Sources**

The change in precipitation, evaporation, and glacier melt have affected the number, water level, and therefore availability of water bodies in Mongolia and in Bayan Ulgii. For example, the changes in glacier melt affects “important stores of water” and the changes therefore affect the downstream long-term water supply (Ministry of Environment and Green Development of Mongolia, 2014, p 54). In a report on *Climate Change Vulnerability and Adaptation in the Livestock Sector of Mongolia* (2006), it was stated that there had been a decrease of 36 percent in water body levels (p. 43). In Bayan Olgii, the Mongolian government has monitored overall totals of water bodies. In 2007, 11 rivers had dried out, 253 springs had dried out, and 179 lakes

![Surface Water Drying Up, Mongolia, 2003 and 2007](image)
had dried out. In comparison, in 2011 no rivers had dried out, 59 springs had dried out, and no lakes had dried out (National Statistic Office of Mongolia, 2014, p. 185-186). When compared to the overall change in water bodies of Mongolia, the changes in Bayan Ulgii’s surface water differs from the total change of water bodies in Mongolia as seen in Figure 2. This may be attributed to the high mountainous placement and increase in glacier and ice melt. The decrease of water body loss in Bayan Ulgii can be attributed to the increase in snow and glacier melt, resulting in increase in river discharge in high mountainous areas.

Implications of Water Resource Change on Herding Populations:

As stated by Mongolia Human Development Report (2011), “climate change may increase variability, diminish water resources, and increase vulnerability especially of the poor people” (p. 34). “Poor people” can more specifically be defined as the rural populations in Mongolia who practice herding. Bayan Ulgii has the lowest GDP and therefore their rural populations are even more economically vulnerable. Climate change will affect water resources and as such will put human populations and livestock at risk of these implications. These risks resulting from changing water resources is extensive and most acutely felt by the vulnerable herding populations in Mongolia. This section will summarize the main findings of how changing water resources, as explored in the above section, affect herders’ livelihoods and contribute to a growing vulnerability to climate change and its implications.

Herder income and livelihood heavily depend on the health of their livestock. As expressed in MARCC-2104, climate and water resource change can impact pastoral livestock directly and indirectly. Heavy snow and storms directly influence animal grazing and inhibit proper weight gain in the summer and autumn. This then prevents animals from surviving the harsh winters and spring (Ministry of Environment and Green Development, 2014, p. 143). In addition, impact of water on pastureland health, such as increase in erosion or changing in melt and river flow, can indirectly affect the weight and survival rates of livestock. For example, according to Batima (2006), the water regime is defined by a winter low flow from December to April, spring runoff from snowmelt from April to June, summer runoff due to rainfall from June to September, and warm season low water discharge from September to December (p. 25). However, due to increased air temperature, the earlier snowmelt has resulted in an increased starting date for spring runoff resulting in a negative impact on the biomass of spring pastureland. This pastureland degradation therefore affects the timing of movement of herders and development of their livestock.
The decrease and change of water bodies and the projected intensification of evaporation and dryness will have challenging effects on water supply for pastoral livestock (Ministry of Environment and Green Development of Mongolia, 2014, p 148). For example, the increase in temperature will cause a decline in water levels of open pools in steppe regions (Ministry of Environment and Green Development of Mongolia, 2014, p. 159). As most livestock’s water supply is from these surface water bodies, the implications of these changes are significant. In addition, future trends according to MARCC-2014 report projected summer rainfall decrease while increases in precipitation in the winter (p. 159). This change therefore increases the likelihood of spring flood dangers of local rivers in mountainous regions. The low precipitation in the summer and increased dryness also contribute to decreased yields of natural hay and fodder production, which is a main source of sustenance for horses and other livestock during dzuds (Khovd Buyant River Basin Council, 2011, p. 14). Thus, herders will irrigate their hay production by spilling over the irrigation channels, an unsustainable water practice induced by changing climate patterns and water availability. Figure 3 is a graphical representation of 100 responses of stakeholder perceptions of climate change and environment factors and how they affect the daily lives of people. The aimags of the respondents were Khovsgol, Ovorkhangai, Tov, and Orkhon. Lack of water and water contamination is the third environmental factor that significantly affects the daily life of people.

Though drinking water for human populations is not an expressed concern in literature regarding Bayan Ulgii, other countries are currently facing the implications of the decreased drinking water access. For example, in a report on the Assessment of Climate Impacts on Water Resources and Vulnerability in Hills of Nepal (2010), the researcher states that drying water sources has become an issue, resulting to forty nine percent of households having to shift to another water sources (p. 19). Women are therefore more vulnerable to this
shift in water access, as they are responsible for obtaining water for domestic needs (Dhakal, Silwal, & Khanal, 2010, p. 20). Though a report on Mongolia Human Development (2011) states that the male involvement of water collection responsibilities is more involved than in other country assumptions, it is still a relevant concern for implications of water (p. 62). In Nepal, significant water stress is felt in the agriculture sector, similar to Mongolia.

**Water Resource Management in Mongolia:**

Water resource management is a major method to address and mitigate the vulnerabilities derived from climate and water resource change. The Integrated Water Management Plan (2013) is currently the system in which the Mongolian government addresses the implications of climate change on water resources. The current system and possible issues of water resource management system in Mongolia will be addressed and explored.

In 1990, natural resources were managed with specific planning frameworks that paralleled the socialist national objectives (UNDAF, 2012, p. 4). However, following the transition to democracy and 1992 Constitution, Mongolia has pursued growing decentralized structures in management and governance. The government structure is now based on 21 aimags, which are then divided into soums (Ministry of Environment and Green Development, 2013, p. 86). These soums are further divided into bags. Bags are managed by small governors, while soums and aimags are managed by governors. Since the instatement of democracy and decentralization of governance and management, water law and policy has been designed under an Integrated Water Resource Management System. This system is reflected in Figure 4. Water resource policy is therefore under the responsibility of the Ministry of Environment and Green Development. According to the Integrated Water Resource Management Plan of Mongolia (2013), the government ministries are involved in water resource management at the level of local administration at the aimag and soum level (p. 87). At a local level, the governor prepares the budget for implementing “water supplies, water resources and water restoration, protection of water quality, and prevention from water related disasters” (Ministry of Environment and Green Development, 2013, p. 88). The Department of Nature, Environment, and Tourism manage water issues and communicate with the governor’s office regarding these issues as well as the Ministry of Environment and Green Development and the Water Authority (Ministry of Environment and Green Development, 2013, p. 88).
In the *Integrated Water Management Plan of Mongolia* (2013) the second of the two sections regarding water management at a local level discusses the Water Basins. In 2004, the water basin councils were established as institutional bodies to manage water at a local level (Ministry of Environment and Green Development, 2013, p. 87). These Water Basin Authorities are “technical officers” who receive guidance from the Water Authority. They implement water management activities in their respective water basins (Ministry of Environment and Green Development, 2013, p. 88). In Mongolia, there are 29 river basins. See Figure 5. The Khar Lake-Khovd River Basin, in which Bayan Ulgii resides (far west, orange section in Figure 5), supports 29 soums and three different aimags (Khovd Buyant River Basin Council, 2011p. 6). The Khar Lake-Khovd Rive Basin has two River Basin Councils, Khovd (15 members) and Buyant (13 members) (Khovd Buyant River Basin Council, 2011, p 9). In the *Integrated Water Resource Management Plan for Khar Lake-Khovd River Basin* (2011), the Khar-Lake Khovd Council states, “In order to ensure the efficient enforcement of the river basin management plan, RBC’s cooperate with local government authorities and specialized institutions” (p. 9).
Weaknesses of Mongolian Water Resource Management:

The River Basin system of management is an attempt of the Mongolian country to implement an integrated resource management system and increase the amount of stakeholder participation. However, by breaking down the Mongolian landscape into 29 river basins as the scale in which water resource management is conducted, several problems arise. As stated by Withanachchi et. Al. (2014) in an argument of (Re)configuration of Water Resources Management in Mongolia, legislation and the establishment of institutional framework is not a process that occurs naturally under the River Basin system (p. 10). The 29 basins are not just individual river basins and ecosystems; they each have several political administrations, economies, and peoples. Therefore the scale in which water is managed is not conducive of proper water management and implementation for local scale management. A suggested solution to the issues posed by river basins is the establishment of sub-basin management systems (Withanachchi et. al., 2014, p. 33). In this way, the “policy-social dialogue” would be strengthened (Withanachchi et. al., 2014, p. 33).

The above issues on the scale of water resource management are strengthened in a project proposal for approaching water resource management by eco-region. A recent project on Ecosystem Based Adaptation Approach to Maintaining Water Security in Critical Water Catchments in Mongolia (2012) explained the current barriers to responding to climate change induced problems in regards to water management. The issue is founded, as explained by UNDAF, in that there are currently no models for soum level water management (p.8). Due to this lack in model and system in which to manage water resources, the decision-making framework is essentially nonexistent, allowing for a continual degradation or lack of attention to key natural resources (UNDAF, 2012, p. 8). Even when soums create a management system of water use they lack the support from the aimag and national government to “identify, monitor, and address climate change vulnerability” alongside water resource change (UNDAF, 2012, p. 8). In a report created by the International Center for Development and Decent Work (2014), the situation of local government institutions and lack of capacity is explained as that local government institutions, such as soum and bag, have little self-governing power due to “a lack of financial power, human and technical capacities, and power and responsibilities” (Withanachchi et. al., p. 33). Moreover, public involvement in decision-making is limited and coordination between soums for resource management has been neglected. This thus leaves a situation in which soums make individual decisions, which has the potential to lead to conflicting management decisions (UNDAF, 2012, p. 8).
In consideration to the policy level of Mongolia, a report on the *Rural Water Supply and Sanitation in Mongolia* (2009) stated that currently no central agency has been given the task of maintaining Millennium Development Goals (MDG) regarding water and sanitation (p. 33). In addition there is no law similar to the Water Law of 2004, which focuses on Rural Water Supply and Sanitation (RWSS) (p. 38). Thus, Rural Water Supply and Sanitation is distributed between several laws leading to institutional gaps in addressing key issues. These mismanagements and institutional gaps results in no central level planning for the provisions such as human resources and finances to address issues in the Rural Water section. Moreover, there is no strong facilitation at the policy level of MDG goals or RWSS given to the responsibility of the soum and aimag level. As stated in the RWSS report, given that Mongolia is still a centralized state with weak local government capacity, the gaps are significant (Basandorj & Singh, 2009, p. 38).

The implications of mismanagement in the face of climate change are consequential. In an *Integrated Water Management National Assessment Report* (2012), it is stated that the interest in water planning is not so much in the change of the climate but the impact on the water management system (p. 258). The Ministry of Environment and Green Development of Mongolia’s report on *Climate Change Assessment Report* (2014) continues the importance of water management by stating that mismanagement of water resources has already caused an increase in tension due to water scarcity (p. 201). Though this occurred in arid areas, the implications of mismanagement in all areas of Mongolia are significant. Misuse in irrigation of fodder and hay-making has been an expressed concern and issue by the Ministry of Environment and Green Development (2014, p. 55). IWRM therefore needs to be designed to address and cope with future climate change implications at a local scale.

**Methodology**

**Location**

In order to develop the narrative and analysis of climate change implications and water resource management, Bayan Ulgii was selected as the province of study. As aforementioned, this province is the location consists of multiple water resources. Two soums were selected in order to understand two different herding populations interactions and perception of changes in water resources.

Altai soum and Altansugts soum were the two locations for this study. Altai soum is located 65 miles from Ulgii, the aimag center, at the base of the Altai Mountains. This
location provided the opportunity to interview a community in a region that is at the very beginning of the water access for Mongolia. Altai soum experiences the Altai Mountain water discharge and snowmelt, giving herding communities one of the best water access situations in Bayan Olgii. Three people were interviewed that live in the soum center during the winter, though two travel to their ger in the countryside during the summer. The rest of the participants of Altai soum interviews lived in their winter homes about 5 to 15 km from Altai soum center. Sixteen herders were interviewed in Altai soum.

Altansugts was the second soum in which interviews and observations were conducted. This soum is located further downstream along the Khovd River, about 30 miles from Ulgii. Altansugts soum is located at a lower elevation than Altai, which made this location optimal for comparison and holistic understanding of climate change implications. In addition, many of the herder inhabitants near Altansugts soum travel to Trsambagarav National Park and attain water access derived from Trsambagarav Glacier. This population therefore maintains a livelihood on water resources available from glaciers. Of the five participants, only one herder lived directly in the soum center and traveled to the summer ger in the summer. The other herders lived a similar distance from the soum center as Altai herders.

Ulgii and Ulaanbaatar were the two other locations in which interviews and information gathering were conducted. In Ulgii, government officials, officers of the Department of Tourism and Environment, and an Environmental officer were interviewed. In addition, the head of an NGO that manages herders and natural resources in Bayan Ulgii and a tourism specialist with a background in Chemistry and Ecology was interviewed. One soum Animal Doctor was also interviewed. He managed Baig animal doctors of the soum. In total, seven specialists were interviewed in Ulgii and the other soum in which the animal doctor worked. In Ulaanbaatar, a specialist on the meteorology and hydrology patterns in Mongolia was interviewed.

Five days of interviewing and observations were conducted in Altai. Three days of interviewing and observations were conducted in Altansugts. A total of three days were spent...
in Ulgii for interviewing and one day of interviewing in Ulaanbaatar. In each location in Bayan Ulgii, observations were conducted through visits to herders and their locations in relation to water resources. Other observations included a short visit to Tulbo Lake, horseback riding and hiking in both Altai and Altansugts, and hiking in Ulgii. Throughout these observation periods, the pastureland, available water resources, and general understanding of location of important glaciers in relation to soum centers and herders was understood.

Though both soums were nestled among mountains, Altai soum experienced snow fall and overcast weather throughout our five days. During the three days spent in Altansugts, there was no snow, nor appearance of snow on the ground, even in time spent among the mountains closest to the soum.

Data Collection

Interviews and observations were selected as the main method of data collection for several reasons. The first being that interviews provided a dialogue in which narratives, perceptions, and opinions could be developed and understood. For example, decrease in water level has multiple implications on the daily lives of herders, but that narrative was only understood after multiple questions and back and forth dialogue. A drawback of this dialogue was that in some cases herders did not directly answer the question and so their responses were unable to use for statistical comparisons in responses. This therefore limits the congruity of total number of herder responses in the tabular data analysis. However, though a survey may have allowed more responses and increased the ability of more congruent number of responses, a survey lacked the personal connection that allowed for the opinions and narratives that have strengthened the results of this report.

The general interview questions asked are provided in Appendix A. The interview was divided into several main components that align with the aims of this study. The first was an understanding of water access and use, the second was designed to understand the changes in climate and water resources and the effects of change, and the third was to understand herder perceptions of government and community management of resources and the relationships derived from this management.

All interviews in Bayan Ulgii required a translator. Throughout the research period, two translators were used. One translator was used for the Atlai soum location and another translator was used for the Altansugts location. Both translators were used in the time spent in Ulgii. During interviews, a portable audio recorder was used. Following the interviews, the
audio recording was used to transcribe all interviews. In this way, themes and categories were then organized based off of the study aims.

**Time Period**

The time period in which data was collected in Bayan Ulgii was November 9th through November 21st. November 9th, 10th, and November 18th interviews were conducted in Ulgii. November 11th to November 15th were spent in Altai. November 19th to November 21st was spent in Altansugts. This time period is opportune for this case study. In the Bayan Ulgii region, most herders travel to their winter homes by November and so descend from the mountains with their livestock. They are thus located closer to the soum center. This provided the opportunity to interview more herders due to the proximity in which they were located to each other and the soum. In addition, it provided the opportunity to understand and observe the water system utilized during the winter period for both herders and livestock. For many, well water was the main source of water usable and so the well location was understood. However, water resource availability is an issue that extends to all seasons, and is in some cases highlighted during specific time periods. To get a holistic understanding of the change in water availability, more time devoted to this study would better highlight and reveal changes.

**Participants**

Of the 24 participants interviewed, eight were specialists who were interviewed in Ulgii, Altai, and Ulaanbaatar. One specialist was female. All other participants were male. Sixteen herders (male) were interviewed. Eleven were interviewed in Altai. Five were interviewed in Altansugts. Four participants lived in a soum center. See Appendix B for coding of participants and references. All interviews with herders were conducted in their winter home. Both Altai Soum and Altansugts have a population of Eagle Hunters, a Kazakh tradition continued throughout their history. As my research partner was focused on eagle hunting and its impact on the ecology of the reason, Eagle Hunters were primarily interviewed. Though they practice the Eagle Hunting tradition in their free time, their livelihood is founded on herding and is what defines their day-to-day schedule.

<table>
<thead>
<tr>
<th>Participants</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialists</td>
<td>8</td>
</tr>
<tr>
<td>Herders</td>
<td>16</td>
</tr>
<tr>
<td>Eagle Hunter and Herder</td>
<td>12</td>
</tr>
<tr>
<td>Herder</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

Table 1: Interview Participants
Monetary compensation was given to all herders interviewed and the soum Animal Doctor. Translators and guides expressed monetary compensation as a necessary compensation for herders’ time with us. For each herder, 10,000 Tugrugs was given.

**Limitations**

The most significant limitation to this study was the time period that was given. Due to limited funding and time, only two weeks were spent in Bayan Olgii. To fully understand the implications of water resource change and management, more interviews would be needed in Altansugs and Altai. More time would also allow interviews with herders further from the soum with resources not as accessible.

In addition, the use of a translator provides possible error. The translator miscommunicating important concepts and questions posed a limitation to effective communication during interviews. In Ulgii, there were several concepts that were unable to be communicated to specialist due to a lack of understanding. In addition, using two different translators may have decreased the ability for good translation. Over the course of the time spent in each study location, each translator had a gradual increased understanding of the purpose of the study and therefore the concepts utilized in questioning. By changing translators, the process of understanding was started again as well as the possibility of different understanding and word usage. This different word usage may be exemplified in the different terminology of baig director, small leader, and tribe leader. It is possible the terms are congruent yet the different translators used different words.

A possible other limitation of this study was the large amount of Eagle Hunters and Herders interviewed. Eagle Hunters usually go hunting at least once a week and can afford to buy or spend the time to obtain and train an eagle. This extra time or money may reflect that these herders feel financially more stable and have not experienced impactful loss or decrease in of access to resources. Thus, by interviewing a majority of eagle hunters within this demographic, a true understanding of the risks of climate change implications may not be as fully understood.
Data Results and Analysis: Interview Responses

Section I:

**Aim I:** To explore the implications of climate change on water resources in Bayan Ulgii

**Aim II:** To explore water resource change implications on pastoral herders in Bayan Ulgii

In order to understand the change and implications of water resource availability, the interviews first established the type of water access for herders. The findings discovered that the majority of herders use rivers and streams as sources of water supply during the summer. As seen in Table 2, four herders specified that their summer water resources were derived from snowmelt or melt water derived from the ground.

As seen in Table 3, a majority of herders use wells as a source of water during the winter. However, a majority of herders do not use wells as a source of water for their livestock. During the winter, most livestock’s water access was from a stream or river not completely frozen over. The location of the river water access for herders during the winter was generally no more than 200 meters from the winter home. However, there was one herder located about 1 kilometer from the water access. He lived at a higher elevation than other herders interviewed. He could not build a well due to this higher elevation. Finally, snow was vital source of water during the winter for livestock.

Herders were also asked the amount of water they use per day. Of the 13 herder-responses, an average amount of water used was 88 liters. The range determined of water use is 40 liters to 200 liters.

<table>
<thead>
<tr>
<th>Access to Water Resources: Summer</th>
<th>Number of Herders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of Water</td>
<td>Number of Herders</td>
</tr>
<tr>
<td>Groundwater (well)</td>
<td>1</td>
</tr>
<tr>
<td>Stream</td>
<td>6</td>
</tr>
<tr>
<td>Source of Stream:</td>
<td>2</td>
</tr>
<tr>
<td>Snow melt</td>
<td>2</td>
</tr>
<tr>
<td>Ground water</td>
<td>2</td>
</tr>
<tr>
<td>Not stated</td>
<td>2</td>
</tr>
<tr>
<td>River</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

Table 2: Access to Water in Summer

<table>
<thead>
<tr>
<th>Access to Water Resources: Winter</th>
<th>Number of Herders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of Water</td>
<td>Number of Herders</td>
</tr>
<tr>
<td>Groundwater (well)</td>
<td>8</td>
</tr>
<tr>
<td>Stream</td>
<td>1</td>
</tr>
<tr>
<td>River</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

Table 3: Access to Water Winter
Climate change and change in water resources: Herder Perceptions

In order to understand how climate change was affecting water resources, herders were asked their perception on water resource change. They were also asked how this change affected them.

Of the 10 herders who responded yes to change in water levels, all stated that there had been a decrease in water levels in the last ten years. However, the five Altai soum herders that expressed a change in water levels, stated that in the recent one to two years, there had been an increase in water levels. This decrease negated the original worry of decrease in water resources. However, all five of Altansugts respondents affirmed that there had been a decrease in water levels and none said that the water levels had increased in recent years.

Herders perceived changes in a variety of water bodies. In Altai, herders mentioned a decrease in stream and river levels. One Altai herder said that he thought that half of the streams had been lost, causing difficulty for his community. In Altansugts, two herders told the story of their childhood and the wild Khovd River. One herder used to fish on the Khovd River, the same river that he lives by now. It used to be a wild river, as told by both herders. This river used to be impossible to cross, but now it is possible to cross by horse and to even swim across. Another herder mentioned an area called Onor, an area of many lakes. This

<table>
<thead>
<tr>
<th>Perceived Change in Water Levels in Lakes, Rivers, and Streams</th>
<th>Herder Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Change</td>
<td>4</td>
</tr>
<tr>
<td>Change</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 4: Perceived Changes in Water Levels

Figure 7 and 8: Herder’s wells at their winter homes near Altai soum.
place in the national park now only consists of three large lakes, no longer a land of many lakes. Finally, in Altansugts, one herder mentioned a decrease in the level of well water.

![Figure 9: Khovd River, the main river that runs through Altansugts.](image)

_Glacier Size_

The understanding of water resource change was continued in the appraisal of herdens’ perceived change in glacier size. The reasoning behind the affirmation of the decrease of glacier size varied but provides an interesting lens in which to understand this change. All five respondents from Altansugts stated that glaciers were melting and referenced change in coloring of glacier, increase in melt, or temperature change. Three respondents stated that they see a growing black area on Tsambagarav Glacier they see every summer. This blackened section was the visible justification of glacier decrease. Other respondents mentioned an increase in the river size and dirt from the increased glacier melt. However, in Altai, only one herder responded with a specific statement of observed glacier decrease. Most other respondents who affirmed perceived change in glacier size mentioned maintenance of snow during summer or amount of snowfall in general. This difference in responses may be attributed to the lack of significant glaciers in the Altai Mountains, while Altansugts community members have summer pastureland in Trsambagarav National Park. Therefore, Altansugts respondents are able to physically perceive the change while Altai members have less understanding and physical experience of change in glacier size.

<table>
<thead>
<tr>
<th>Perceived Change in Glacier Size</th>
<th>Herder Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Change</td>
<td>3</td>
</tr>
<tr>
<td>Change</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
</tr>
</tbody>
</table>

_Table 5: Perceived Change in Glacier Size_
Water resource change exploration continued with the perceived change in precipitation. The expressed change in precipitation varied. In some cases, the change in precipitation had recently increased, for the most part in the manner of increase of snowfall. However, the five respondents of the eight that expressed change recounted a recent (one to two year) decrease in the amount of precipitation. One respondent specifically mentioned that the wintertime was the specific time in which there was a decrease in precipitation.

If a respondent expressed a change in precipitation, they were then asked what the impact of this change was on their herding lifestyle. The responses were numerous and varied. For many respondents, the largest impact of precipitation change was associated with pastureland health. Five respondents explicitly stated that the increase in precipitation was good, as it meant good pastureland and the same was true for the adverse situation. The change in precipitation was also expressed as affecting the timing of herder movement. Two respondents stated this impact. The springtime and autumn were becoming longer, leaving the summer time to only two months. In addition, the change in snowfall and melt was changing the timing of the availability of good pastureland. Now, expressed one herder, pastureland was available later in June or mid June, reflecting the change of time in which herders move to summer pastureland.

The implications of change in precipitation were further understood in terms of human and livestock’s need of water bodies as a source of drinking water. If less snow, herders living in the mountains do not have access to snow that is used as drinking water. If less snow and snowmelt, the livestock then have to travel further to access rivers or streams. One respondent of Altai soum explained that there is a river about 3 kilometers from his winter home. This river is the water source for his animals when there is no snow to eat and utilize as a water resource. Thus, when there is no snow, they must travel 3 kilometers to access water. The translator then added, three kilometers is quite long. As expressed by two respondents in latter interviews, this increase in travel causes decreased energy and therefore decreased fat for animals. This then causes the animals to struggle to survive through the winter. For one herder, his livestock has had to travel 15 km to find a water source, resulting in decreased energy and fat.

<table>
<thead>
<tr>
<th>Perceived Change in Precipitation</th>
<th>Herder Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Change</td>
<td>1</td>
</tr>
<tr>
<td>Change</td>
<td>8</td>
</tr>
<tr>
<td>Varied Change</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

Table 6: Perceived Change in Precipitation
Several respondents stated a final negative result of precipitation change. This impact was associated with the increase in heavy, fast rainfall. Three respondents said that this heavy, fast rainfall caused flooding. This heavy rainfall had other implications as well. Two herders stated the negative impact of the heavy fast rain on the pastureland such as the inability of water to permeate the ground and broken pastureland. One herder had recently experienced the destructive nature of flooding. In July 2016, the stream close to his home overflowed and flooded his home. He decided to rebuild his house on his own with the help of his sons.

![Image 10 & 11: Herder’s newly built winter home and remains of home destroyed by July 2016 flood.](image)

**Expressed Concern and Impacts**

Respondents were asked the effect of the change in water level water resources and if concerned about this change. Table 5 is a compilation of all responses that expressed understanding of the impact of water resource change on their herding, their community, or the future water security of the community. Some of the expressed impacts included change in grazing sites, increased travel time for herds, and lack of water to grow fodder for winter. Expressed concerns for future impacts were general water security concerns of enough water for all animals and humans in the community.

<table>
<thead>
<tr>
<th>Herder Response</th>
<th>Impact</th>
<th>No Impact</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Impact</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 7: Expressed impact and concern of future decrease in water availability**
Herder 15 (see Appendix B), a Tribe leader and a wise and respected man in his community said the following:

*I have a really worried thing in my mind. I am not afraid of things like if I don’t have money, nothing like that. But I am very worried about what will happen in the future, for my grandchildren, for the generation that will be coming. Because as far as I know, the water levels are going down. But what about the future? What will happen?… Some times I just sit there and look at the mountain and thinking deeply in my mind of what will happen…*

*Figure 12: Stream in Altansugts*

*Figure 12* reflects a stream that was the water source for the winter home of a herder in Altansugts. The above picture shows where their animals access water. Further above the broken ice is dirt where the river was crossed by foot. In that above section, water is not noticeable. Translator affirmed the low level of the stream.

**Climate Change Implications on Herders as Expressed and Understood by Specialists:**

A specialist in tourism with a degree in Ecology and Chemistry explained the implications of climate change, stating that it is a significant problem due to climate change causing increased dryness, less area for the animals, and less grass. He continued, explaining that herder families move to higher locations in the mountains during the summer and their water access is from snow or from glaciers. His parents lived in the mountains when he was younger and 10 to 15 years ago they were experiencing problems. They would move to this mountain location in the beginning of June and stay until the beginning of August. However, by the middle of July the small streams that originally had enough water were decreasing in size. He attributed this to less snow. By July, the water was very far and him and his animals
would have to walk very far to get water. He finished by saying that the herder people have no idea why the water is getting less and causing such problems.

An Officer of the Bayan Ulgii Department of Tourism and the Environment explained how research under a government ministry had established that in five years the small lakes of the region had decreased in size. Climate change, he continued, also affects the amount of snow. This negatively affects the herders, he expressed. Too much snow means that animals die. In addition, he stated that 200 families have recently been washed out by mudflows caused by Khovd River flooding.

Section 2: Management of Resources

Aim 3: To explore the current water management system at a local level and herder perceptions and interactions with this management

Throughout interviews, there was no expressed government management of water in the rural areas in which herders lived. One respondent who lives in Ulgii but is originally from Saiga and travels throughout Bayan Ulgii as his occupation stated, “No, there is almost nothing. The Mongolian government is almost doing nothing for our water management. He continued stating, “right now most of our land is free from the public using. That is why nobody cares about water problems.” (Specialist 2, 2016). Other respondents expressed water management in terms of building wells but not in the rural setting. Thus, in order to understand the herder perception of water resource management, current natural resource management in general was explored.

Resource Management as Perceived by Herders

When asked how natural resources were managed, almost all herders expressed that the land was free and that for the most part it, it is their decision on where to go. During the Soviet Era, the government would tell herders where to go and regulated the management and distribution of land. The change to land privatization has been understood by the herders interviewed as free land and free movement. In addition, for many herders the land that they currently use was owned by their father and their and grandfather. They have continued to use this land.

The response on the government involvement in the pastureland management and use varied. Several herders explained that often land sharing relied on agreements by word of
mouth while ownership derived more from ancestral ownership. For example, one herder explained that if you go somewhere to use pastureland you need to have permission from your neighbors. There is no government contract that needs to be filled out just permission by word of mouth. Two herders expressed that the government does not come to visit herders to manage pastureland or animals and explained that the government does not tell them when or where they have to go. If you travel to someplace outside of your soum, however, one would need to tell the governor and would have to pay a duty of 200 to 500 Tugruks per sheep grazing in that new area.

Resource Management as Expressed by Specialists

There was a discrepancy between herders’ perceptions and specialists. According to the Head of the Herder’s Association in Bayan Ulgii, herders express their opinion to administration regarding natural resources and the administration will then discuss the issue with the government and make a decision based on this discussion. These decisions resulted in contracts on issues such as water and pastureland. The specialist pulled out a large blue folder and placed it onto the table, flipping through an extensive amount of maps and contracts. One of the maps reflected the border of the pastures that belong to specific families, the date of when the herder uses the pastureland, and the number of animals that can be brought to graze in this area. When asked how these divisions and boundaries were established, Specialist 1 explained that the land ownership is based on traditional, ancestral ownership. The territory once owned by their families many years before are now made into a contract with the government as official documentation of the use of that territory. An officer of the Department of Environment and Tourism in Ulgii explained that a soum has an administration with a specific person that sees locals and tells them of this land ownership and where they go for their summer pastureland. However, he stated, the government knows that this land is theirs traditionally and so they do not come all the time with these instructions.

The animal doctor confirmed the several of the comments of the two specialists above. Starting in 2010, he started managing all the herders under one system. On June 15th all herders have to the summer pastures and in the beginning of September they must move back to their winter homes. If they do not move, they have to pay money to the government. In this way, the land is being protected for the winter. Finally, an Environmental Officer of Ulgii explained policymaking in the context of communication between herders and government. When creating a policy, the government does not make it without listening to
other opinions, she said. Thus, before policies are implemented there is a meeting at a soum level in which voting takes place. Following this voting and discussion, the local instructor provides advice on the specific policy. She finalized her explanation by saying that the local herders know better on what’s going on in nature.

*Role of the Small Governor:*

In order to understand the government management of resources at a local level, two leadership roles in Altai and Altansugts were explored. The soum governor or small leader was a mentioned source of connection and communication between herders and the government in Ulgii. Herder 6 has been the small leader for 16 years and has won four times. He visits herder families once a month. He also goes to town every Monday talks to the other four small leaders of the other bags of the soum. During these meetings, the small leaders discuss the life of the herders and how they can help them. For the most part, the biggest needs expressed by herders to the small leader are in relation to completing and submitting documents to the soum government. The communication between small leader and the government in the soum was expressed as a continuous conversation regarding news of animal such as the amount of animals that are weak and the number that survived the winter. From the objective of herders, the relationship with the small governor varied. Several herders mentioned that they never see the governor and joked that he only visits families when elections are coming. When asked who makes decisions about the number of livestock and the location of his pastureland, a herder responded as follows (Herder 5, 2016):

> It is our decision because no one from the government comes and asks and says you have to go to that place to stay.

When further question if the small governor aided in the management, the herder responded:

> Not really because the small governor does not come much. He comes very rare.

*Response to Resource Strife*

When asked if the government would help herders during difficult times, such as bad winter or water insecurity, a majority of herders said that the government would only be able to help a little. Hardships that necessitated outreach to

<table>
<thead>
<tr>
<th>Perceived support of government during resource hardship</th>
<th>Herder Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>No support</td>
<td>2</td>
</tr>
<tr>
<td>Little support</td>
<td>5</td>
</tr>
<tr>
<td>Sufficient support</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>

*Table 8: Perceived support of government during resource hardship*
government included no grass to grow, too much snow or cold, or animal disease. Many herders expressed that the government in times of bad winter provide horse feed and grass yet the perception of whether this aid was enough to sustain and fully support herders varied. The government, another herder added, helps take care of a few animals during a hard winter, but because of limited government money, they cannot help much. A herder in Altai expressly stated that even during a bad winter there is no help from the government, that no one from the government has come and help him. This herder lived higher in the mountains in a less accessible location, which may have influenced his perception of no support from the government. The perception of little to no support from the government encouraged an expressed mentality that herders must take care of themselves or that the government knew that herders could take care of themselves. A government officer explained what had occurred in the past when streams were drying out and water levels were decreasing (Specialist 7, 2016):

The herders would come to the government and say please help our water access. That means the herders wanted water for their hay. At that time, there was not much snow and rain and the herders wanted the water stream to come to their place to grow the grass. They would come to government and say please help me make a water stream to the grass. And the government would make a little stream from the big river to where they cut the stream.

Thus, the government as expressed by this government officer, responded to the expressed needs of the herders to ensure that they were still able to irrigate their fodder for the wintertime.

Resource Strife: Conflict

Herders were asked if there ever were issues of herders sharing natural resources in their community. The question gradually developed to include use of fodder without expressed permission and herders grazing in other family’s pastureland without permission. A majority of herders said that there were no such problems and conflicts surrounding resources. In Altai, several herders denied this type of conflict as the area had enough water and pastureland for everyone. However, there were several Altai herders that stated that they had heard stories from other soums of these types of issues. One herder recounted a situation in which two herders competed for fodder. When one herder encroached on another’s hay making land and was using the fodder without expressed permission, tensions escalated to violence quickly. The herder whose fodder was being used without permission resorted to
cutting off the other man’s hand. The man who owned the fodder but who cut the hand of the
other herder was sent to prison.

When specialists in Ulgii were asked the similar question if conflict and tension arise
between herd ers regarding resources, two responses confirmed that this type of conflict and
fighting occurs often in Bayan Ulgii herding communities. A government officer explained
that there is a current law that the herd ers in
the countryside can own land only in the
places where they build houses. Thus, they
cannot own land next to their house. When
neighbors come to use this pastureland,
tension and sometimes fighting ensue.
Sometimes these herd ers come to the
government. However, when asked how the
government resolves these issues, it was stated that the government cannot tell help them
resolve the issue because pastureland is for everyone and they must share. A different answer
was given by a specialist, an Officer of the Tourism and Environment, who explained that
when issues over “ancestral land” arise, local managers look at the coordinates of the land
and where the herder’s coordinates are located. The government will look at this map and tell
the encroaching herder to leave based on the fact that the location is not his coordinates.

Discussion

The purpose of this study is to explore the effect of climate change on water resources in
Bayan Ulgii and the implications these changes have on pastoral herd ers (Aim 1 & Aim 2).
In addition, this study’s intent is to explore the water management system at a local level and
how herd ers perceive the degree to which their water resources are managed (Aim 3). With
this knowledge, an assessment of current water management system’s ability to respond and
mitigate climate change threats is understood. The interviews conducted and synthesized in
Data Results provides the foundation for discussion on the study aims posed.

Table 7: Expressed tension or conflict

<table>
<thead>
<tr>
<th>Expressed tension or conflict regarding resource management and distribution</th>
<th>Herder Response</th>
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<td>Tension and/or Conflict</td>
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<tr>
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</tr>
<tr>
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To explore the effect of climate change on water resources in Bayan Ulgii

To explore implications of water resource change on pastoral herd ers in Bayan Ulgii
**Aim 1** and **Aim 2** states the intent to explore climate change and water resource change in Bayan Ulgii but more importantly to understand the implications of this change for herders. These implications can be understood in three major manners. The first being water access. As reflected in Tables 2 and 3, herders are incredibly reliant on the availability of water bodies. During the summer, rivers and streams are the major sources of drinking water for both livestock and herders. Thus, the changing in water levels of water bodies has direct implications for herders. Almost all herders interviewed stated that in the past 10 to 15 years, there had been at some point a decrease in water levels. This data is confirmed by the National Statistic Office of Mongolia’s data regarding the fact that 11 rivers, 253 springs, and 179 lakes had dried out (National Statistic Office of Mongolia, 2014, p. 185-186). It is thus interesting the degree to which most herders perceived this change and reflects the degree to which they rely on this direct water supply. Herders use about 90 liters of water per day. When the main water source is gradually retreating the implications for this pastoral population are significant.

The implications, however, do not just affect herders and their water supply for drinking water. The change in availability of water also has an effect on herders lives in regards to their livestock. As stated by herders throughout the interview portion of this study, livestock mainly rely on bodies of water for their water supply. When this water supply becomes further away, the increase in amount of traveled kilometers needed to access water is increased. A herder of Altai soum expressed the difficulty of losing a main water resource. He expressed, “It wasn’t easy because they have ben camping quite a long time in the same place and when they change the place to another place it is not easy for them. It is not good for their animals. Because the animals they learn to that place and when they move to other places they couldn’t get fat” (Herder 3, 2016). This issue is usually exacerbated by the trend of decrease in snow coverage, as expressed in the Mongolia Climate Change Assessment Report-2009 (p. 60). During the winter, many herders have the option to install wells as their water access (See Table 3). However, livestock’s water access is both rivers and snow. The decrease in snow coverage therefore further intensifies the issue of streams and rivers becoming less available (Ministry of Environment, Nature, and Tourism 2009, p. 58). The combination of these two decreasing water resources results in increased travel for livestock water access.

The results of this change in water access and increased movement by livestock negatively affect the livestock. As expressed during herder interviews, increase travel of livestock results in decrease in energy and decrease in fat. This energy and fat is incredibly
important for livestock when facing challenging and harsh winters. Due to climate change, there is an increase in natural disasters such as these extremely harsh winters, white dzuds (Ministry of Environment and Green Development, 2014, p. 127). This trend therefore puts livestock in a more vulnerable position and exacerbates the implications of less energy and fat in animals during the grazing and growing season.

Secondly, the change in water resources due to climate change affects water supply for pastureland and fodder growth. Herders stated there is a change in precipitation, though there was no specific trend of whether this precipitation change was an increase or decrease. However, the implications of change were specifically attributed to pastureland health and therefore timing of movement of herders. The availability of good pastureland is getting later, as stated by one herder, and so the time in which they should go to their summer pastureland is changing. This availability of pastureland is currently changing due to climate and water resource changes. Increased air temperature and earlier snowmelt cause a change in the start of spring runoff. This results in a decline of the biomass of spring pastureland (Batima, 2006, p. 25). With the practice of animal husbandry being highly dependent on the pastureland biomass and health, the loss and degradation due to dryness and decreased precipitation are significant.

Moreover, as discussed by the Khovd Buyant River Council in the current issues and concerns portion of the Khar- Lake Khovd Integrated Water Resource Management Plan (2011), low precipitation in the summer and increased dryness can contribute to decreased yields of fodder production (p. 14). Herders use fodder during harsh winters to ensure their animals survive and maintain weight. Without these resources, it is difficult for their livestock to survive. As expressed by a government official, “The herders would come to the government and say please help our water access. That means the herders wanted water for their hay. At that time, there was not much snow and rain and the herders wanted the water stream to come to their place to grow the grass…” (Specialist 7, 2016). This statement is a reflection of the degree to which water supply affects herders, extending to resource maintenance for surviving winter months.

Finally, increase in intensity of rainfall is a trend that is stated by both academic literature and herders. The perceived herder impacts of this trend parallels academic literature as well. As one herder perceived, the intense and heavy rain hurt the pastureland, which is explained by the implications of increase in rainfall volume and resulting water erosion. The high mountainous region of the Altai Mountains is particularly susceptible to erosion, thus the perception of the negative aspects of this heavy rainfall is accurate and significant. In
addition, the problem of flooding was a final perceived implication from this increase in volume of precipitation. Flooding directly affected one herder interviewed, causing him to completely rebuild his home. This was expressed as an expensive project to undertake and also reflected the vulnerability of herders to these natural disasters. The low precipitation in the summer and, conversely, the trend of increase precipitation in winter will cause an increase in spring flooding (Ministry of Environment and Green Development, 2014, p. 159). Thus, flooding will continue to pose threats to the herders of Bayan Ulgii with resulting significant implications.

These findings confirm previous studies on the vulnerability of herders to climate change with a specific relation to water resources. Based on these vulnerabilities, the significance of future changes in water resources can be understood. In some areas of Bayan Ulgii, like Altai soum, surface water resources may increase due to increase in glacier melt. The increase in precipitation in the winter will also contribute to an increase in snowfall and snowmelt. For this area, water supply and access may not face intense water insecurity. Instead, issues derived from too much snow could occur, such as white dzud, negatively affecting the health and mortality of livestock and the food availability and production for herders (Ministry of Environment, Nature, and Tourism 2009, p. 58). However, in areas lower in elevation and not directly in the mountains, such as Altansugts soum, the implications of change in availability of water bodies will be more significant. The projected evaporation increase has the potential to surpass increase in precipitation, and so, herders and pastoral herders will be affected face more water insecurity. For example, the increase in temperature will cause a decline in water level of open pools in steppe regions (Ministry of Environment and Green Development of Mongolia, 2014, p. 159). These open pools are currently the water sources for livestock, increasing travel time to other areas of water access and affecting the livestock health. Moreover, Altansugts will face the future implications of glacier melt. The herders interviewed have summer pastures in the Tsambagarav National Park, in which the Tsambagarav glacier resides. This glacier provides melt water for multiple bodies of water and hundreds of herder families. The Tsambagarav glacier is already experiencing intense retreat, resulting in a slight and then significant decrease in river discharge in the future.

To explore the water management system at a local level and how herders perceive the degree to which their water resources are managed
Aim 3 explored the current Mongolian water system with the specific focus on local and rural level management. The perception of herders understanding and involvement in water management also included understanding of land management. The decision for this parallel understanding is explained in the Integrated Water Resource Management Plan, saying, “From the viewpoint of IWRM, water management should always be looked at in close conjunction with land management and environmental management as these are strongly interrelated” (Ministry of Environment and Green Development, 2013, p. 91). However, it is important to keep in mind that almost no herders and few specialists had an understanding of the current water management system, emphasized by one of the first interviews in which it was stated, “The Mongolian government is almost doing nothing for water management” (Specialist 2, 2016). Moreover for land management, herders strongly identified with the idea of free land and land ownership defined not by government contract but by ancestral ownership and community relations. The transition from Soviet Era to Democracy allowed herders to return to the lands of their grandfathers in some cases and for others, they continued their pastoral lives but with the knowledge of “free land” (Herder 1, 2016). Additionally, one herder stated, “It is our decision because no one from the government comes and asks and says you have to go that place to stay” (Herder 5, 2016). This perception of almost no management is not necessarily accurate which was later revealed in interviews with specialists. As told by the head of a herder and resource management NGO, herders’ land and water resources are mapped out, approved by the government, and given coordinates. Herders’ movement is regulated by specific times in which they go to their summer and winter pastureland. Finally, policy-making and management is discussed at a local level before implemented.

In addition, the involvement of local governors is an important piece of resource management, as stated in the Integrated Water Resource Management Plan (2013) and expressed by Figure 4. At a local level, the soum governor prepares the budget for implementing “water supplies, water resources and water restoration, protection of water quality, and prevention from water related disasters” (Ministry of Environment and Green Development, 2013, p. 88). And as expressed further in the explanation of the “institutional landscape at the local level”, the water basin organizations are responsible for “implementation of all water management activities within their respective water basins” (Ministry of Environment and Green Development, 2013, p. 88). These water basins work directly with the local government authorities regarding water management activities. At a rural level, the small governor, or leader of the bag, is also a source of leadership in
management. Herders explained that the small governor helped with animal management and animal health not specifically land or water. When asked if the small governor ever helped with decision-making regarding pastureland location and number of animals, a herder stated, “Not really, because the small leader doesn’t come much. They come very rare” (Herder 5, 2016). Though at policy level and in legal framework the soum and small governor are responsible for management, herders do not express this understanding. This is significant. Small governors are the main connection between governance and policy and rural settings and herder inhabitants. Thus, the results reflect a current issue. The small governor role is either lacking in responsibility of resource management or the small governor role is not communicated sufficiently to herders. When issues of water security arise, it is important that this small governor role be capable of sufficient communication and management of herders and their water resources.

The issue of resource management was also explored through herder actions during resource hardship and strife. By assessing these actions, it can be understood how current issues regarding resources are addressed. In times of resource hardship, herders did say they would go to the small governor or soum governor for help. If there is a problem with lack of water, as one government official expressed, some herders are willing to reach out to their government. Additionally, when issues between herders over land or water occurred, several herders said that they would go to the government to solve these issues. However, many other herders revealed that they had no relationship with the small governor or felt that the government could not help them in hard times. Several herders stated that the government would try to help but that it lacks the finances to help the herders significantly. In addition, several government officials stated the difficulties in addressing resource conflict, derived with the fact that the land ownership is defined by tradition and ancestry, making land distribution and land conflict resolution difficult. Thus, it can be perceived that the herders do communicate resource hardship to local governments. Communication is not the biggest issue in resource management. The issue lies in the ability for governments to respond and provide sufficiently. Finally, it is important to note that the herders never addressed how the government is involved in preventing resource hardship. The responsive instead of preventative action was only understood. This reveals possible issues with the current water management system, which will be explored in the next section.

*As water resources change in supply and availability, will the Mongolian water management system be able to address the needs and vulnerabilities of herders?*
**Aim 4** addresses the vulnerability of herders to climate change implications on water resources. This assessment is in relation to the current system and criticisms of the water resource management system in Mongolia. Currently, water resource management in Mongolia reduces the scale of implementation only to River Basin level. Though local governors create the budget for water management activities, as stated in the 2013 *Integrated Water Management Plan Mongolia*, the Water Basin Organizations are given the responsibility of implementing water management activities (Ministry of Environment and Green Development, p. 88). The implications of this are significant, as revealed in a project of *Ecosystem Based Adaptation Approach to Maintaining Water Security in Critical Water Catchments in Mongolia*. For Khar-Lake Khovd, policy decisions affect three different aimags and 29 different soums (see Figure 5) (Khovd Buyant River Basin Council, 2011, p. 6). Thus, local level responsibilities are decreased and communication gaps occur. Moreover, the soum and bag levels have little legal framework and capacity to implement management systems and monitor water resource change (UNDAF, 2012, p. 8). These issues can be seen throughout the interview data results. Herders mentioned the inability for the government to sufficiently provide for them during resource hardships. This was attributed to the government’s weak financial situation. Though at a national scale there is a growing fiscal crises, this lack of money can also be attributed to a lack of financial capacity at a local scale. This lack of capacity inhibits the ability to fully address herder needs and to sufficiently assess how water resource change is affecting herders and therefore how to respond to this issue.

In addition to lack of capacity, the local level does not have sufficient herder decision-making framework. Meaning, herders are not involved in decision making at the local government scale. Thus, herders lack involvement in resource management. The small governor was said to visit each herder family once a month, but several herders said that this only happened close to the time of reelection, every four years. Though this may be an exaggerated statement of the relationship between herder and government, it does reflect the lack of involvement herders have in governance. Currently, resource management is a large concern at a national level. The fact that herders are not aware of the national goals and need of management is concerning. Herders need to understand that their “free land” and resources should be managed and that this management will address significant climate change implications. The herder population is vulnerable to the changes in climate and water resources and the implication of lack of participation in decision-making is far-reaching.
Lack of participation and understanding will be exacerbated in water insecurity scenarios by the current influence in resource ownership derived by tradition. When herders expressed their understanding of management, it was under the assumption that ownership derived from territory established by their grandfathers. New families relied on word of mouth instead of government contracts. Even government officials expressed the limitations of this ownership derived from ancestral ties. Resource conflict settlement was one way in which this issue was expressed, as explained by several government officials. Thus, the traditional herder understanding of ownership may exacerbate already existing issues with water management. For example, in Bayan Ulgii there are enough water resources to provide herders with water security currently. However, in the future, as issues such as water insecurity, natural disasters, and resource conflict increase, will land and water ownership derive from heritage or will it be altered and adapted? The movement of herders and their livestock will change and the management of traditionally owned resources will be put under major strain. Moreover, the increase in tension due to water scarcity is a future challenge that will necessitate government response and understanding of the extent of herder ownership (Ministry of Environment and Green Development, 2014, p. 201). Therefore, the government and management systems will need to adapt to changes fluidly. Currently, the water management system incorporates too extensively traditional ownership and lacks the capacity to change necessary water management activities. Thus, responding to ownership issues in the face of climate change will be a challenge.

In addition to the challenge of adapting alongside the concept of traditional ownership, the current water management system lacks the capacity to “identify, monitor, and address climate change vulnerability” alongside water resource change (UNDAF, 2012, p. 8). The current water management system utilizes an implementing institutional body at the River Basin scale. Therefore, much of the climate change monitoring is done at a river basin scale. This scale ranges from high precipitation mountainous regions to low elevation river valleys and does not encourage extensive monitoring at a local scale. This poses a problem. Each soum experiences the effects of water resource change differently, as exposed in this study on both Altai and Altansugts herders. In Altai, there was a recent increase in water levels. However, in Altansugts herders did not express an increase in water levels and were concerned about the decrease in water bodies. Therefore, monitoring changes at a local scale is necessary in order to understand where water levels are decreasing and where flood dangers are high among many other issues. Currently, the water management system lacks the responsibility and capacity to monitor these changes and risks, therefore decreasing the
understanding and communication of the true implications of water resource and climate change for herders in Mongolia.

Finally, adaptation is an expressed goal of the Ministry of Environment and Green Development. In multiple reports, ranging from climate change to water resource management, adaptation strategies and goals have been provided for Mongolia. However, a main criticism of these current proposals is that they lack the suggestion and emphasis on a need for a strong water management system. OECD (2013) stated that a government needs a water system that is “resilient, flexible, and future-oriented” (p.18). Moreover, this water system needs to have a strong legal framework at a national and local scale to implement adaptation strategies. The local scope of this study provided an assessment of the Mongolian water management and its ability to be resilient and future-oriented for the purpose of addressing water resource change for herders. Currently, the water management system is unable to address herder vulnerabilities and adapt sufficiently. In the MARCC-2014 report, the Ministry of Environment and Green Development suggested several adaptation strategies including collecting winter snow and using it for soil moisture and pasture water supply, establishing early warning systems to prevent floods and water shortages, and building water resource reserves of groundwater and lake water (Ministry of Environment and Green Development of Mongolia, 2014, p 188-189). Each of these adaptation strategies has potential to mitigate some of the risks posed by climate change. However, the manner in which these strategies will be implemented needs to be localized in order to ensure that rural herders are being protected from their vulnerabilities outlined in this study.

Not only do these adaptation strategies need to be localized but they also need to be paralleled by a possible reconfiguration of the current water management system in Mongolia. Suggestions of this reconfiguration were proposed by the International Center for Development and Decent Work (2014). Sub-basin management systems were proposed while UNDAF suggested eco-based adaptation approaches to addressing water security issues. Both studies highlight the current weakness of water resource management in the face of climate change and increasing water insecurities. A final suggestion focused on the efficient implementation of adaptation strategies at a local scale is at a policy and legal level. There needs to be a law specifically focusing on Rural Water Supply and Sanitation (Basandorj & Singh, 2009, p. 38). The Water Law of 2004 is already facing issues at the national scale, as there are many institutional gaps. These gaps are exacerbated in regards to rural water supply, as this is a narrower topic and focus. The lack of communication from herders exacerbates the already present issues. Therefore, a law on rural water supply would help address herder
vulnerabilities to climate change and aid in implementing adaptation strategies at a local scale.

Conclusion

The rural population “who worships nature and the environment” is clearly the most vulnerable to climate change, as stated by the Ministry of Environment and Green Development of Mongolia (2014, p. 156). Thus, this study explored the implications of water resource change and water resource management at a local, rural level. By analyzing the specific target population of pastoral herder populations in Bayan Ulgii, the perception of one of the most vulnerable populations to climate change is understood. As a population that lives intimately close to the glaciers, rivers, lakes, and snow capped mountains of Bayan Ulgii, this study discovered that water resource change has significant implications on herders, even in areas that contain a high density of water. The implications are exacerbated by a lack of local level water resource management.

OECD in a report on water resource change and management explained that the accelerated water cycle results in a growing uncertainty regarding the availability and distribution of water resources (OECD, 2013, p. 33). Thus, climate change is intensifying the water regime, causing a change in water supply, water distribution, and water security. In Bayan Ulgii, a province of glaciers, rivers, lakes, and streams, the implications of this change in the water regime are significant. This significance derives from the large portion of the Mongolian herders that rely heavily on the availability of natural resources. Vulnerability to the changes in these resources derives from the decrease in water supply for herders and their livestock. This can result in an increase in distance to water resources and decrease in the health of livestock. Additionally, water resource change can cause a decrease in water resources for irrigation for fodder, a resource needed for herder livestock survival during the increasingly harsh dzuds. Finally, water resource change can intensify the vulnerability of herders to natural disasters such as floods. Thus, water resource change is identified as a major influence of herder vulnerability to climate change.

The implications of water resource change are exacerbated in the situation of lack of management. Based on the perceptions of interviewed herders of Altai soum and Altansugts soum, this is a relevant issue in Bayan Ulgii. The small governor, the main connector between herders and soum government, is not perceived by herders as aiding in management nor communication of the management of natural resources. However, government officials and specialists in resource management did not confirm this lack of management. Instead,
they gave several examples of management of resources at a local level. However, the Integrated Water Management Plan (2013) assigns budgeting of water management activities to local governance while the larger scale Water Basin organization is responsible for the actual implementation of water management activities. The discrepancy between Ulgii officials and herder perceptions of management is therefore understood. The implementing institution of Water Basin Organizations is a far too large scale to allow for the degree of herder involvement necessary. Local soum governors, small governors of bags, and herders need to have a larger role in water management decision-making and an increased capacity to implement water management activities at a local scale.

Thus, in order to implement government suggested monitoring and adaptation strategies, the current water resource management should be re-assessed. The local water resource management framework should be reconfigured to include more responsibilities, financial backing, and human and technical resources. This increased capacity will allow for monitoring water resource change at a local level. This will be invaluable in the future as climate change challenges and risks will affect soums and their herders in different manners. The increased capacity on a local scale will also allow for local adaptation strategies to be implemented successfully. Finally, at a national level, rural water supply needs to be centralized into one central agency and law, allowing for adaptation and understanding of climate change effects on herders. The decrease in institutional gaps and strengthening of water resource management at a local scale is important to emphasize along with the focus on climate changes and its implications.

In conclusion, herders, as reflected by this study, are incredibly vulnerable to climate change. In Bayan Ulgii, herders are defined by the placement and availability of water resources. Thus, they deserve a water management system that integrates from the rural level, ensuring that the challenges of climate change and water resource change can be monitored and adapted to successfully. As climate change further intensifies water security issues, Mongolia will need to respond with a water resource system that is flexible and future oriented. More importantly, Mongolia should further highlight and incorporate the voices and responsibilities of their most vulnerable population. Nomadic pastoralism extends far back into Mongolia’s history. If the story of this nature-worshiping population will continue, water and natural resource management should be strengthened in the face of climate change.
References


Appendix A

Herder Interview Questions

Background:
1. What is your age?
2. How long have you lived in [Altai or Altansugts] soum?

Water Access:
1. What is your water source for the summer and for the winter? How many meters is that source from your home?
2. How many people use your water access?
3. Have there ever been issues of water quality or pollution?
4. What is the water source for your livestock?
5. How many animals do you have?
6. How many liters of water do your household use a day?

Perceived change in water resources:
1. Do you think that water levels in the rivers, streams, and lakes have changed? What change have you perceived in the last 15 years?
2. How did the change in water level affect you and your herding?
3. Have you noticed a change in the size of glaciers? How does this affect you and your herding?
4. Have you noticed a change in precipitation since your childhood? What is the effect of this change?
5. Have these changes affected where you herd?
6. Based on the changes in health of pastureland and water resources, do you have any concerns for the future?

Perceived resource management and relationship with government:
1. How are decisions made in herding communities? How is land and water distributed?
2. When you meet with the small leader what do you discuss?
3. Have you ever heard of situations of tension or conflict between herders over sharing good pastureland and natural resources?
4. Does the community express concerns to the small governor? What problems are expressed to the government?
5. Do you think there is good communication between Ulgii government and herding communities? Why do you think that?

6. During hard times, like a bad winter or dzud, does the government help herders?

7. When you meet with the small leader what do you discuss?
### Appendix B

#### Interview List

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<th>Code</th>
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<td>M</td>
<td>Ulgii</td>
<td>Head of NGO that manages herders and natural resources</td>
</tr>
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<td>Ulgii</td>
<td>Tourism Manager; Background in Ecology and Chemistry</td>
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