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Local perceptions of glacial retreat and livelihood impacts in the At-Bashy Range of Kyrgyzstan

Ann Piersall · Sarah J. Halvorson

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Abstract Glaciers are critical water reservoirs in Central Asia, and their retreat has been the subject of scientific inquiry and regional water policy discourse in recent years. In the case of Kyrgyzstan, the total glaciated area has decreased approximately 25–35 % over the past 100 years—a statistic that has raised serious national security and economic development concerns. Scant research has addressed the topic of deglaciation from the perspective of local populations living in close proximity to glaciers. This paper reports on an effort to document local perceptions of, and relationships to, glaciers in the unique physical and socio-cultural context of the At-Bashy Range of Kyrgyzstan's Tien Shan Mountains. The analysis draws upon data collected over an 11 month period through interviews with Kyrgyz herders, focus group interviews with diverse community members, and extensive field observations and interactions in high-elevation pastures and sub-basins. The analysis suggests that interview participants are unanimous in recognizing the economic, cultural, and symbolic roles of glaciers and mountain environments in sustaining semi-nomadic, livestock-based livelihood systems. Nevertheless, wide ranging and often contradictory opinions emerged about glacial retreat-related vulnerabilities and impacts. Further, extant and pressing political, economic and institutional challenges influence and mediate the extent to which glacial retreat is perceived and assessed as a local priority.

Keywords Climate change · Glacial retreat · Environmental change · Central Asia · Livelihood · Local perceptions

A. Piersall (✉) · S. J. Halvorson
Department of Geography, The University of Montana, Missoula, MT, USA
e-mail: annpiersall@gmail.com

S. J. Halvorson
e-mail: sarah.halvorson@umontana.edu

Introduction

This paper evaluates recent trends related to climate change with a focus on the socio-cultural dimensions of glacial retreat in Central Asia. Specifically, the goal of this paper is to consider the pronounced trend towards deglaciation that is underway in the Tien Shan Mountains and explore the implications for the well-being of mountain communities and long-term sustainable mountain development. While there has been a good deal of attention in the climate change literature to the implications and meanings of current trends with respect to water security, hydropolitics and resource governance at macro or basin-level scales in Central Asia, there has yet to be a discussion of the implications of these trends at sub-basin scales for mountain people and their livelihoods, cultural

survival and deep connections to landscapes that have sustained communities for centuries. Similarly, while there is a growing literature that explores the intersections of rural community vulnerability to climate change threats and human adjustments to climate risk (see for example: Adger et al. 2005, 2009; Field et al. 2012; Orlove et al. 2008) there is relatively little that expressly interrogates the local experience and perceptions of these trends associated with deglaciation in Central Asia.

Assessing these literatures together, we argue that: (1) there is a need for more attention to the complex and sometimes contradictory perceptions of impacts of deglaciation as this process unfolds in the context of the Tien Shan of Central Asia; (2) an examination of these literatures reveals that there are assumptions about vulnerability and impact that are made that endorse and perpetuate a view of 'the powerless and less privileged' without empirically assessing/testing these assumptions with data from mountain communities in remote, headwaters regions (which are very distant from the major sources of greenhouse gas emissions); and (3) there are particularities with respect to high mountain experiences, as well as vulnerability and response to perceived risk which hold importance for the specific ways that deglaciation is being observed locally and might be adjusted to in the future. With growing worldwide research on local perceptions of climate change, the validity of peoples observations are often called into question especially when they contrast with the scientific data. Highlighting these issues allows for several interventions to be made with respect to the concerns for mountain communities and cultural survival within the broader debates related to climate change.

This paper addresses the ways in which quantifiable and observable changes in glaciers are having an impact on resource-dependent livelihoods in the At Bashy region of Kyrgyzstan, a mountains headwater region of the Tien Shan where numerous small communities utilize the mountain environment and glacial melt to sustain their semi-nomadic, livestock-based livelihoods. Despite drastic environmental and social transformations over the past two centuries, livestock and the landscape have continued to define Kyrgyz identity and livelihoods. This observation is especially true in the case of the At-Bashy Range, the setting of this study, which is located in the Naryn Oblast. Of the seven oblasts of Kyrgyzstan, the Naryn Oblast is the most sparsely populated, poorest and only mono-ethnic oblast in the country. We focus here on the building an understanding of how people in rural areas perceive the impacts and challenges associated with glacial retreat in light of the prominent economic dependencies, cultural connections and spiritual ties to glaciers and this mountainous landscape.

The findings presented in this paper draw upon empirical data collected over an 11 month period from November 2009 to October 2010. Methodology included: (1) conducting semi-structured interviews with semi-nomadic herders, (2) undertaking field-based visual surveys and assessment campaigns in communities, high-elevation pastures and alpine environments and (3) numerous informal conversations with government representatives, community leaders and local academics throughout the research setting. The primary method of data collection, the semi-structured interviews, was conducted using an interview questionnaire containing both closed and open-ended questions. The questionnaire primarily pertained to the local importance of mountains and glaciers, observations of long-term environmental change and the impact of changes in glaciers and water on livelihood activities. Study participants were (1) required to be life-long residents of the At-Bashy Range and (2) to have a livelihood connected to high mountain areas through pastoralism, hunting and/or guiding. Participants were found by visiting seasonal yurts in the major high altitude pastures in the At-Bashy Range. To ensure confidentiality, study participants quoted in this paper have been given pseudonyms.

This paper proceeds as follows. First, we provide an overview of the data related to glaciers and deglaciation in the Tien Shan, highlighting some recent national and regional water security concerns. Second, we provide details on the research setting, underscoring the historical context and pastoral traditions of this Kyrgyz cultural heartland. This section also gives attention to the data sources and methods. In the third section we highlight the major findings from this study. In the concluding section, section four, we address what the particularities of mountain communities, as connecting issues related to marginalization and environment as well as particular concerns for the status of mountain communities in discussions about adaptation.

Deglaciation of the Tien Shan Mountains

Central Asia holds the greatest mid-latitude concentration of ice in the world, with high mountain glaciers contributing a substantial proportion of the fluvial runoff that forms the Amu Darya and Syr Darya, the major rivers serving as the primary water sources for over 100 million people. With the regional population increasing, hydrologic changes and seasonal water scarcity could exacerbate existing geopolitical conflicts and environmental problems, including the depletion of the Aral Sea (Micklin 2007).

Glaciers are a predominant feature of the Tien Shan Range that dominates Kyrgyzstan and extends into Xinjiang Uyghur Autonomous Region of western China. Recent satellite analysis indicates the Tien Shan, the headwaters of the Syr Darya, holds over 10,000 glaciers covering an area of at least 13,000 km^2. Reductions in glacial coverage in the Tien Shan resemble patterns observed elsewhere in other mountain areas worldwide (Aizen et al. 2006; Narama et al. 2006,2010; Bolch 2007; Niederer et al. 2008; Sorg et al. 2012). Research estimates a reduction of glacial area of approximately 15 % in the past 60 years for the entire Tien Shan (Aizen et al. 2007), with accelerated loss since the mid 1970s (Sorg et al. 2012). Reductions in glacial area have been attributed to increases in air temperature and corresponding changes in precipitation, with more rain falling than snow (Aizen et al. 2007). Amplified melt and increases in precipitation may initially increase water resources but reduced glacial area will result in reduced melt and a less stable water supply that could lead to shortages in the future (Narama et al. 2010; Hagg and Braun 2005).

Of special interest here are the reductions in glacial coverage that have been observed in the At-Bashy Range. Within the At Bashy Mountain range there are 192 glaciers, ranging in elevations of 3,526–4,740 m (Narama et al. 2010). The greatest concentration of glaciers is in the center of the range, with a number of glaciers clearly visible from the vantage point of villages especially those on the northern slope of the range. It is important to note that from a distance during most of the year ice cover is difficult to differentiate from seasonal snow cover. Recent satellite imagery analysis of the At-Bashy Range indicates a 12 % reduction in glacier area from 1970 to 2000 and an additional accelerated loss of 4 % from 2000 to 2007 (Narama et al. 2010).

Most of the scientific work to date on climate change-related impacts on glaciers has stemmed from global glacier monitoring and remote sensing-based research efforts. Initial results have stimulated significant interest within the country and among the international scientific community. However, little research has been conducted on the human dimensions of glaciers and glacial retreat in Kyrgyzstan despite the importance of glaciers as a local and regional water resource (Lioubimtseva and Henebry 2009). There are a range of government and non-governmental programs in place in Kyrgyzstan associated with climate change policy and mitigation but activities have generally lacked consistency in facilitating local participation, cooperation and awareness. Recent upheavals within the government, bloody ethnic clashes, and the lack of funding have only worked to slow discussions about the need to build adaptive capacity and enhance resiliency within the country. In the face of these challenges, the Kyrgyz government has started a national climate change committee, been present at international climate change negotiations and written two National Communications to the UNFCCC. Recently established, the Ozone and Climate Change Centre in Bishkek has begun drafting a National Adaptation Programme of Action.

Research setting: the At-Bashy Range

The At-Bashy Range is located within the Naryn Oblast, the most sparsely populated of the Kyrgyz Republic's seven provinces (see Fig. 1). The Naryn Oblast is often considered to be the Kyrgyz cultural heartland. True to this generalization, it is the only mono-ethnic oblast in the country in which 99 % of the population is ethnic Kyrgyz and very little Russian is spoken. Situated just north of the Chinese border, the At-Bashy Range defines the region, stretching for 160 km (100 miles) with peaks in elevation up to 4,800 m (15,500 ft).

Numerous small villages, including the town of At Bashy (population 10,000) are located on the northern side of the range in the At-Bashy basin. The Torugart Pass road, the main road connecting Kyrgyzstan's capital city of Bishkek with China, also passes along the north side. Many herders travel into the mountain

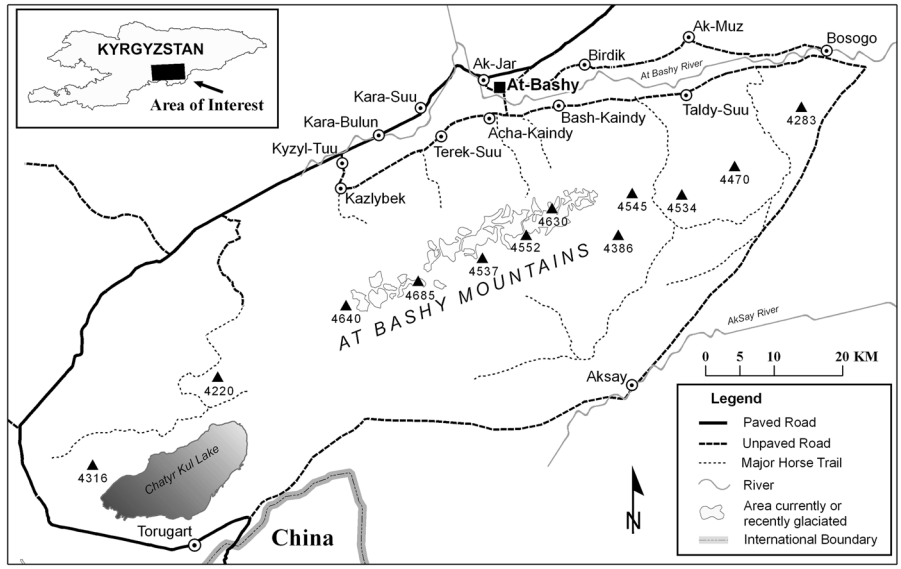

Fig. 1 Map of the At-Bashy region of Kyrgyzstan showing the study area

Fig. 2 A Kyrgyz yurt in a summer pasture (*jailoo*) on the south side of the At-Bashy Range. Photo: A. Piersall

valleys on the north side of the range to access summer pastures. Other herders travel greater distances to the northern and southern tips of the range for premier grazing in the Bosogo or Chatyrl-Kul areas. On the southern side of the range sits the Ak-Sai basin, a high elevation grassland plateau with a median elevation of roughly 3,200 m. The valley is extremely isolated, only being accessible by two improved dirt roads, which pass around either end of the At-Bashy Range. Speckled across the valley are yurts belonging to herders not only from the At Bashy Valley, but also from across Kyrgyzstan who have traveled great distances to graze their livestock (see Fig. 2). Indeed, pastoralism continues to be the main livelihood for many in this area as topographic and climatic constraints limit crop cultivation. The economic and traditional ties to the landscape are reflected by a strong cultural pride in Kyrgyz nomadic heritage. As one individual put it, "Every family must have a herder."

Early history and practices

The nomadic practices of the Kyrgyz, along with other nomadic tribes of the region, began with the arrival of horseback riding in Central Asia around 1000 B.C. (Bacon 1954). Pastoral nomadism has been a dominant way of life for thousands of years as the land and climate across Central Asia's steppe and mountains are poorly suited for agriculture. The region is characterized by a continental climate with low precipitation, extreme summer heat and severely cold winters. In this region, herding is a more efficient way to utilize the environment compared to sedentary practices (Bacon 1954; Barfield 1993).

The early nomadic practices of the Kyrgyz are similar to other neighboring nomadic groups such as the Kazakh and Turkmen. Tribes were divided among clans composed of related family units. These clans had no permanent settlements, dwelling in yurts year round. Sheep and horses were the most important animals, belonging to clans not individuals. Men took main responsibility for herding, hunting and warfare

while women tended to camp chores, dairying and making felt. Historically, the diet was composed of milk and meat products. At the beginning of the nineteenth century as many as 100 families might move together as a clan unit for protection from other raiding clans and tribes. However, most camps consisted of only five to ten yurts (Khazanov 1984).

Kyrgyz herders (*chaban*) utilized in a three-pasture, four season cycle that was vertical in nature. Large groups gathered in lowland valleys during the winter, from November to April. In the spring, groups would split into smaller family units and begin moving to spring pastures before moving to high altitude summer pastures (*jailoo*), occupying them from June to August. Migration distances varied from 20 to 200 km between ancestral encampments (*ata-konush*). In the autumn herds would slowly move back to mid-elevation pastures before returning to winter camps.

Soviets and settlement

Disruption of traditional nomadic practices first occurred with the arrival of the Russian Army in present day Bishkek in 1860. Thousands of Russian and Ukrainian settlers quickly followed, creating permanent settlements in fertile lowland valleys and converting large areas into agricultural land on areas that served as winter pasture for many Kyrgyz families and clans. The reduction in winter pasture and reduced water access forced families with small herds to settle. These were the first permanent Kyrgyz settlements (Bacon 1954; Wilson 1997). It is estimated that by 1914, 22 % of the Kyrgyz population had settled (Leeuwen et al. 1994).

The Kyrgyz were incorporated into the Soviet Union similar to the Kazak and Turkmen nomadic groups. By 1932 all nomadic peoples had been forced into permanent settlements and had been required to surrender their animals to state control and management (Leeuwen et al. 1994). Many nomads had slaughtered their animals in opposition to surrendering them (Barfield 1993). Large scale mortality occurred in the first years among the animals incorporated into the state collectives from neglect and cold exposure. Over the next decades changes were brought to animal husbandry including mechanization for transportation, production and processing. Traditional patterns of transhumance, or elevation-based cycle of migration, continued with the aid of trucks to access productive summer pastures. Agricultural production in the form of grain and fodder cultivation began on a wide scale to support settlements and provide winter fodder. By 1989, livestock numbers were estimated to be at least twice the capacity of winter pastures due to the Soviet emphasis on productivity, the strong dependency on imported fodder, overgrazing and unsustainable land use (Barfield 1993). Although the nomadic lifestyle had ceased, livestock remained of central importance and Kyrgyz traditions continued within households.

Independence, transition and revival of nomadic identity

Independence and a transition to a free market economy led to economic collapse of the newly formed Kyrgyz Republic leaving industries without support or access to markets (Duncan 1994; Leeuwen et al. 1994; Ludi, 2003). Privatization and restructuring (1991–1994) divided arable land and animals among households. However, livestock numbers plummeted with forced reduction in herd sizes, the end of imported fodder and drastic declines in the prices for livestock products. Widespread overuse of land occurred in close proximity to villages as most households did not have large enough herds to justify lengthy migrations resulting in initial abandonment of high summer pastures (Babu and Pinstrup-Andersen 2000). Additionally, accessibility to mountain pastures became increasingly difficult due to deteriorating road conditions and high transport costs (Ludi 2003).

Economic factors resulted in drastic increases in poverty and food insecurity. Within Kyrgyzstan the number of people living in poverty rose from half a million (12 %) in 1987 to 4 million (88 %) in 1995 (Babu and Pinstrup-Andersen 2000; UNDP 2002) despite the fact that Kyrgyzstan was one of the more progressive former republics to attempt to embrace market-based economies. Statistics for Kyrgyzstan underscore significant social, economic and development challenges. The most recent Human Development Index (HDI) ranks the country at 109th out of 169 countries [HDI value = .598, Multidimensional Poverty Index (MPI) = 0.019] (UNDP 2010).

With dire economic circumstances, many Kyrgyz remained or became self-sufficient through a

combination of agriculture and animal husbandry (Schmidt 2001). With agriculture limited in the arid mountainous landscape, livestock provided individuals with economic opportunity. As herd sizes of sheep, and to some extent horses and yak, increased, a revival of nomadic practices emerged in the area, as evidenced by a return to high elevation pastures for summer grazing. Many herders began living in yurts and continuing traditional practices, such as making felt and fermenting mare's milk (*koomiz)*. Today's so-called "modern" Kyrgyz herders integrate motor vehicles and cell phones into a semi-nomadic way of life. Fully nomadic lifestyles have not been re-adapted as herders and their families return to houses and permanent settlements for the winter.

Today, Kyrgyzstan's continued development efforts and geopolitical engagement with the West (for example, hosting the US military at its air base at Manas Airport) at times counteract and complicated its struggles to respond to political instability, narco-trafficking, impediments to corruption and continued economic crises (Sinnott 2007). These instabilities and perceived economic risks reinforce the value of livestock as an economic and cultural investment for rural people. With this backdrop in mind, the following section turns to the empirical data and observations of the study.

Major findings

Despite the dramatic historic assaults into the socio-economic footholds of the nomadic system and way of life, the importance of mountains and glaciers continue to be profoundly interwoven into the cultural heritage that dominates Kyrgyz ethnic and national identity. Yet, the opinions and observations of deglaciation more generally that were captured during this study reveal a much more complicated and varied picture of impact that at times exposes contrasting and contradictory notions about risk and vulnerability, environmental change and climate science.

Interviews were conducted with 76 participants. All respondents had a livelihood connected to high altitude mountain areas and had been lifelong residents of the At-Bashy area, with a majority of respondents' families residing in the At-Bashy area for multiple generations (see Table 1).

Table 1 Summary of study participants (n = 76)

Average age	53 years old
Average generations of family residing in At-Bashy	5.5 generations
Gender	
Male	51 (67 %)
Female	25 (33 %)

Table 2 Noted importance of glaciers and mountains (n = 76)

Importance	Frequency	% Mentioning
Primary source of water	48	63
Sustains local community	26	34
Supports livestock and pasture	23	30
Beauty and enjoyment	19	25
Crop irrigation	17	22
Supports native plants and wildlife	15	19
Part of Kyrgyz heritage	15	19
Generation of electricity	6	8

Cultural ties to mountains and glaciers

Study participants in the At-Bashy area unanimously recognize the importance of mountains and glaciers as a source of cultural identity and a physical resource (see Table 2). Glaciers and mountains were primarily identified as sources of water (63 % mentioned), sustaining the local community (34 % mentioned) and supporting livestock and pasture (30 % mentioned). The other most commonly noted attributes of mountains and glaciers were beauty and enjoyment (25 % mentioned) and the importance as part of the Kyrgyz heritage (19 % mentioned). The cultural and historical importance of mountains and glaciers is widespread throughout Kyrgyz culture. For example, natural elements and features connected to the surrounding landscape including mountains, pastures, rivers, trees and domestic and wild animals continue to be represented in commonly used designs decorating traditional clothing, dwellings, jewelry and other objects. The shape and colors of the traditional Kyrgyz hat, the *kalpack*, symbolically represents the outline of a mountain covered in snow and ice and continues to be an important marker of ethnic identity for male

Fig. 3 Kyrgyz men wearing traditional hats (*kalpak*) whose shape and color are associated with mountains. Photo: S. Halvorson

Kyrgyz (see Fig. 3). As the landscape influenced all realms of nomadic life, terms and stories about mountains are interwoven into traditional expressions, songs, funeral lamentations, poems and national literature such as the historical Kyrgyz epic 'Manas.' There is an extensive quantity of terms to describe mountain landscapes, including numerous human body parts used to describe the topography of a mountain (Kochumkulova 2010). The predominant themes about human connections to a mountainous environment have been carried over into new uses. The national anthem starts with the lyrics"… White glaciers, steep mountains and fields … ("Ak mungloo aska too"). Traditional handicrafts are being produced on a larger scale for urban dwellers and tourism and many goods are taking new modern forms, such as baseball caps made out of felt. Nomadic and landscape motifs are increasingly used to indicate Kyrgyz unity in political campaigns and advertising.

In conversations in At-Bashy, the strong ties of mountains and glaciers to Kyrgyz identity were frequently noted. An elder herdsman, Bakyet, summed it up in this way:

> Mountains are like the Kyrgyz people. Kyrgyz people cannot live without meat, milk or mountains.

The strong ties of the Kyrgyz to the mountains were reiterated throughout informal and formal conversations across all generations. The dependency of the environment was often reiterated with water continually emerging as one of the most important topics of conversation. As explained by Ibraev:

> Mountains are the motherland. We are proud to live in mountain areas. They are a gift from our ancestor and glaciers are the wealth of the people. Glaciers are blood for the Kyrgyz people as without water there would be no life. Our water comes from the At Bashy Mountains. If the amount of glaciers is less there will probably be less water and life for all would be very difficult if there was less water.

Table 3 Lifetime observation of changes in glacier size (n = 76)

Change observed	Frequency	% Mentioning
Overall decrease	29	38
Fluctuates yearly with snowfall	24	31
No change	17	22
Don't know	6	8
Overall Increase	1	1

Observations of glacial retreat

Despite the opportunity for lifelong individual observation and the possibility of trans-generational information transmission, observations in regards to deglaciation of the At-Bashy Range are not unanimous (see Table 3). Although glaciers are visible from nearly every village in the area and many herders and hunters travel to base of glaciers (see Fig. 4), a wide range of observations detailing change were recorded. A little over a third of respondents (38 %) stated they had observed an overall decrease in the size of local glaciers during their lifetime. A similar number of respondents (31 %) stated that the glaciers fluctuate yearly with changes in snowfall. Slightly less than a quarter of participants (22 %) responded that they have observed no change in glacial size over their lifetime. Only one respondent stated there had been an overall increase and six respondents (8 %) said they did not know what the change had been. The contrast in observations was recorded in interviews; here two contradicting views stand out:

> I ride horses and sometimes go close to glaciers. There I see changes in the glaciers. There is less. It is the same, there is no change. Just people are changing.

Fig. 4 A Kyrgyz herder looking for a lost yak at the foot of a glacier in the Oshariak drainage of the At-Bashy Range. Photo: A. Piersall

Some individuals, despite a lifelong residency in the area offered no observations despite the numerous vantage points for seeing glaciers from valleys and towns. Some individuals seemed to question their own powers of observations, as one respondent stated:

> I don't get that close to glaciers, so we cannot see exactly how high they are and where they end.

In addition to ranging opinions detailing changes in observed glacial coverage, basic understanding of what constitutes a glacier was not widespread. Many residents were not able to differentiate the definition of a glacier from seasonal snow cover of a mountainside. This would often become apparent when discussing the perception of glaciers growing drastically during a big snow year. Respondents were unanimous in recognizing that glaciers provide meltwater that contributed to runoff. As explained by Nurbek:

> A glacier is the most important wealth for us as the ice becomes our water. The snow that falls becomes frozen ice. When I was a little boy there were more glaciers, but now the amount has decreased. In the past there was more, now it is getting less. Up that drainage those three cliffs use to be covered with glacier. Now there is no glacier there, just stones. The changes impact each person's life. My grandmother died when she was 102 years old. She would tell us that water is very important and that in the future it would be more valuable than gold because the amount of water will be less and less.

The concern voiced by Nurbek over water availability was shared by many residents. In discussions, it was often difficult to gain insight on long-term trends because historic drought and flood events were often more memorable than trends represented in the climatological data (for example, rise in temperatures). Even opinions on annual differences varied between individuals. In regards to the water levels that year as Aijan, the wife of a herder explained to me:

> There is less water compared to other years. Some people say the amount of glaciers are getting less. In the past ten years I have noticed the glaciers are smaller. When I was a small I would go with my parents to pasture, in the neighboring mountain valley and there were more glaciers.

Other residents offered contradicting opinions such as from Adilet:

> This year there is more water. This year I cannot cross the big river with my horse. When I was a child we could cross, but now there is a bridge so it doesn't matter.

Adilet's perspective reflects the varying opinions on water levels that differed across study participants and even between neighbors. Furthermore, his comments as well as those of others underscore the ways in which other interventions such as infrastructure buffer and even divert individuals from direct engagement with the environment.

Other factors, such as religion, played strongly into certain individual's opinions about the environment and cause-effect relations in general. Islam was brought to the Kyrgyz in the tenth century and today most Kyrgyz self-identify as Sunni Muslims. Although religion is a component of cultural identity, a significant diversity of practices and interpretations exist. Most residents of At-Bashy consider themselves Muslims and mosques, some of which have recently been built with Saudi Arabian funding, can be found in every village. However, adherence to Islam laws varies greatly and in general Islam is practiced lightly. Religion still plays a central role in many families and certain individuals would defer to God when talking about changes in glaciers, such as this elder.

> Allah created water reservoirs at the top of mountains called glaciers. The mountain is close to the sun, so the snow could melt faster. There is still glacier and from the water reservoir built by god, there is still water coming. Researchers and specialists are telling us that glaciers are decreasing, but actually God is controlling it and there still are glaciers. There has been no change.

It is important to note that Kyrgyz media sources, mainly television and newspapers which serve as the primary source of information in rural areas have had some coverage, albeit limited, of the status of Kyrgyzstan's glaciers. The extent to which media coverage and other sources of information influence public opinion was not systematically addressed in the context of this study.

Recognizing and responding to change?

Interactions in the research setting in combination with field observations and interview data suggest an overall slow erosion of traditional ecological knowledge (TEK) about climatic, hydrologic and glacial processes. In the At-Bashy area, modernization and industrial agricultural practices have been widely promoted since the arrival of the Soviets decades ago. In the process, informal norms that once regulated the use of mountain environments and ensured access to high quality pasturelands were disabled. Although the Kyrgyz take tremendous pride in their nomadic identity, long term disruption occurred as most individuals became specialized technicians and bureaucrats during the Soviet era. Even with the re-emergence of semi-nomadic herding, detailed environmental observation, especially careful, measured and consistent environmental monitoring does not appear to be a high priority.

It is also critical to point out that at present, environmental change and deglaciation were not identified as major causes of the disruption to livelihoods and social safety nets for individuals and families of the At-Bashy Range. Given the pressing perturbations into rural life that have been caused by inter-connected and complex political, social and economic variables, environmental change seemed miniscule, if it is noted at all.

But widespread consensus exists as residents recognize the importance of the land and water quality, especially in regards to concerns for future environmental conditions. Even following the April 2009 revolution, one study participant explained:

> The environment is first. Second the economy and then politics at the end. We don't need politics, politics spoils the people.

This view was shared by many other locals, such as this resident:

> The environment is the most important. Everything here depends on the environment. There will be no economy or politics if there is not an environment.

Many subjects ranked environmental quality as the highest priority, above economical and political concerns, in maintaining or improving livelihood quality. Given recent and volatile political, economic and institutional disruptions this agreement highlights the dependency and continued bond that At-Bashy residents share with the landscape and will likely greatly influence the extent to which future climate changes and glacial retreat is perceived and assessed as a local priority.

Concluding remarks

Kyrgyz communities have demonstrated their great capacity for social resilience through significant periods of governmental and economic changes. These political and social factors of change are noted more than environmental change, but residents

quickly place the environment as having the greatest importance in their future. As residents balance multiple concerns, traditional rural livelihoods based on pastoralism are expected to continue to shape the economic, environmental and cultural landscape of the At Bashy region and rural Kyrgyzstan.

Individual opinions regarding changes are shaped by specific opportunities and constraints faced by families. In the At-Bashy area, maintaining social resiliency presents one of the greatest challenges to local communities' response to climate change and mountain hazards, including severe weather, cold stress, flooding and drought. At the national level, there has not been the promotion of strong social cohesion or mechanisms for collective action that would help support community and household resilience. Political instability, corruption and a lack of transparency in systems of governance impede the buffering capacity of society in the face of future risks. The implementation of disaster risk reduction and disaster planning to increase adaptive capacity are relatively weak.

The results of this study provides assistance in understanding misconceptions regarding climate change impacts in Central Asia which may, in turn, facilitate efforts to better respond to the country's potential future challenges.

In light of the general paucity of information and research on this topic, we would like to outline several avenues for future environmental social science research on the impacts of deglaciation. First, assessments of long-term response to glacial retreat and climate change in Kyrgyzstan must integrate a critical understanding and sensitivity to local culture. There is a need to focus on the range of adjustments people adopt to compensate for changes in water security associated with glacial retreat, including detailed studies of adaptations in agricultural systems, migration decisions, land use changes and differential impacts on the most vulnerable social groups and segments of the population such as elderly, children, young women and women. There is also a need to understand the potential for local systems of governance and decision-making to participate in crafting adaptive strategies that strengthen agricultural, health and social sectors and buffer food and water insecurities. Furthermore, in developing adaptive responses and planning, it will be critical to assess the distribution of and access to sound climate change science.

There is no doubt that the mountainous country of Kyrgyzstan is particularly vulnerable to glacial retreat. Despite the heightened awareness of the growing amount of evidence of environmental change, the current and long-term impacts on mountain communities in the At-Bashy Range and elsewhere in mountainous Central Asia are uncertain. An absence of qualitative studies addressing local people's observations and perceptions is an important missing link in assessing impacts. Environmental change, including changes in precipitation and runoff and severe weather events depend on location and may vary between upstream and downstream communities. Beyond these types of location-specific variables, as noted by Duerden (2004), translating environmental changes into more informed understandings of human vulnerabilities and adaptive strategies is not simple as communities are not passive and may not always respond in predictable ways.

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