

ADAPTABILITY OF KYRGYZSTAN'S PASTORAL SOCIAL-ECOLOGICAL SYSTEM

by

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Abstract

The location of Kyrgyzstan's Naryn province within the Tian Shan Mountains of Central Asia makes the country especially sensitive to the effects of global climate change. It is a poor region where over 70 percent of rural residents support themselves through small-scale agriculture and animal herding, activities that depend on ecosystem services including natural grassland productivity and melt-water runoff. While much of the literature on adaptation to climate change has focused on preventing disturbances or reducing their magnitude, this study focuses on "adaptability," or the properties of the rural Kyrgyzstani social-ecological system that could aid in recovery following a major disturbance. In 2010 I interviewed 65 residents of Karasu, a rural herding community, on issues related to access to sources of information, perceptions of the environment and levels of financial and social capital. Furthermore, I conducted an analysis of Landsat-derived NDVI to assess pasture degradation over the past decade. I found that social capital, financial capital and the ability to exercise mobility in herding practices are linked variables, and low levels in one reinforce low levels in the others. This relationship also has implications for ecosystem services, as less-mobile herders are more likely to overexploit nearby pastures. Another finding relates to the acquisition of new ecological knowledge.

Residents were much more willing to seek out new information during times of crisis, suggesting that for external state or NGO actors, the early recovery period might offer the best opportunity to influence local practices. Recent World Bank development projects in rural Kyrgyzstan are also reviewed in this study in order to assess the ways that their stated goals create or inhibit local adaptability. One finding is that there is a large emphasis on agricultural intensification in many projects, an objective that could limit other future adaptive options among local communities.

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1. INTRODUCTION

In the summer of 2010, I lived for four months in Kara-suu, one of many small rural settlements in Kyrgyzstan's mountainous Naryn province. Kara-suu is a modest collection of five villages totaling just over 5,000 residents. As in numerous other rural communities throughout Kyrgyzstan, livelihoods in Kara-suu are primarily created through the utilization of local ecological systems. In Naryn, the abundance of high-elevation meadows has historically favored a form of mobile pastoralism, called transhumance, as the primary economic strategy of local societies (Schillhorn van Veen 1995). This traditional form of subsistence continues to occupy a central place in the culture and economy of Kara-suu. Country-wide, Kyrgyz of all walks of life, even in urban areas, identify strongly with their pastoral heritage.

Given the importance of pastoralism to Kyrgyz today, it is tempting to view this practice as a timeless endeavor, the witnessing of which offers a glimpse into an earlier time. However, a closer inspection reveals how Kyrgyz pastoralism has been shaped by even very recent history, and how its practitioners continue to face novel challenges that demand continued innovation. .

Kara-suu, despite suffering through a period of acute human hardship in the 1990s following the disorderly dismantling of the Soviet planned economy, is fortunate to have returned to some approximation of the quality of life that existed before privatization. However, climate change in particular has the potential to generate severe future disturbances in Kyrgyzstan. Yearly temperatures in the "greater Himalaya," an area which includes Kyrgyzstan's Tien Shan Mountains, are increasing at a rate three times faster than the global trend (Xu et al. 2009). The Intergovernmental Panel on Climate

Change's Fourth Assessment Report cites increased flooding, irregular melt-water runoff, late-summer water shortages, and landslides as changes in mountainous areas that are likely to impact downstream communities (Parry et al. 2007). In terms of ecology, it warns that warming temperatures will result in the extinction of numerous alpine species as they are no longer able to retreat upward (Parry et al. 2007).

All of these impacts carry serious risks for residents of Kara-suu. Animal raising is a precarious business. In a country where in 2009 per-capita GDP was \$814 (data.un.org, July 12, 2012), and even less in rural areas, a household typical of Kara-suu might today own a modest herd of 20 sheep and 5 cattle or horses – assets which in 2010 could readily sell for \$5,000 US. Protecting this investment each year requires the convergence of several climate and market factors. Kara-suu is today in a position where current livelihoods demand a relatively strict adherence to a particular land use strategy, while at the same time, climate change is increasing the potential for severe and novel disturbances.

With these two conflicting trends of economic precariousness and increasing climatic uncertainty, it is clear that Kara-suu faces serious risk for future crisis. It is this very threat that motivated this study. While one approach for an external actor to address this problem might be to identify specific vulnerabilities in a community (e.g. soil erosion) and address them before they are compromised, this study takes a different perspective. Rather than hoping to prevent an unknowable future crisis from occurring, this study contends that it is more productive for an intervening agent to help ensure that a society has the capacity to thoughtfully respond to its own unique local needs and effect its own recovery when a crisis does inevitably occur. Throughout this study, the term

adaptability, in following with Walker et al. (2004), is used to denote this capacity of a society to plan and implement its own responses to crises.

This study aims to inform both state and non-governmental actors working in rural Kyrgyzstan, such that they are better able to consider the implications of their policies or development projects for the adaptability of local communities. The research objective, more specifically, is to identify what factors in Kara-suu either contribute to or detract from its adaptability at the scale of the community. For a given settlement, these factors might be anything from the biodiversity of nearby pastures to the level of education of residents to the kinds of cultural beliefs about land use held by the community. Already much work has been done by social and natural scientists to define in very broad terms the kinds of *general* categories of factors which contribute to adaptability (Anderies et al. 2006; Walker et al. 2004). This study is structured around identifying the *specific* attributes of Kara-suu that fall into two general adaptability-generating properties, both drawn from Walker et al. (2004): The first category examined is the community's **access to capital** in multiple forms, here understood as natural, financial and social. The second category is a **diversity of knowledge**, which comprises the breadth of information available to residents regarding land use options, and the ability of residents to identify relationships that exist between human and natural processes in the settlement—relationships that may structure or reinforce particular land use strategies.

It should be noted that this study does not attempt to demonstrate conclusively that access to capital or a diversity of knowledge ultimately do contribute to community-scale adaptability. Rather, it takes for granted these two dimensions of adaptability

identified by Walter et al. (2004), and *applies* them as the criteria for assessing the potential for future adaptive behavior in a specific, real-world social-ecological system. Thus, the primary question asked by this study is not “What generates adaptability in societies?” but rather, “What generates adaptability, as defined by access to capitals and a diversity of knowledge, in the rural Kyrgyz social-ecological system?” A second question investigated by this study is “Given the set of specific local factors that this study has identified as either contributing to or detracting from adaptability, to what degree have the goals outlined in regional development projects been congruent with generating greater adaptability?” While the findings of this study regarding adaptability-building factors are only applicable to rural Kyrgyzstan, this work does have value for sustainability professionals in other regions. The methods used to assess adaptability are quite general and could be applied in a variety of social-ecological systems. This study serves as a model for how to conduct similar adaptability assessments in other regions of the world, assessments which must give equal attention to the local culture, ecology and economy. Ideally, such assessments would inform development organizations about the kinds of specific development actions which would create the largest gains in adaptability.

This project was designed with several hypotheses about specific factors that might influence adaptability in Kara-suu. Following Schillhorn van Veen (1995), an early assumption of this research was that the recent hardship in the community might disrupt the mobility of herders, resulting in uneven range exploitation and resource degradation. Another is the relationship between poverty and weakening social networks in rural Kyrgyzstan (Kuehnast & Kuehnast (2004)), a dynamic that I hypothesize could

potentially exacerbate the magnitude of a disturbance at the household level. In addition, the research design allowed for ample opportunities for other factors to arise.

Interviews with residents of Kara-suu served the primary investigative tool. In administering interviews, I inquired about such topics as a respondent's household economy, perceptions of the natural environment and decision-making process regarding land use. Wherever possible, I also sought to corroborate the accounts of residents with other sources, including satellite imagery of pasture areas.

This study is divided into seven sections. Section 2 expands on the history and composition of Kyrgyzstan and Kara-suu. Section 3 provides an in-depth description of key theoretical frameworks used in this study. In particular, it provides a guide to the concepts of adaptability, resilience, social-ecological systems, and the adaptive cycle. Section 4 provides additional detail on the methodology used for conducting household interviews, satellite imagery analysis, and a review of local development practice. Section 5 identifies local factors in Kara-suu which fall under Walker et al.'s (2004) definition of adaptability. Section 5.1 is focused directly on land use in the upland meadows, or *jailoos*. It draws primarily from interviews with *chabans* (full time herders) and the analysis of Landsat imagery. Section 5.2 identifies factors that influence the diversity of knowledge within the settlement, and touches on economic diversification, cultural affinity for pastoralism, and educational opportunities. Section 5.3 looks at both social and financial capital within the community, and identifies obstacles to accessing them. Section 5.4 presents a review of the stated objectives of recent World Bank projects in Kyrgyzstan and evaluates them in relation to the set of adaptability-influencing factors that are identified in this study. Furthermore, it is here that I offer some policy

recommendations for future work in communities like Kara-suu. Section 6 provides summary and synthesis.

2. STUDY SITE

The history of Kara-suu is typical of much of alpine Kyrgyzstan. The rugged landscape of Kyrgyzstan has historically favored animal raising over agriculture as a primary subsistence strategy. This economic predisposition of the landscape continues today, as livestock production on natural grasslands remains a major component of the rural economy. Traditionally practicing a form of short-range mobile pastoralism, the rural Kyrgyz population was forcibly sedentarized through Soviet collectivization initiatives beginning in the 1930s (Schillhorn van Veen, 1995). Since gaining independence in 1991, the Kyrgyz Republic has dismantled the collectivized farm system. By 2006, less than 10% of agricultural production occurs in collective enterprises (NSC, 2008). In its place, small-scale family operations have established themselves. The transition to smallholder animal raising was sudden, and the collapse of the collectivized system precipitated a pronounced rural economic crisis from which the country is only now recovering (Table 2.1).

Table 2.1: Recovery of Kyrgyz economy following privatization

(data.un.org, July 12, 2012)

	<u>GDP Per capita</u>
2000	276.5
2005	471.2
2008	835.1

Ninety percent of Kyrgyzstan's territory is situated higher than 1500m asl, and 40% is higher than 3000m asl (Januzakov, 2003). The country's extensive highlands are predominately covered by open grasslands, and tree cover is sparse. Only seven percent

of the country is comprised of arable land, most of which is found in Kyrgyzstan's portion of the Fergana Valley (World Bank, 2003a). Beyond this, small arable zones are found along rivers and streams running through the country's numerous minor valleys. Before its inclusion in the Soviet Union, the Kyrgyz pastoral sheep economy was characterized by a system of transhumance, whereby herders lived in permanent low-elevation valley settlements in winter, and in the summer set up mobile camps in higher *jailoos* (Schillhorn van Veen, 1995). This system allowed Kyrgyz pastoralists to take advantage of the sharp ecological gradients created by the steep terrain. As a growing season advanced, the zone of productive grassland moved progressively higher in elevation. Valley floors surrounding permanent settlements were left uncultivated, as their natural grass cover was needed to supply animals with fodder throughout the winter (Schillhorn van Veen, 1995).

During collectivization in the 1930s, the Soviet state outlawed private agricultural activity, and transferred all responsibility for animal raising to collective farms. Collectivized agriculture in Kyrgyzstan differed from traditional transhumance in several ways. First, the number of community members participating in animal raising decreased dramatically, as herds of thousands of sheep were now kept under the care of just a handful of specialists. Second, rather than allow herders and their animals to react to seasonal variation and move animals among the various *jailoos*, summer pasturing locations were fixed for the entire season by the state agricultural service. Finally, low-elevation riparian areas were converted into irrigated agricultural land. This tilling removed the traditional source of winter nutrition for animals, and collective farms were

thus forced to either import feed, or transport animals long-distance to Kazakhstan to overwinter (Schillhorn van Veen, 1995).

This system persisted until the early 1990s, when the newly independent Kyrgyz Republic enacted a policy of radical decentralization and privatization of all state-owned agricultural assets (World Bank, 2003a). Over several iterations between 1991 and 1995, all agricultural land, farm machinery and livestock were distributed among the rural population. Depending on the size of its household, each family received around 2-4 hectares of land and 10-30 sheep. This sudden transfer created numerous problems for rural communities. First, under the Soviet Union, the collective farm was the sole provider of ancillary agricultural services such as veterinary care and machine maintenance, and in its absence, such services were not widely available. Second, most Kyrgyz no longer had any first-hand experience with small-scale agriculture and animal raising, as for 60 years only a select few members of each community were actively employed in agricultural work. Finally, there was no private sector that could handle the marketing of agricultural products on a national scale. The result was a severe crisis in rural areas, as crops and animals were lost to inexperience and lack of support services, and, in the absence of a functional market, families were forced to barter away whatever assets they still possessed. In the ensuing years, and with the assistance of development programs from several organizations like the World Bank and USAID, the rural sector did eventually reorganize and develop into the current system of smallholder animal raising and farming.

In the Kyrgyz Republic, administrative areas are divided at the largest scale into provinces (*oblast*), followed by regions (*raion*), and finally by districts, or *ayil okmotu*

(literally “village government”). This study was conducted in the Kara-suu *ayil okmotu*, a settlement of around 5000 inhabitants, which is located in northern Naryn province (Figure 2.1).

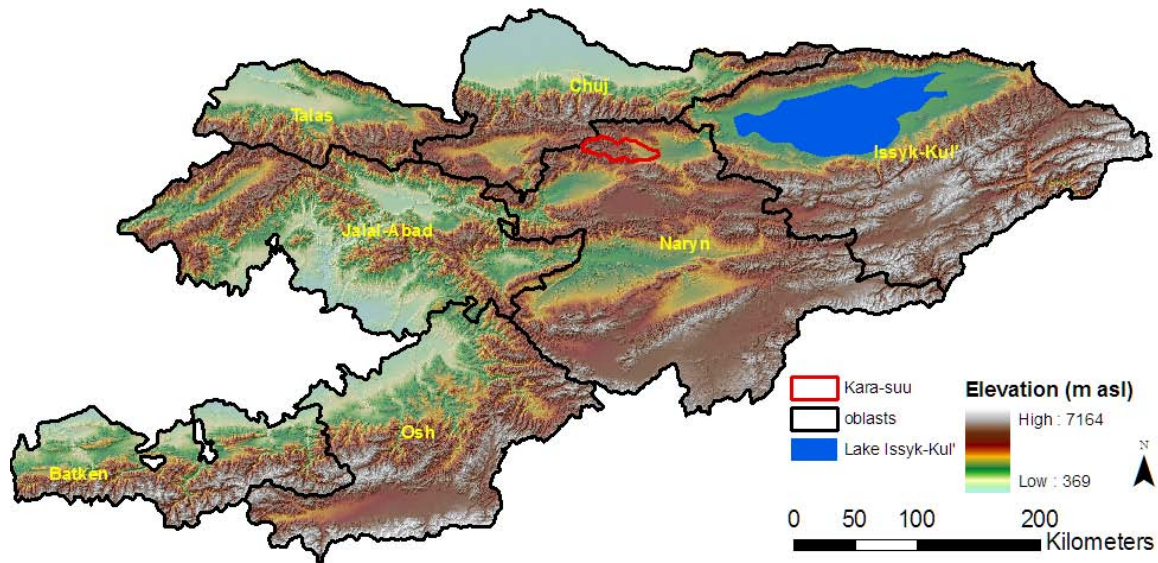


Figure 2.1: Location of Kara-suu in Naryn Province

The five villages that comprise Kara-suu are spread for 15km along a broad valley between elevations 2100 and 2300m asl. (Figure 2.2) Kara-suu abuts the Sook Valley, a narrow valley which extends from the villages 50km to the west. It is through this valley that herders gain access to upland pastures.

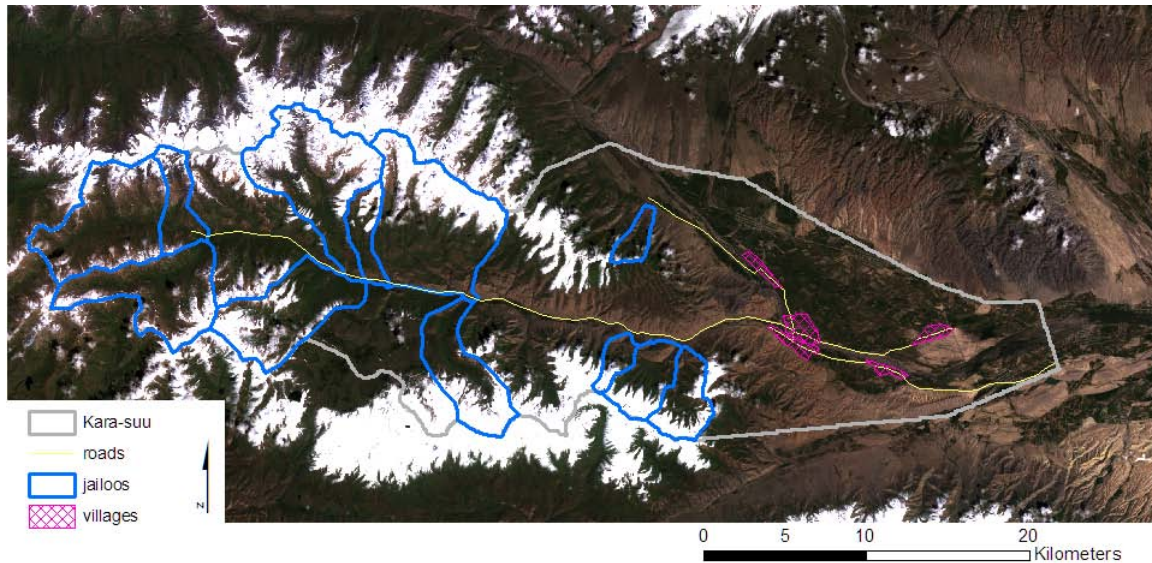


figure 2.2: Location of villages and jailoos within Kara-suu ayil okmotu

While Kara-suu is not representative of all of Kyrgyzstan, it does possess several features that are shared with many other individual communities in the country. Kara-suu is first and foremost an agricultural community, as virtually every family is engaged in agriculture to some degree, and often exclusively. Country-wide, agricultural production in the past decade has comprised 30-40% of GDP (World Bank, 2007a). Around 50% of the country over this same period has been employed in this sector. Given the fact that 64% of the national population is rural, and assuming all agricultural activity occurs in rural areas, these figures suggest that around four out of five rural jobs are agricultural. In this regard, Kara-suu reflects most rural settlements. Country-wide, animal products and crops each make up roughly half of all agricultural output. Kara-suu, and Naryn province as a whole, is much more specialized in animal production, which accounts for 67% of Naryn's agricultural production (NSC 2008). While no official records exist for Kara-suu, residents themselves report only occasional or casual sale of non-animal products. Thus, while Naryn's strong focus on animal production is somewhat atypical among

provinces, herding is nevertheless a practice that is an important part of the economy in rural communities nationwide and a study of Kyrgyz pastoral communities is relevant to the country as a whole.

Naryn province is highly ethnically homogenous; over 99% of the population identifies as Kyrgyz in a country where Kyrgyz comprise 69% (NSC 2004). Notably absent from Naryn and Kara-suu are ethnic Russian and Uzbeks, who reside primarily in urban areas (Russians and Uzbeks) or the cotton-producing Fergana Valley (Uzbeks). Thus, any insight gained from the cultural practices of the residents in Kara-suu should only with caution be applied to more ethnically diverse, generally urban, areas. Overall, Kara-suu is as good a representation of rural Kyrgyzstan as could be found in any single settlement.

In this study, Kara-suu is an example of a well-bounded **social-ecological system**—or **SES**. This term, which is defined in more detail in Section 3, refers to a society, the ecosystems it exploits, and importantly, the interactions between these two spheres which ultimately influence the land-use decisions of that society. Kara-suu is a good case for conceptualizing as an SES for two reasons. Firstly, it is easy to delineate its boundaries. National rangeland policy in Kyrgyzstan dictates that each *ayil okmotu* enjoys exclusive access to a certain area of the rangeland. For Kara-suu, this area is coincident with the boundaries of the *ayil okmotu* (Figure 2). Thus, there is a 1:1 relationship between pasture area and dependent community. Any anthropogenic disturbance in Kara-suu's pastures can be presumed to have been caused by residents of Kara-suu, and any ecological changes in the area are of primary interest to this same group of residents. For analytical purposes, this self-contained quality significantly

simplifies the assignment of causality in ecosystem change. The second quality that makes it attractive is the fact that in terms of land-use decisions, the *ayil okmotu* is highly autonomous. While de facto autonomy has existed since the collapse of the state-run agriculture sector in the 1990s, in 2009 it has become national policy as the government devolved all authority in pasture management to “pasture committees” in each *ayil okmotu*. As is discussed further in Section 3, a key characteristic of complex adaptive system (of which a social-ecological system is a variety) is self-organization without a central controller (Miller 2007). Because of the weak state role in Kara-suu’s pasture governance, the community itself is afforded a high degree of latitude to plan and implement its own responses to current or predicted future disturbances within its SES.

3. THEORETICAL FRAMEWORK

A deeper understanding of the concepts of social-ecological systems and adaptability requires a review of the foundations of “resilience thinking.” According to Walker (2007), resilience thinking is “an approach to observing and managing natural resources in a way that embraces the complexity of human and natural systems.” In effect, resilience thinking treats sustainability problems as the manifestation of complex adaptive phenomena, and can be thought of as complexity theory applied to social-ecological systems. Struntz (2012) acknowledges that while resilience thinking is a “vague” concept insofar as its tenets are difficult to test empirically, this “conceptual vagueness” is not a weakness, but rather a tradeoff that opens up the potential for interdisciplinary problem solving and encourages creativity. Therefore, it is particularly well suited to finding solutions for “wicked problems” (Rittel & Webber 1973) (Ludwig 2001) where the complexity of the problem is high, there is significant disagreement

about the very definition of the problem, and the risks of inaction outweigh the risks of imprecision

Resilience thinking finds its origins in ecologist C.S. Holling's *Resilience and Stability of Ecological Systems*. Before Holling, the paradigm in natural resource management was "maximum sustainable yield," or MSY. Maximum sustainable yield refers to an idealized maximum level of exploitation that an ecosystem can withstand, without suffering irreparable loss in productivity. (Larkin 1977, Walker et al. 2004) Typically MSY is stated in terms of a single coveted resource, such as timber, fish or rangeland fodder. MSY presupposes that the natural tendency of any ecosystems is to gravitate towards a single, predictable and stable equilibrium. Although MSY may be useful in simple systems, where variables can be closely controlled like a single agricultural field, Holling (1973) drew attention to the fact that many ecosystems exhibit strongly cyclical or chaotic behavior in their biological and physical compositions. Furthermore, he popularized the notion that many ecosystems alternate between two or more semi-stable equilibria, or **regimes** (Holling 1973). This insight suggests that what we understand to be the "equilibrium" state of an ecosystem may just be one phase of a complex relationship of semi-stable regimes. For Holling (1973), resilience is "the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables." Thus, a regime is defined primarily by its internal *relationships*, not by the absolute values of any of its constituent variables.

The concept of resilience within the ecological discipline initially represented a more nuanced view of ecological systems, one that emphasized the importance of non-

linear relationships between variables, feedback loops, and thresholds beyond which an ecosystem would transition from one regime into another (Walker et al. 2004). However, a major shortfall of resilience as originally conceived by Holling (1973) is that it portrayed ecosystems existing as an entity independent from human society and as systems that are subject to exogenous human disturbances. However, at over seven billion humans on Earth, and with five people supported by each hectare of arable land, this division of ecological and human systems is increasingly becoming an irrelevant abstraction. Management schemes that rely on exclusively ecological principles, and that view human activities, such as resource extraction, as an exogenous disturbance into the system, discount the myriad of ways in which human societies and local ecosystems are already closely interrelated and actively influence each other's development. The particular set of services provided by an ecosystem defines the sorts of human livelihood strategies that could conceivably succeed in a region. Furthermore, the manner in which a society chooses to convert these ecosystem services into a livelihood can have a range of effects on the very processes that support that economic practice, such as altering soil properties or encouraging or discouraging the presence of certain species (Folke 2005; Walker et al. 2006).

The concept of the **social-ecological system** (SES) represents an attempt by an interdisciplinary group of ecologists and social scientists to extend the insight of resilience as conceived of by Holling (1973) into the social realm (Folke et al. 2005). Rather than conceptualizing a society as an intelligent, rational agent with the ability to pick and choose the ways and places through which it influences the environment (like some sort of omnipotent resource manager), an SES presents a model of a society whose

interactions with its ecosystem are very much driven by diffuse, unguided processes within a society, such as cultural beliefs, market conditions, household economies and customs. An indispensable characteristic of an SES, as a complex adaptive system, is the ability to self-organize without a strong external guide (Folke et al. 2005). In an ecosystem, this could be exemplified by a forest destroyed by wildfire, which, relying on the surviving seeds and the sudden release of nutrients, returns to a similar assemblage of canopy species to that which existed before (Walker & Salt, 2006). In an ecosystem, a regime is defined by the relationships between species, and between biological and chemical processes (Holling 1973). With an SES, a regime's identity encompasses any variable, social or ecological, that reinforces its particular relationship between a society and its environment. (Folke et al 2005.) Abel et al. (2006) illustrate the concept of alternate SES regimes using example of Zimbabwe's rangeland economy. In response to a severe drought in the 1980s, and without any strong national mandates, a majority of former cattle ranchers transformed their operations into bases for wildlife tourism. Under both regimes, herding and tourism, society self-organized around the exploitation of a single resource. Neighbors acting independently simply advised and emulated one another, and capitalized on the availability of ancillary services supporting the predominant regional industry.

The example of the Zimbabwe rangeland SES represents a positive outcome, as both its ecosystem and society were able to recover from the crisis into a regime that was at least as desirable as the previous; income rebounded and biodiversity actually improved. However, a system experiencing a crisis and a collapse can permanently lose resources (natural, human, etc.) that could have aided its recovery. The risk of such losses

has encouraged resilience researchers to find ways to keep systems from ever collapsing in the first place (Abel et al. 2006).

In discussing the dynamics of a complex adaptive system, the **adaptive cycle** provides a useful heuristic for understanding various stages in the development of an SES (Figure 3.1). According to Holling (2001), a system that experiences a major disturbance will undergo a release of “potential.” In a collapse (Ω) phase, resources, whether natural resources or the creativity and time of a society’s residents, are freed up from the relationship that defined the organized, pre-collapse system. Phases α and r represent the time of reorganization and the reestablishment of relationships within the system. It is also a time of high potential for innovation, as well as a time where a system is most likely to transition into an alternate regime.

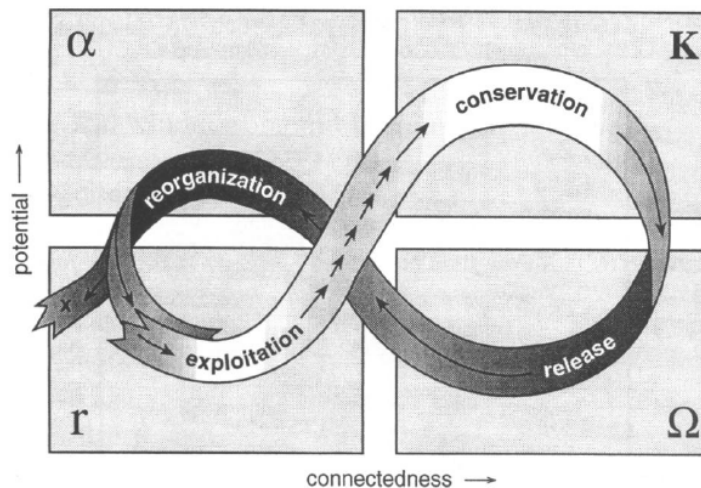


Figure (3.1) Phases of the adaptive cycle (Holling 2001)

Resilience when viewed through the framework adaptive cycle is the capacity of a system to resist external influence and remain in the conservation (K) phase of development, which is to say the capacity to avoid a collapse (Ω event) (Holling 2001).

Anderies et al. (2006) divides resilience into two categories: specific and general.

Specific resilience describes a regime's vulnerability to a particular kind of disturbance (e.g. drought or market crash), while general resilience is an amalgamation of a system's ability to cope with a wide range of plausible stressors.

To maintain the resilience of a SES that already resides in a desirable regime is of course an important goal for any society. However, this study takes the position of Walker et al. (2004) that maintaining an SES in a desired regime is only half of what constitutes long-term sustainability and human welfare. To focus exclusively on preserving SES resilience is to expect that society has an unfailing ability to determine the single ideal resource-use regime and complementary social order for a particular geographic region. Even if it could be agreed that some traditional societies and their environments form persistently resilient social-ecological systems, massive global changes, including population increase, climate change, globalizing markets and biodiversity loss all represent external disturbances that can reasonably be expected to challenge the persistence of such resilience (Folke 2005). Just as ecology once moved away from the single-equilibrium model of ecosystems, researchers studying the environment now need to move away from the idea that a single ideal SES regime can be identified. In addition to managing resilience in the K phase of development, it is necessary to prepare societies to cope with unforeseen stresses and, when society deems necessary, to use the opportunity to reorient the system towards a novel regime (as occurred in the case of Zimbabwe). In some situations, it may even be advantageous for a society to intentionally lower the resilience of an SES in order to facilitate a transition into another more desirable regime.

This study is guided by the contention that long term sustainability depends on what Walker et al. (2004) term **adaptability**, or “the capacity of [human] actors in the system to influence resilience (in a SES, essentially to manage it).” Because the specific relationships that structure the resilience of a SES’s regime are tied to a unique combination of regional culture, history and ecology, I agree with Ostrom’s (2007) position that societies need to “avoid adopting standardized blueprint solutions but to search to find the appropriate types of solutions for specific niches and help to adapt these to particular situations.” From the perspective of an external actor (NGO, State) wishing to improve the sustainability of an SES, fostering adaptability, as opposed to resilience itself, avoids exactly this one-size-fits all approach, as high adaptability allows a community to find solutions specific to its own “niche,” or SES.

This identifies the characteristics of the Kara-suu SES that contribute to or detract from adaptability. These characteristics into two broad categories based on Walker et al.’s (2004) description of adaptability. The first contribution to adaptability is the presence of institutions that encourage the acquisition, creation and preservation of the knowledge that enables a society’s members to understand the relationships that structure its SES. This category is termed “**diversity of knowledge**” for the purposes of this study (Figure 3.1). This knowledge can come from such sources as local ecological knowledge, social networks, formal science, and experience-based learning. No single source alone is sufficient (scientific, cultural beliefs, personal experience), but access to a broad array of sources allows a society to understand how individual, measurable variables contribute to or detract from the resilience of its own SES regime. Furthermore,

this knowledge helps members of a society to envision a larger range of alternate SES regimes, thus allowing them a better chance of identifying desirable regimes.

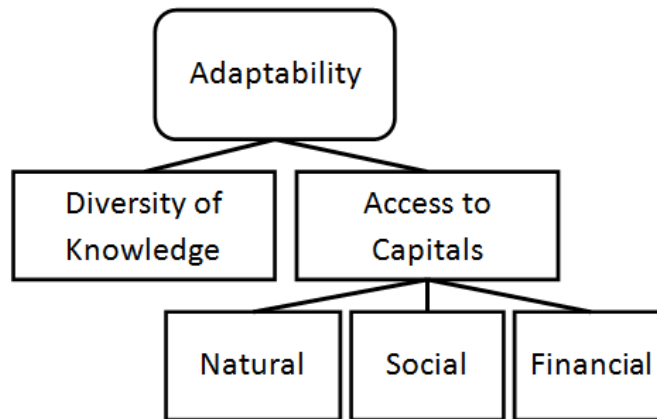


Figure 3.1: Components of adaptability

The second component of adaptability is comprised of access to capitals that a society must draw on to actually enact any plans to manage resilience, by means of an adaptation or a transformation. This category, or **access to capitals**, includes three types of capital: financial, natural, social. A resource is only “accessible” insofar as it is available for use in adaptation. High levels of trust and perceived legitimacy with the structure of governance, and the attendant heightened participation that legitimacy encourages, are necessary preconditions for the mobilization of society as a whole around a course of adaptive action (Walker et al. 2004). Thus, rather than focus exclusively on the quantities of these resources, this research also takes into account the conditions that might preclude their deployment, such as social inequality or the marginalization of certain groups within the community.

The organization of this study mirrors this definition of adaptability. Diversity of knowledge and access to capitals are each explored in Sections 5.2 and 5.3, respectively. The only deviation from this structure is natural capital. Because natural capital features

so prominently in the economy and culture of Kara-suu, it is discussed separately in Section 5.1.

4. METHODS

4.1 Interviews

I chose interviews with longtime residents of Kara-suu as my primary tool for investigating adaptability. Over the four-month period that I lived in this settlement, I conducted interviews with 65 residents. I divided my data collection efforts between two groups of subjects. The first group consisted of 45 community members who had in 2010 lived in Kara-suu as adults for the preceding 20 years. I conducted these interviews in respondents' homes in the lowland, permanently-settled villages. The second group was comprised of 20 *chabans*. I contacted these *chabans* by approaching them in their summer dwelling throughout the various *jailoos* of Kara-suu.

For the group of 45 village residents, my primary inclusion criteria for subject selection were that all respondents should be over the age of 38 and have lived in Kara-suu for the majority of the previous 20 years, and that my sample group should consist of no more than two thirds of either gender, and should be drawn from each of the five villages that comprise Kara-suu in proportion to the populations of each village. I included the age restriction to ensure that respondents were adults for the entire 20-year period targeted in my interviews, in order to give myself greater confidence in the accuracy of their responses related to the earlier years of this period.

To select individual respondents within a particular village, my strategy was to walk to an arbitrary location in the village and approach the nearest house. If no one was home, I would go door-to-door until someone was available who was willing to be

interviewed. For each interview, I tried to target a different area of the village. While not randomly selected, the locations of the households I interviewed were at least dispersed throughout the extent of each village (Figure 4.1.1)



Figure 4.1.1: Location of interviewed households in three villages (GPS malfunction prevented recording in remaining two villages) Base map: Landsat TM, false natural color, 6/15/2009.

Approaching a household, I generally asked to speak with the head of the household, believing that he or she would be best able to answer questions related the family’s economic practices. The only exception to this was when I needed to add more female respondents to achieve my goal of a minimum of one-third of respondents from either gender. In these situations I simply asked to speak with the *ezhe* or “mother” of the

household, and most families obliged. I employed a native speaker of Kyrgyz as an interpreter throughout all of my interviews and interactions with local residents.

In accordance with the inescapable customs of Kyrgyz hospitality, I was always invited into a family's home to conduct the interview. One corollary of this treatment was that my interviews often attracted the attention of many members of a household, and thus most of the responses to my questions were provided in the presence of other family members. While this scenario is not ideal, I believe that because my questions were not of a personal nature but related to information that should have been common knowledge to multiple family members, that the effect of the presence of others was minimal. While other members would sometimes interject their own opinions throughout an interview, I only recorded the answers of a single subject.

My interviews lasted anywhere from 30 minutes to two hours, depending on the level of patience exhibited by the respondent and the amount of detail they chose to provide in response to questions. Overall the average interview lasted around 45 minutes to 1 hour. It is these through these household that I investigated diversity of knowledge and access to capitals within the community. The full list of interview questions can be found in the Appendix.

In terms of a **diversity of knowledge**, I investigated four general questions. 1) What is the role of education in the community? Are certain specializations either favored or discouraged? 2) What sources of information regarding land use do resident prefer? 3) How do residents perceive the environment? Do they perceive change, and if so, what are their thoughts on the causes? 4) What do residents perceive as the main problems facing the community? What course of action would they propose? Together,

these questions were designed to establish the diversity of external sources of information (questions 1 and 2), how residents are producing their own knowledge about the SES (question 3), and finally, the degree of diversity across the community in perspectives related to local problems and potential solutions (question 4).

For the property of **access to capitals**, questions were designed to establish not only the absolute amount of these capitals, but also whether there are conditions that might discourage their use in implementing an adaptation. Beginning with **financial capital**, I looked at three factors: 1) What are the kinds of assets that households own? 2) By what means do families convert their labors into livelihoods? How do they derive income from their agricultural products? 3) What are the kinds of non-agricultural sources of financial capital do families pursue? **Social capital** is understood here as the strength of social networks to which a household belongs, and the value that a household can expect to derive from that network. Interview questions were organized around the following general questions: 1) How do residents of Kara-suu construct their social networks, and of whom are they comprised? 2) What kinds of value have they derived from these contacts, and what kind of value would they expect to derive in the future?

Wherever possible, I asked respondents to contrast their answer with the answer they might have given in the years immediately following privatization of the early-1990s. In any instance where a respondent was able to confidently identify a change in a particular variable over the past 20 years, I asked them to explain the reasons for the change. In doing so, I sought to identify adaptability-influencing characteristics of Kara-suu that might only be apparent during a time of reorganization and recovery.

For the investigation of access to natural capital, only upon arriving to Kara-suu did I make the decision to exclusively target *chabans*. This decision was made after learning that although most households are engaged in animal raising, it is not economical for most households to spend all summer tending just 20-30 animals in a *jailoo*. Rather, a subset of dedicated herders rent their services out to their neighbors, pool the animals of many households, and tend for them as one large herd for the summer. The rationale for interviewing these *chabans* is that they are the only residents of Kara-suu who spend a large amount of time each year, and over many years, living in the highlands and observing pasture conditions. In addition, they are the community members who should have the most immediate economic interest in the quality of vegetation in the *jailoos*. Just as in the village interviews where I stratified my sample selection over multiple villages, I attempted to meet with *chabans* residing in a variety of different *jailoos*. To accomplish this, I divided the *jailoos* into three categories, near, medium-range, and remote. These categories correspond to the distance that a *jailoo* is located from the village, respectively up to 15km, 15-30km, and 30-45km. Depending on the size and accessibility of the *jailoo*, I observed anywhere from five to twenty individual yurt camps in one valley. Because I was interested in information about any changes over the previous 20 years, I first approached camps nearest to the main road and ask if they could direct me to the camp of any *chaban* who has been coming to that particular *jailoo* for many years, ideally at least 15.

I conducted most of these interviews inside a respondent's yurt. Again these interviews attracted the attention of other members of a *chaban's* family also living in the *jailoo*. The typical length of interviews was again around 45 minutes to an hour.

My questions related to **natural capital**, and focused primarily on the ecology and governance of upland pastures. I target the following general research questions: 1) How do resource users perceive the state of this natural resource, and what are their perceptions of the causes of any identified changes? 2) Are resource users likely to attribute changes to human activity? 3) How has the intensity of pasture exploitation changed, either in magnitude or distribution, over the past 20 years? 4) How is pasture governance handled by the community? 5) How do *chabans* react to environmental change, and what is the role of mobility?

Not only did these questions seek establish the institutional determinants of access to natural capital, but also assess the degree to which pasture resource users are able to identify and formulate responses to ecological changes. Through this series of interviews with *chabans*, I always asked respondents to give their answers based on current conditions, and also how they remember the subject from 15-20 years prior. As with the household interviews, I asked *chabans* to explain what they perceived to be the causes of any identified changes.

In both sets of interviews, the general village interviews and those conducted in the *jailoos*, I encouraged respondents to elaborate on answers to my specific questions. While I always attempted to incorporate all of my planned questions, this was not always possible. Sometimes a respondent would show particular interest or knowledge in one topic and would talk at length, which opened up many avenues for me to respond with questions that deviated from my original list. In contrast, some respondents displayed discomfort with certain lines of inquiry, and I often made the decision to skip questions in order to maintain good rapport for the remainder of the interview. Despite these

inconsistencies, I was nevertheless able to achieve over 90% response for most of my questions, and over 80% for the remainder, which included questions of household assets. Because I encouraged respondents to elaborate on all answers, and to provide any additional information or anecdotes that they felt were pertinent, my analyses are also informed by information that does not necessarily derive from any specific planned interview question, but which was relevant to my more general research questions. Due to the small sample size of my interviews, 45 in the villages and 20 in the *jailoos*, no formal statistical analysis was applied to the responses. Rather, I looked for common themes among responses that suggested a particular sentiment is shared by a larger portion of the community.

4.2 Remote Sensing of Vegetation

My interviews with *chabans* asked questions related to their perceptions of ecological conditions. In order to corroborate these responses, an analysis of satellite imagery was employed, as satellite images represent the most complete source of data for land-cover change in a region where recordkeeping is poor.¹

To assess changing pasture conditions, I generated a Normalized Difference Vegetation Index (NDVI) for Kara-suu's pastures. NDVI, which ranges from -1 to 1, is a measure of the difference in infrared and red light reflected from a point on the earth's surface. Vegetated areas produce highly positive values, while non-vegetated areas generate values around 0 or negative values. To conduct this analysis, I identified every single TM and ETM+ scene available on USGS's GLOVIS server

¹ There are no existing records of yearly, or even decadal, pasture conditions at the scale of *ayil-okmotu* for Kara-suu. Soviet-era records, if they once existed, I was never able to locate in my visits to both the Koch-Kor (regional) and Naryn (provincial) archives.

<http://glovis.usgs.gov/>]. From this set, I selected only images taken in the month of August. This resulted in a sample of 8 scenes taken between 1999 and 2010. I selected only August images for two reasons. First, in order to reduce variance introduced by a difference in the season of images. The second reason was that in order to compare the NDVI values of a given pixel over multiple images, the spatial extent of my analysis is restricted to the intersection of the area of usable (cloud free, not affected by SLC malfunction) data for all scenes included. By restricting the sample to only eight scenes taken in August of different years, achieving good coverage of the entire 1999-2012 period was possible while still retaining large areas of pixels which are represented by each year. Ideally this sample would have also included images from 1993-1998, as this would have covered the entire temporal scope of the survey questions. However, a lack of usable pre-1999 images precluded assessing pasture conditions in the early-mid 1990s.

Before calculating NDVI, clouds and cloud shadows were manually identified and masked from all scenes, and COST atmospheric correction was applied to each image. The COST method only takes sun zenith angle at time a scene is recorded as an input, and applies a universal adjustment to each sensor band based on a model of Rayleigh scattering (Mahiny & Turner 2007). While mountainous Kara-suu would have been a good candidate for a more robust topography-based process, the 90-meter resolution SRTM data available at the time of analysis included too many data artifacts to be useful, as it risked introducing new error into the Landsat images.

With the eight scenes atmospherically corrected and cleaned of clouds, each scene was cropped to the intersection of usable data for all years. NDVI was calculated using bands 3 (red) and 4 (near-infrared) from the TM and ETM+ sensors (Huete et al., 2002).

With NDVI values for all years, pasture degradation was assessed pixel-by-pixel. The slope and intercept of the linear regression for each pixel was calculated, using year as the independent variable and the eight NDVI values as the dependent variable. An area that in 1999 was vegetated, but was degraded and barren by 2010, produces a regression with negative slope, positive in recovering areas. The goodness-of-fit for each of these linear regressions was calculated using R^2 . In order to identify notable change in pasture conditions, I looked for areas where there is a high magnitude of NDVI change ($>.015$ absolute change/year), and this change is at least somewhat well explained by year ($R^2 > .5$). A mean annual change in NDVI of 0.015 will over 12 years result in a change of 0.18.

4.3 World Bank Projects

The methodology applied in the analysis of World Bank projects (Section 5.4) differs significantly from the work I conducted in the field in Kara-suu. After having returned from the field and analyzed the results of my interviews, I settled on a set of factors in Kara-suu that I found to be influencing adaptability, as defined by Walker et al. (2004). These factors are detailed in Section 5. Using this set of factors as a guide, I read through the program documentation of every World Bank initiative in rural Kyrgyzstan from 1990 to 2010. I identified, for each of these factors, the set of projects that was likely, based on their stated goals and implementation plans, to have a significant effect on adaptability. In cases where multiple projects were found to be relevant to any one of the identified adaptability factors, I incorporate this result into a set of recommendations for future development work in Kyrgyzstan.

5. RESULTS

5.1 ACCESS TO NATURAL CAPITAL

The natural grasslands of Kara-suu are a major source of natural capital, as they provide most of the nutrition for livestock. Herders told me that animals are fattest and most marketable in the autumn after spending summer in a *jailoo*. Mobility is an essential adaptation that has allowed historical and modern societies to prosper in many areas unsuitable for an exclusively agrarian economy (Frachetti, 2008). Constraints on permanent settlement in such areas include low rainfall, remoteness from surface water, high climatic variability, and a short growing season. Because water and pasture availability are spatially and temporally variable, successful pastoralism demands the ability to move to resources as they become available (Fernandez 1999). From the point of view of a pastoral society, this adaptation serves the purpose of safeguarding livelihoods. In addition, this mobility also has many important ancillary benefits for preserving the health of ecosystems and, ultimately, natural capital. Given an equal amount of resource exploitation between two pastoral societies, the more mobile of the two is less likely to precipitate irreversible rangeland degradation and loss of productivity. Humphrey and Sneath (1999) demonstrated that among three Eurasian pastoral societies, Buryat (Russia), Mongolian and Inner Mongolian (China), regional-scale rangeland productivity is highest where mobility among herders is least restricted. The reason for this is that a mobile society is able to cease exploitation of an area before it crosses any critical ecological thresholds (Cingoliani et al. 2005). Furthermore, in the absence of wild ungulates, grazing by domesticated animals at a moderate level actually plays an important role in maintaining the diversity of a range, even if rangelands

invariably experience a loss of biodiversity after a certain threshold of exploitation (West 1993). For example, soil fertility is aided by manure and seed deposition (Augustine and McNaughton, 2007), and grazing creates spatial heterogeneity that preserves habitat for floral species with diverse reproductive strategies (Cingoliani et al., 2005; Hirst et al.'s 2003).

While this observation highlights the potential sustainability of pastoralism, it nevertheless presents a problem for practitioners. The exact curve of the relationship between grazing intensity and species richness is highly variable among different ecosystems, as it is dependent on the unique co-evolutionary history of its constituent species (West 1993). West (1993) argues that in the face of a high degree of uncertainty regarding the ecological resilience of a given rangeland ecosystem, practitioners should prioritize maintaining ecosystem functionality over intervening on behalf of particular species.

In Kara-suu's pastoral economy, mobility is an important predictor of adaptability as it preserves natural capital. Virtually all families own animals and tend for them at home during the winter. However, during the summer, most residents, for a fee, entrust their animals to the care of a *chaban*, who is typically male. A *chaban* then pools the animals from several families, and brings the combined herd to a high-elevation pasture, or *jailoo*, for the summer (Figure 5.1.1). In this *jailoo* he constructs a yurt that serves as his residence through the summer. Each day in the *jailoo*, the *chaban* accompanies his animals from a nearby pen to a more remote feeding location. Thus, mobility in Kara-suu can be understood as existing on two scales: short and long distance (Figure 5.1.2). Long-distance mobility is the ability for a herder to relocate camp to different *jailoos* in

different years. Short-distance mobility is the day-to-day ability to move freely with one's animals within the chosen *jailoo*.

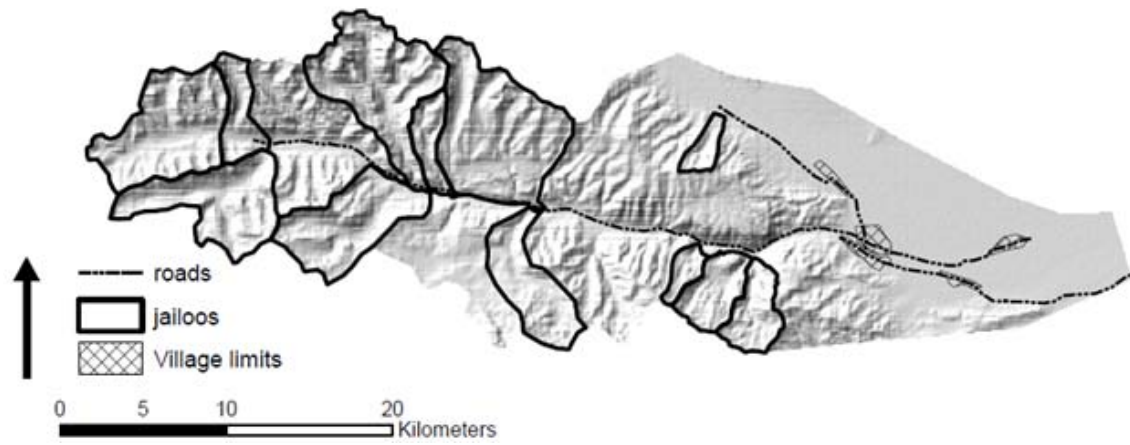


Figure 5.1.1: Topography of Kara-suu and location of upland jailoos.

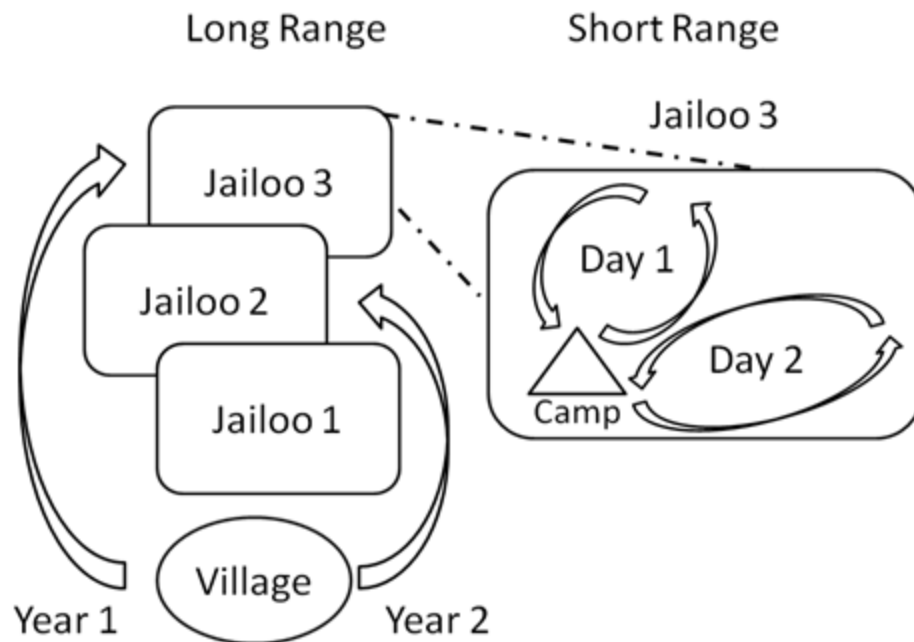


Figure 5.1.2: Difference between long and short range mobility in Kara-suu

Based on the interviews conducted with *chabans*, this study identifies geographic conditions, herding practices and local customs that contribute to or detract from the capacity for each kind of mobility among herders. Short-range mobility is supported by a

lack of manmade barriers within *jailoos* and by the presence of steep environmental gradients that allow for quick and low-cost movement between different pasture zones. Short-range mobility is increasingly infringed on by two practices. First, the commercialization of dairy and fermented horse milk (*kymys*) production among herders has resulted in the continuous occupation of valley floors by concentrations of large animals. A second threat is the recent innovation of high-altitude irrigation canals by a small number of families, which has resulted in these families attempting to lay claim permanent claim to the resulting irrigated pastures.

The study also finds that long-range mobility is supported by a strong sense of egalitarianism as far as it concerns sharing a *jailoo* with other herders, and a prevailing lack of any formal institution for restricting a herder's access to a particular pasture, assuming that herder is from Kara-suu. The most pressing threat to long-range mobility is financial inequality, as less wealthy herders are often unable to afford travel to more remote *jailoos*.

Short-range mobility: An individual *jailoo* is not a particularly large area; the largest of those studied encompasses an area of 53 km². Figure 5.1.3 displays an example of a single *jailoo* visited in this study. Camping in the lower elevation zone, a *chaban* is able to reach most areas within a *jailoo* in just an hour or two on horseback. Steep slopes, localized drainage patterns and orientation of slopes in relation to sunlight (aspect), combine to create highly heterogeneous conditions for range flora.

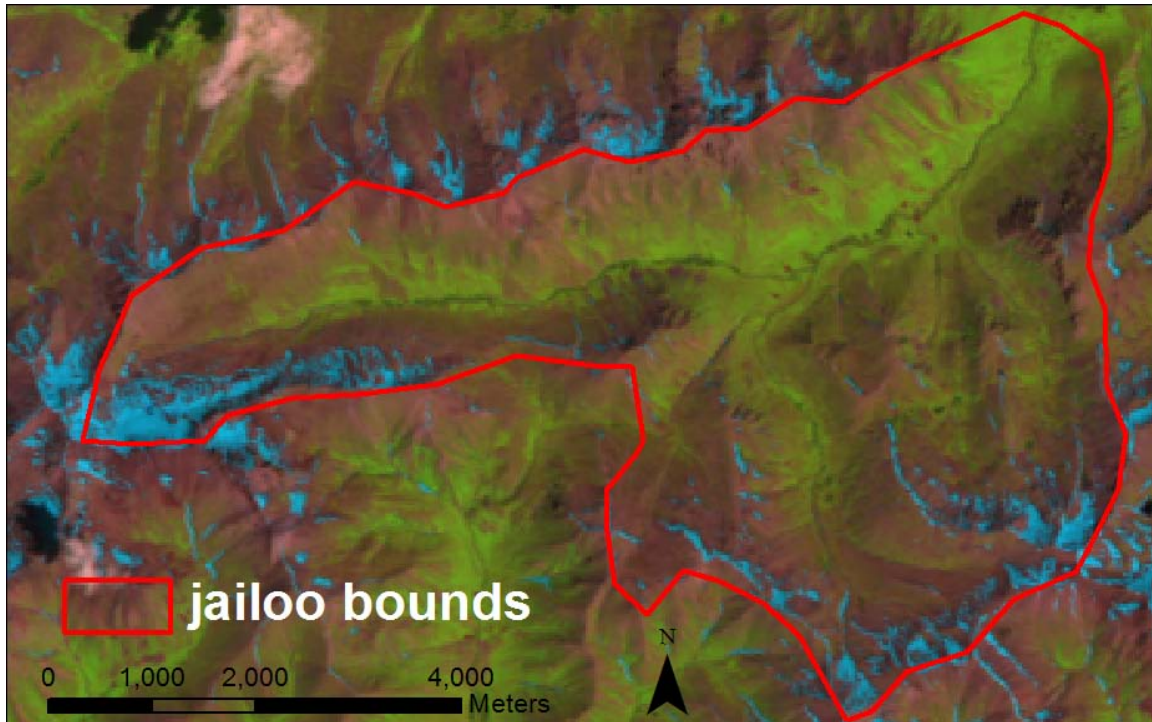


Figure 5.1.3: “Kugandy,” a remote jailoo of 33km². Valley floor elevations range from 2950–3400m asl. Base map: Landsat TM, false natural color, 7/27/2010.

The ability to move between different areas is an important coping strategy for herders. When asked how they coped with difficult conditions, such as drought and unseasonal cold or hot weather, 85% of *chabans* reported the strategy of bringing animals to elevations higher or lower than their typical range. Because ecological gradients are so steep over even just a few kilometers, herders are generally able to find suitable pasture somewhere within the *jailoo*, regardless of anomalies in seasonal weather. With no manmade barriers to movement within *jailoos*, the geography of the region promotes mobility and consequentially mediates grazing pressure and prevents soil loss.

While overall this short range form of mobility has not been significantly threatened over at least the previous decade, the two developments listed above, irrigation canals and dairy production, are already beginning to lock certain areas of the *jailoos* into

perpetual exploitation by specific herders, especially with larger animals. This continued occupation has the effect of not only concentrating the impact of trampling and grazing in one area, but of also excluding these same areas from serving as a fodder reserve for other animals when conditions are poor in other areas. One herder mentioned that *kymys*, or mare's milk, has over the last 20 years been transformed from a rare holiday treat into a major national commodity. Of the 22 *chabans* interviewed, all but a handful were actively tending to anywhere from five to 30 lactating mares. These herds are in addition to a comparable quantity of dairy cows. Whereas herds of sheep and goats can be moved throughout a *jailoo*, mares and cows do not tolerate the steep slopes beyond the valley floor, and in any case must be kept near camp to accommodate frequent milking. Several *chabans* complain that the valley floor was traditionally an area that was reserved for grazing in autumn, as higher areas became inaccessible. Now the valley floor is exhausted by the end of the season, which forces herders to choose between continuing to graze on already exploited areas, or cutting their losses and returning home early. While dairy and *kymys* production are observed in all *jailoos*, alpine irrigation was observed in a single *jailoo*. However, it is not yet possible to say whether this alpine irrigation constitutes an incipient trend or an anomaly. Irrigation canals feeding several hectares of alpine meadows have been constructed by two different camps. According to a *chaban* who is not affiliated with either of those camps, conflict has arisen when other herders have attempted to graze on the land watered by these canals. Moreover, a nascent practice of laying exclusive claims to areas within a *jailoo* is being tested by at least two resource users. Should such a practice proliferate, it threatens to create further obstacles for free mobility within *jailoos*.

Long-range mobility: Each spring, a *chaban* must choose to which of the twenty or so *jailoos* to bring his animals. I asked each respondent how they make this decision each year. Common responses included perception of the quality of the pasture, nostalgia or family tradition, desire to camp near friends, and proximity of the *jailoo* to the village. The general pattern that emerged from these responses is that *chabans* prefer to return to a single *jailoo* year after year as long as they continue to find acceptable conditions for their animals. Many respondents had been returning to the same *jailoo* for 10 or 15 year. However, often conditions such as overcrowding dictate that herders select a new camp for the coming season. I asked *chabans* how this movement was mediated by the community, as I anticipated the potential for conflict among resource users between newcomer and established users of a *jailoo*. At the time of this study, there were apparently no formal institutions regulating the distribution of *jailoos* among herders within a single *ayil okmotu*. What typically transpires, according to *chabans*, is that newcomers seek counsel and permission from those who have a history of frequenting the *jailoo*. Herders report that permission is generally forthcoming and without caveats, and that in cases where concerns are raised, newcomers are willing to consider other *jailoos* in its place. From the perspective of maintaining the freedom of mobility, the common belief among herders that the *jailoos* represent a shared commons is a positive property of Kara-suu. Not only does it discourage a high concentration of exploitation in any single *jailoo*, but it promotes trust among resource users. As long as this remains the case, herders should have the option to easily relocate in response to changing conditions.

While open access to pastures removes one obstacle to long-range mobility, the actual ability of different *chabans* to take advantage of this freedom of mobility is

dependent on wealth, a resource that is not equally distributed in Kara-suu. In the interviews in *jailoos* located less than 15km from the villages, several herders reported that they continued to frequent these nearby pastures despite what they characterized as deteriorating conditions. For a variety of reasons, they explained that camping in more remote *jailoos* incurs significant additional costs. One reason given by multiple *chabans* is that village crops must be tended to at least as often as each week. In lieu of a trusted relative to leave at home, *chabans* must either pay for hired help or themselves make frequent trips home. Another is the increasing necessity of personal or hired automobile transportation as the distance from the settlements increases. Fernandez (1999) notes a similar phenomenon in post-socialist Mongolia, and concludes that “poverty is strongly linked to declining nomadic mobility.” Not only does a lack of resources restrict Kara-suu’s less wealthy herders to certain cramped, overgrazed *jailoos*, but the resulting decrease in animal health restricts herders’ ability to improve their economic situation. This inequity in mobility has negative implications for the entire range. Nearby pastures suffer chronic overexploitation and risk soil loss, while remote valleys are underutilized. Both of these conditions threaten range biodiversity. The observation of the poverty-immobility link in this study lends support to Fernandez’s (1999) assertion that any intervention into a pastoral society must first and foremost “consider how to help herders overcome material as well as social constraints on mobility.”

To put these observations into perspective, a strong majority of *chabans* are still able to maintain a high degree of mobility, both short and long range. The Kyrgyz government has so far been very helpful in this regard, as it has formalized the devolution of pasture governance to the communities that use them. However, a minority group of

chabans are restricted in their long-range mobility by financial considerations, and the result has been the degradation of close-range *jailoos*.

Ecological Knowledge: For mobility to be a successful pastoral strategy, herders need to possess more than just the means to move. They also require the ability to make accurate judgments about the state of the rangeland ecosystem at any given time, so they can identify when it is appropriate to move. It is tempting to understand the Kyrgyz herders and their connection to the environment as an example of what Gadgil (1993) terms “indigenous peoples” who possesses “a broad knowledge base of the behaviorally complex ecological systems in their own localities.” However, due to the sixty-year regime of Soviet collectivized agriculture, it is not readily apparent to what degree the settlement of Kara-suu can be said to have a “historical continuity of resource-use practices,” which Gadgil (1993) believes are necessary to accumulate indigenous local knowledge. Therefore, the design of this study does not make any assumptions about the degree of “indigenous” knowledge among herders. I asked *chabans* several questions related to the ways through which they assess pasture conditions, and the kinds of environmental signals that would lead them to consider relocating or making an adjustment to their practices. The inconsistency in the responses to these questions suggests that, at a minimum, there is not a commonly-shared set of beliefs and practices employed to make ecological assessments. One possible explanation is that whatever local ecological knowledge existed a century ago is no longer widely shared, and that the ecological frame of reference among herders extends only a few decades into the past. Another explanation might be that, aside from the few overexploited close-range

pastures, pastures have not exhibited any significant changes beyond the noise of inter-annual variation.

Even within a single *jailoo*, herders often offered widely varying opinions regarding the current state of the pasture, as well as with equally varied accounts of their development over the past 15-20 years. It was not uncommon to hear from separate *chabans* who have long frequented the same *jailoo* that current conditions are alternatively among the best and the worst they have ever been. These responses challenged early assumptions that these *jailoos* should have experienced significant ecological changes as the result of transitioning from high exploitation levels in the late-Soviet period, to near abandonment in the 1990s, to a return to high exploitation in recent years. One important point is that ambiguity was more pronounced in moderately and highly remote *jailoos*, while responses were more consistent in *jailoos* located near the villages. In these nearby *jailoos*, there was generally more agreement that conditions have worsened over the past ten years. It appears that *chabans* are at least able to identify long-term changes assuming the magnitude of the change is high enough.

The question then becomes whether this inconsistency in the identification of ecological trends is a product of human error (cognitive or observational), or of an environment where inter-annual climatic variation is so high that it masks a comparably minor human-generated stresses. Indeed, owing to Kyrgyzstan's highly continental climate, conditions in any given *jailoo* do vary considerably from year to year. In responding to questions about about years with difficult conditions, some spoke of dry years that turned pastures brown by July, while others spoke of cold, wet summers where vegetation flourished, but humans suffered. To validate and reconcile the *chabans'*

disparate descriptions, satellite images collected through Landsat TM and ETM+ sensors were employed to establish whether there was in fact any significant change in pasture quality.

The results of the NDVI-trend analysis over the extent of the study area indicate that areas of degradation significantly outnumber areas of regeneration (Figure 5.1.4). Focusing only on pixels that exhibit both a high magnitude of change ($>.015/\text{year}$) and an R^2 of over 0.5 leads to the interesting observation that, among the *jailoos* studied, the highest concentration of change pixels occur in the medium-range and far *jailoos*—areas where respondents were least consistent in their identification of change (Figure 5.1.5). The easternmost *jailoos*, only 10-15 km from the villages, did not exhibit significant change in NDVI. Because the report of close range *jailoos* were reasonably consistent I hypothesize that these pixels are not showing significant change because these areas had already been degraded by 1999. Yet, without earlier images, it is not possible to thoroughly test that hypothesis.

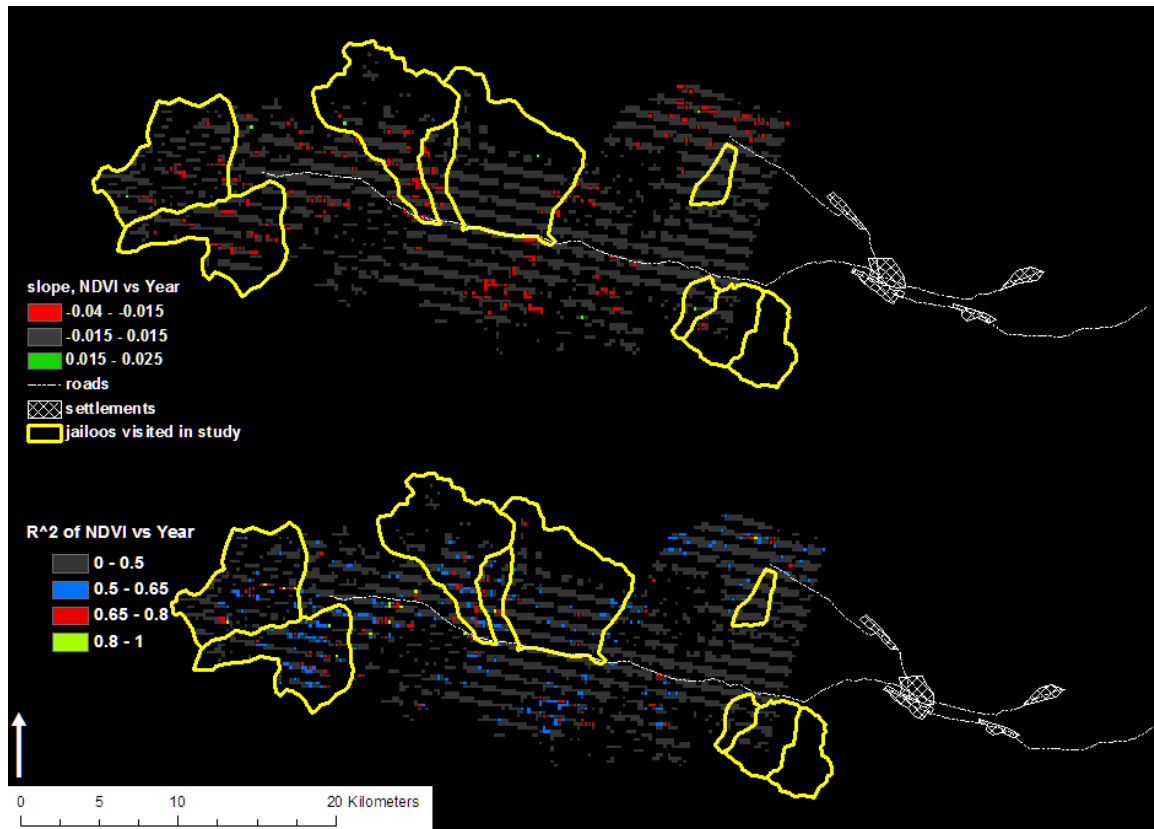


Figure 5.1.4: The top map highlights areas where the magnitude of NDVI change was greater than .015 per year, based on the linear regression for each pixel. The bottom map shows areas where at least 50% of the variation in NDVI is explained by year as a continuous variable.

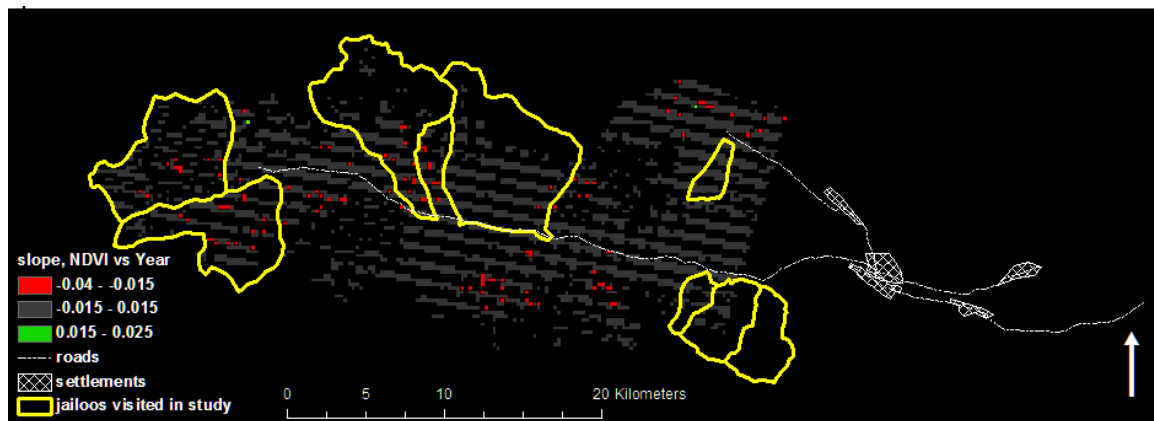


Figure 5.1.5: Pixels where change is notable ($>.015/\text{year}$) and well explained by year ($R^2 > .5$)

Despite the counterintuitive nature of these results, they may in fact make sense given the responses of some *chabans*. In each *jailoo*, I asked how many different *chabans* made camp in that area in past years. Across all *jailoos*, the consistent response was that there were fewer families in the past, and that over the years the number had increased. However, it is only in the close-proximity *jailoos* that the number of resource users is reported to be generally stable for at least the past 10 years. In one close-proximity *jailoo*, a respondent explained how year after year the number of users does not change much, but the families themselves change. Apparently, sometimes a family will acquire the means to decamp to a more remote and ostensibly more productive *jailoo*, creating room for a new user in the original *jailoo*. The NDVI analysis supports an argument that the *jailoos* of Kara-suu are filling up with users, with the frontier of fully-exploited pastures moving further and further from the settlement each year. Thus, areas of relatively steep decrease in NDVI likely do in fact represent a real process of degradation in Kara-suu.

Assuming this finding withstands future remote sensing investigations, then these results support two conclusions about the *chabans*' perceptiveness of ecological change. The first conclusion has already been stated, that in an area where the magnitude of degradation is high, resource users in Kara-suu are able to identify the problem and react to it by modulating land-use behavior (discouraging entry by new users). The second conclusion is that collectively *chabans* do not appear to be particularly perceptive to the early stages of pasture degradation, as identified through NDVI.

This finding suggests that Kara-suu's continued access to natural capital, and ultimately adaptability, that there is a need for a formalized system of long-term pasture

monitoring. While there were at least some users whose perceptions of ecological change did agree with the NDVI analysis in each jailoo, this information is evidently not shared or accepted among a majority of *chabans*. However, the fact that *chabans* in close-range *jailoos* were already perceiving and responding to ecological change suggests that the barrier to action is the availability of reliable information identifying a problem, rather than the will to act.

5.2 DIVERSITY OF KNOWLEDGE

This section presents findings related to Kara-suu's ability to access and generate a diversity of knowledge regarding its social-ecological system. Most significantly, this study finds that in Kara-suu there are two institutions that support a diversity of knowledge: first, the willingness of many residents to experiment and seek advice regarding agricultural or economic practices, especially following a crisis; and secondly, a widely-held belief in the value of higher education, and a generally liberal attitude towards the range of acceptable specializations for one's children. Diversity of knowledge is restricted by a pervasive association of Kyrgyz ethnicity with the pastoral economy, and by a non-diversified local economy that provides few opportunities to experiment with non-agricultural economic strategies.

Seeking advice: In response to questions related to information sources, residents cited with roughly equal frequency agronomic texts, newspapers and pamphlets, organized outreach training sessions, and the advice of neighbors. Only 27% of responses to this question claim to never have sought out any new information regarding economic practices. This access to and willingness to explore a diversity of information sources is certainly a positive source of SES resilience. However, it is tempered by another

observation. When describing their trusted sources of information, over 50% of those who cited sources external to the community went on to qualify their response by saying that they no longer have as much of a need for new information. These respondents describe the 1990s as period of disorientation when their lack of agricultural experience resulted in crop failures and animal deaths. However, they believe that they have now weathered the crisis and accumulated sufficient knowledge and experience to ensure the security of their crops and animals. It seems that having now weathered through the crisis, the range of sources of knowledge has contracted.

This change, from greater openness towards a more conservative attitude makes sense within the framework of the adaptive cycle. As a system moves from the exploitation (r) phase to the conservation (K) phase, the potential for introducing novelty into the system decreases as its ability to self-organize strengthens. In Kara-suu, this phenomenon appears to manifest itself as a tapering off of interest in new agricultural and economic practices. The implications of these observations is that the community of Kara-suu does demonstrate the ability to seek out new sources of economic and land-use information, even if this willingness decreases in times of relative stability and prosperity.

However, another important component of adaptability is the willingness to initiate transformation, i.e., to intentionally decrease resilience and actively push an SES into a new regime before an uncontrolled collapse occurs. A decreasing potential to alter a well-organized SES regime is a symptom of a “rigidity trap” (Holling 2001), a condition that can ultimately lead to even more severe and unmanageable collapses.

This study finds, however, that a second custom helps to keep the society open to new ideas related to economic and agricultural practices – a practice of observation and imitation of successful neighbors. Without specifically being prompted, ten respondents independently made some statement to the effect that they are most likely to respect the knowledge of a neighbor who has demonstrable success in a particular activity. One respondent puts it most succinctly, saying “No matter what anyone here says, if one neighbor has a good harvest, and everyone else has a poor harvest, everyone in the village will be visiting this neighbor to learn what he did differently.” If it can be accepted that there is a shared community value whereby authority is contingent on tangible results, this is potentially an important avenue for introduction of novelty once the SES has proceeded to the conservation phase of the adaptive cycle. Even though the community collectively loses interest in seeking out new knowledge, they do continue to look to each other for advice on new practices. This creates a situation where a small number of innovative, information-seeking households can introduce new practices into the community which, if successful, have the potential to spread throughout the settlement.

Taken together, these observations describe a community where the most active pathways for new knowledge acquisition change based on the position of the SES within the adaptive cycle. Any proposed information outreach program for a community like Kara-suu by an external actor would benefit from taking note of the community’s position in the SES cycle. During a time of collapse and disorganization, a strategy of extensive information dissemination is most appropriate, while in a more established

regime, it would more effective to seek out and work intensively a small subset of innovative community members who could serve as models for their communities.

Education: A second adaptability-generating feature of the community of Kara-suu is a widespread liberal attitude towards the education of children, as well as a high degree of importance placed in post-secondary education. Respondents were queried about their own level of education, specialization in school, and whether they had given any sort of advice to their own children regarding their own education. The rationale behind this line of questioning was that the collective skills of a community help determine the range of possible SES regimes, and that educational backgrounds should be a primary factor influencing community members' occupational skills. All but a handful reported that they encouraged their children to attend a university or technical school outside of Kara-suu. This strong value placed in education is further substantiated by responses given to questions regarding household finances; several families reported selling off large numbers of animals to finance a child's university education, thus choosing education over other needs like home repair and clothing. A further finding from these interviews was the high degree to which parents in Kara-suu support a child's right to select his or her own educational specialization. One woman summarized this sentiment, saying "The most important thing is a university-level education. As long as my son achieves this, the specialization is unimportant." Those with children currently attending college, or having recently attended in the past, did indeed report a broad range of specializations including the humanities, sciences, and technical fields. One possible explanation for this attitude is a legacy of the Soviet Union's strong support for education.

This study argues that that this liberal and supportive attitude towards education is a cultural value that contributes to SES resilience. First of all, students must reside in either Bishkek or a regional or oblast capital such as Koch-Kor or Naryn to attend a university or technical institute. There, they have the opportunity to form new, geographically-broad social networks that can help them to keep abreast of opportunities and developments in other regions of Kyrgyzstan. Secondly, the freedom afforded by most parents to allow their children to select their own educational specialization ensures that, across members of a particular community, there continues to be a high diversity of formal knowledge and expertise. This diversity of formal knowledge contributes to SES resilience as it provides the diverse knowledge base to introduce innovative adaptations within the SES.

In addition to the aforementioned desirable features of the Kara-suu SES, this study identifies two closely-related properties that may constrain change towards a more desirable transformative state. First, the economy in Kara-suu is highly optimized for a single production strategy, which limits opportunities for experimenting with alternate models. Secondly, a deep cultural association with herding persists among Kyrgyz. In conducting the interviews, I asked respondents to list the kinds of household assets they possess, the kinds of economic activities they are engaged in, and how they manage their finances. Of the 45 residents interviewed, raising animals represented the primary source of income for 93% of residents. While two of these families were professional *chabans*, virtually all families devoted the bulk of their labor towards tasks that directly support the raising of animals. Most significantly, this included the work that each family must put into cultivating feed crops for winter provisions on their two to three hectare plot of land.

As of 2007, 83% of cultivated land in Kara-suu was used for growing crops that were directly used as animal feed, predominantly barley (NSC, 2008). When asked to what degree these animal-feed products are being consumed locally or sold, of the 36 residents who reported selling a large amount of crops, 86% explained that they only did this to dispose of extra produce after a windfall harvest. This finding demonstrates the degree to which the cultivated lowland component of the Kara-suu SES is specialized to support animal herding. Only a 7% of respondents reported significant income from positions as school teachers, taxi drivers and tractor drivers. The economic situation in Kara-suu is thus one of high specialization and low economic diversity.

Kara-suu, and much of Kyrgyzstan for that matter, does inhabit a landscape that is highly suitable for animal raising. It is indeed difficult to imagine a future where herding does not play at least some role in the community. However, in light of the accelerating frequency and magnitude of global environmental, climatic and economic change, this high level of specialization might become a liability. While this study has argued that Kara-suu is likely to possess a diversity of formal knowledge (gained through education), which could help residents to envision a range of adaptations, there is a conspicuous lack of hands-on experience in alternate economic strategies. Furthermore, this deficit in experience is reinforced by a national mythology in which Kyrgyz pastoral and nomadic heritage feature prominently. One question I asked was about the source from which respondents initially learned agricultural and pastoral practices. While the majority cited obvious sources such as parents or employment in a collective farm, several respondents took offense at the question, and made some variation of the statement that, as Kyrgyz, these skills are conferred at birth. Virtually all respondents reported at least several days

spent each summer in a *jailoo*, living in yurts, for the purpose of recreation and reconnecting with pastoral customs. Several respondents cited various curative benefits of mountain air and consumption of fresh dairy products. It is clear that Kyrgyz cherish the pastoral lifestyle, as they make a point of experiencing it, even if for only a few days a year. Even the national flag of Kyrgyzstan is a depiction of the *tündük*, the iconic ceiling vent of a yurt. (Figure 5.2.1)



Figure 5.2.1: The tündük, the ceiling of a yurt, is the national symbol of Kyrgyzstan

Several times I heard repeated the stereotype that only Kyrgyz are herders at heart, while Uzbeks are farmers and merchants. The cultural association with herding is so strong that there is the distinct possibility that it could complicate any attempt to adapt or transition into a regime which entails a reduced dependence on animal herding. While there is nothing wrong with this heritage, one implication is that any aid agency needs to be conscious of whether it is reinforcing these stereotypes and lack of diversity, or whether they are improving the range of economic options available to communities.

5.3 ACCESS TO FINANCIAL AND SOCIAL CAPITAL

According to the framework for SES resilience put forth by Walker et al. (2006), high levels of multiple forms of capitals are needed within a community in order to successfully effect an adaptation or a transformation of an SES. The various sources of knowledge presented in Section 5.2 allow societies to envision innovative adaptations, but they are useless without the access to the resources needed to make them a reality.

This section identifies the institutions that shape the community's access to both social and financial capitals. *Social capital* reflects the strength of the network of friends and family, upon whom an individual can call in a time of need, what Portes (1998) refers to as the “positive consequences of sociability” that can be “important [nonmonetary] sources of power and influence.” Financial capital in Kara-suu includes not only monetary assets, but also assets that are easily monetized such as livestock.

This section of the study was initially designed to identify institutions that created access to capitals for the community as a whole. However, what became clear through these interviews is that the degree to which access to both social and financial capital was unequal across households, and access to one form was often contingent on access to the other. This observation brings up an interesting question as it relates to adaptability, whether it is the distribution of capitals within a community most important, or rather the net value. This study assumes that a higher degree of equity in access to capitals is desirable for fostering adaptability. Following Wilkinson's (2005) observation that greater inequality leads to lower levels of trust within a society and less legitimacy of governance, an inequitable Kara-suu would be a detriment to the “ordered rule and collective action” that Holling et al. (2006) cites as necessary for implementing SES-wide adaptations or transformations.

Social capital – In Kara-suu, this study identified a disparity in access to social networks that has implications for the geographic range, function and their utility of a households social networks. “Rich” and “poor” household are defined here as those owning assets (animals, machinery, land) that place them in either the highest or lowest 25th percentile within the village, respectively. The networks of rich households are more

geographically-broad, and they often provide benefits such as new business ventures, while the networks of poor households are commonly restricted to the local region and provide minimal benefit, and often only in times of crisis.

I initially asked respondents to list who, outside of their household, would they turn to if they needed help, where do they live, what kind of help (if any) have they received from these contact in the past, and whether they would consider asking others not initially listed. When asked about the benefits gained from their networks, respondents cited a wide variety of examples from providing manual labor to placing a child in a university. Despite the variety, a pattern did emerge. All households, regardless of wealth, relied on social contacts in times of crises. However, several of the more wealthy households described situations where a social contact was able to provide an advantageous opportunity. One respondent explained how he was given the opportunity to split the costs and proceeds of an automobile to be used as a taxi in the regional capital, Kochkor. Another woman described how her friend in Bishkek had helped her arrange for a yearly language camp, run by the French embassy, to be held on her property in Kara-suu – an opportunity that paid well. For wealthy households, a geographically widespread network provides opportunities for advancement. Poor households told a much different story. Over half of the poorest households reported the need to ask for aid to mitigate some kind of ongoing or impending crisis in their household agricultural production. Needs included gasoline to run farm machinery, seed, and fodder to support animals after a poor harvest. In each of these examples, failure to procure the necessary product could have catastrophic results. One respondent was, several years earlier, reduced to raising poultry for subsistence when a late planting due

to a lack of gasoline precipitated a total crop failure and the later loss of all his animals. Thus, in the case of the poor, the failure to actually receive needed aid can have dire consequences.

The responses to the question “Who would you ask?” were a mix of friends, relatives and neighbors, with no particular pattern. However, the geographic locations of the contacts varied strongly based on household wealth. Each of the 11 wealthiest respondents listed multiple contacts from other provinces of Kyrgyzstan, and eight listed at least one contact from a major city like Bishkek or Osh. Only five of the 11 poor households listed contacts outside of Kochkor region. Four poor respondents did not list any contacts from outside of Kara-suu itself. When listing the geographic locations of their contacts, several respondents commented that they had relatives or friends in a particular distant city or province, but that either the price of transportation or the opportunity cost of suspending work at home prevented them from visiting, and consequentially their relationship was not close. Apparently the cost associated with visiting plays an important role in limiting the geographic range of the social networks of at least some residents in Kara-suu.

Responses to the final question, which asked whether respondents would consider asking for help from others not previously listed, again showed a discrepancy related to the wealth of a household. I asked whether they had any relatives that they did not previously list as contacts. For the 83% respondents who responded affirmatively, I asked why that relative would not be a suitable person to ask for help. The most common answers among wealthy households was that they either did not expect that this contact would be in a position to offer any kind of help, or simply that were never particularly

close with this person. These answers were also given among poor households, but several also added a reason that was entirely absent from the responses of rich households, that is, that they had fallen out of favor with this relative, and were no longer welcome in their household. When asked to elaborate, three of these respondents mentioned that to maintain a relationship with this relative meant attendance at important feasts like weddings and birthdays. According to them, custom dictated that guests bring small gifts for the hosts, and that guests reciprocally plan later feasts of their own and invite their current host. Having witnessed several of these feasts first hand, I can report that they are expensive affairs, where one or two valuable sheep are customarily consumed. It seems that for some of the poorer households, the expense of participating as both guests and hosts in these social events is prohibitive, and that their exclusion from these events makes it difficult to maintain a social relationship. I asked one such respondent how, then, was she able to maintain a relationship with those that she had listed as contacts. Her response was that her contacts nowadays were mostly like her, people with little means who were forced to abstain from gifting and celebrations. If her explanation indeed represents a wider phenomenon, then one implication is that poor households are more likely to have social networks comprised of other poor contacts who will be in less of a position to actually help in a time of need. In fact, a similar phenomenon was also observed by Kuehnast & Dudwick (2004) elsewhere in Kyrgyzstan. Thus, it does not appear that, even under conditions of relative prosperity settlement-wide, there exists a mechanism to help less wealthy households escape from a vicious cycle of declining material and social capital.

Despite the prevalence of wealth-based differences in access to social capital, at least one group of institutions uniformly improved access across the community, that is, the custom of neighbors cooperating to complete necessary maintenance tasks on village infrastructure. In one case, a respondent described how, each spring, one member from each household would volunteer for several days to clean and repair irrigation canals that served agricultural fields. Another mentioned that in response to flash floods, neighbors in one village banded together to repair an important road that had been washed out. For at least some poorer residents, these projects are the only way that they are able to contribute to the welfare of their neighbors, and it thus serves as opportunity to maintain a relationship on good terms. One respondent from a poorer household explained that sometimes a family will fail to send someone for a project, and that they consequentially become the subject of gossip among their neighbors. The willingness to work cooperatively with neighbors on village maintenance, regardless of wealth, appears to be an important institution for linking poorer households to wealthier households. These links might offer more value to poor households than links with other poor contacts, as they would presumably be in a better position to actually give aid in a time of need.

Financial capital - In Kara-suu there are two primary means for acquisition of financial capital: credit in the form of small cash loans of up to as much as a few hundred US dollars, and the sale of live animals at the local market. Respondents who reported a major household purchase over the study period described one of two ways of accumulating the necessary money: the sale of several animals or a short-term bank loan. Across the settlement as a whole, access to both of these forms of capital has unambiguously improved since crises of the 1990s: livestock levels have increased from

an average of around eight sheep per household in 1996 to over 30 in 2010, access to market has become stable, and credit has been made available through several state and private enterprises. However, as is the case with social capital, the ability of individual households to access financial capital is uneven.

In terms of credit, 62% of families mentioned taking small loans after 2000. They cited reasons such as home construction, buying seed, livestock, gasoline and clothing. Of these needs, the most commonly cited were those that served to either support or expand existing agricultural practices. One respondent described a scheme to quickly purchase several dozen sheep and to support them on several hectares of newly inherited land. In this respect, credit allows residents to quickly exploit new and unexpected economic opportunities. Seven respondents mentioned the necessity of taking loans to cover agricultural expenses in years where they did not have sufficient cash available, and were not willing or able to ask a friend or relative. When I asked about the details of these loans, respondents cited annual interest rates in excess of 20% and repayment period of one to three years, which respondents characterized as high and difficult to repay. Nevertheless, given the number of households that reported taking loans in the past, the risk of default is apparently considered less of a concern than the risk of a failed harvest. Thus, access to financial capital in the form of credit serves two important purposes at the scale of a household. It allows households to quickly exploit economic opportunities and it helps to protect them from agricultural crises. However, the usefulness of this service is not available to all households. For example, three respondents mentioned that high levels of collateral are often demanded by the lenders. One respondent described an attempt to secure a loan of \$200 in 2007 for medical care,

but was unable to because the lender was unwilling to accept any of her possessions as collateral. This contrasts with respondents who owned more durable and transferable assets, such as automobiles and farm equipment, who were more likely to report having taken loans on several occasions in the last decade. Thus it appears that wealthier households are most able to take advantage of the opportunities and risk aversion afforded by credit.

Credit thus appears to be an important tool in the strategies of Kara-suu households, but the production and selling of live animals represents the primary source of financial capital generation among residents. While the size of household livestock assets varies across households, livestock are the primary means of monetary income for 93% of respondents regardless of level of household wealth, and only one interviewed household owned none. In contrast to the unequal access to credit, access to markets and the ability to convert this resource into cash is even throughout the community. Kara-suu hosts a weekly *mal bazar*, or animal market, where local residents can sell animals to visiting merchants from Bishkek or Koch Kor. It is accessible to all residents, and no respondents mentioned receiving differential treatment as a result of social or economic status. Thus, as long as community pastures are maintained as a collective resource and the care of a modest herd of at least 20-30 sheep is within reach of all households, the local *mal bazaar* should continue to provide some access to capital for all members of the community.

Taken together, social and economic capital appear to be linked in Kara-suu. Financial considerations prevent poor households from maintaining potentially lucrative and risk-sharing social networks. This results in the poor forming less valuable networks

comprised of other poor households from a geographically restricted area. The rich are able to leverage their wealth into creating valuable, wide ranging networks.

In terms of adaptability, the significant finding is not related to the absolute levels of these capitals in the community, but rather to their uneven distribution within the community, and the relationships which cause this inequality to be persistent and self-strengthening. Walker et al. (2004) cites trust within a community and the perceived legitimacy of the system of governance as important preconditions for successful adaptive responses, as distrust within a society could cause members to resist changes which they do not necessarily feel will benefit them. For any external actor planning development work in rural Kyrgyzstan, one implication of this disparity in social and financial capital is that activities that disproportionately benefit those who already have high levels of capital might actually exacerbate the status of poor residents and ultimately reduce local adaptability. One potential positive measure would be to encourage the creation of social links that are not dependent on the wealth of its members. Not only would this improve the welfare of the community's poorest members, but it would also strengthen the ability of the society to organize collective action around an adaptation or transformation of the local SES.

5.4 DEVELOPMENT IN RURAL KYRGYZSTAN

The World Bank has played a very active role in rural development in post-Soviet Kyrgyzstan, as it has initiated 17 projects between 1995 and 2011. The intent of this section is to review the goals and proposed methods of these projects and assess whether they are congruent with the creation of greater resilience within Kyrgyzstan's rural pastoral social-ecological systems, considering the institutions already identified in the

Results section. This analysis relies exclusively on official World Bank reports published at the initiation and completion of each project.

Overall, these projects have implemented several measures that are congruent with the goal of fostering adaptability of rural SESs. These include non-collateralized or social-collateral group lending schemes, community-based pasture governance and community-designed micro-projects. While these components target different aspects of rural life, they have several things in common. First, they all attempt to bring the scale of decision-making into agreement with the scale of the resource being managed, which in this case means a devolution of power to the community level. Secondly, many of these projects create new opportunities for knowledge creation, acquisition and sharing. Examples include the creation of exchange programs between communities and community-run pasture monitoring systems.

One point of potential criticism as it relates to SES resilience is the strong emphasis in many projects on increased agricultural efficiency and net output as a means to achieve reduced rural poverty – in some projects, to the point of excluding other options. Whether or not this can be considered a criticism is debatable, as agricultural activities do represent the main source of income for rural Kyrgyz, and especially the poor, 75% of whom were rural dwellers in 2003 (World Bank 2003a). This sector should clearly factor prominently into any aid program. However, in the context of shrinking alpine glaciers in conjunction with global climate change and the threat of a disruption of predictable runoff (Kutuzov & Shahgedanova 2009), it is critical to understand whether intensification of meltwater-fed agriculture is prudent. While I did identify some examples of language in project documents that seem to advocate for greater rural

economic diversity, these instances are typically peripheral to a stronger pro-intensification attitude shared by most of the projects.

Two projects focused on the provision of financial services to the rural sector, the *Rural Financial Project I & II* (World Bank 2002 & 2005), implement group lending, or lending based on social collateral. The purpose of group lending is to provide credit to those who lack traditional forms of collateral. Social collateral refers to the social pressure that members of a group exert on each other to guarantee repayment of a loan. Because in this scheme, loans are made out to groups rather than individuals, the consequences of a single group member's failure to pay his or her portion can result in greater difficulty at obtaining future credit for all of the group's members.

I expect such a project component would play a positive role in increasing the resilience of an SES like Kara-suu in two ways, and at two different points along the adaptive cycles. In the event that such an SES undergoes another cycle of collapse (Ω) and reorganization (α), such as the one that characterized the 1990s, it might be difficult for households experiencing hardship to overcome the collateral requirements on receiving credit. A poverty trap occurs when too much of a system's potential "leaks" out during a time of disorganization (Holling 2001). An example from Kara-suu is the deterioration of infrastructure due to a lack of maintenance funds during privatization. If too much potential is lost, the system will lack the resources needed to reorganize into the either the previous regime, or a desirable alternative regime. Although the Kara-suu community did manage to avoid a poverty trap in the 1990s and has recovered greatly, the loss of this infrastructure was a loss of system potential, which at the time of this study continued to limit the economic options available to residents. As it pertains to

social collateral, this kind of lending could be an important lifeline to a reorganizing system. By giving affected households the ability to continue to maintain economic activity, health, and social bonds, they may be less likely to incur irreversible loss of the resources which would enable them to contribute to a swift reorganization of the SES as a whole.

The second instance where social collateral could contribute to SES resilience pertains to the conservation (K) phase. In a system like Kara-suu, an SES regime in which animal raising on natural grasslands remains an important component, the conservation phase is characterized by high levels of animal stocking. Under such a regime, a dispersed distribution of grazing pressure across the entire rangeland is important to prevent overexploitation of any particular area. As was observed in Kara-suu, lack of access to financial capital was a primary cause of excessive animal concentrations in *jailoos* located near the village. Giving the poorer members of the community access to credit using through a social collateral system would be expected to reduce the spatial imbalance in pasture utilization, and ultimately result in a more productive resource with higher biodiversity and, hence, higher levels of natural capital.

While the effect of *Rural Finance Project I & II* on SES resilience is restricted to the provision of financial capital, the *Village Investment Project* (World Bank 2003a) has wider-ranging goals that, if implemented, should have a positive effect on adaptability through increased creation and access to knowledge. The primary component in the *Village Investment Project* is the administration of “micro projects” within rural villages. This component provides grants to communities to undertake democratically selected local development projects. Examples of micro projects selected by villages include

physical infrastructure works and cooperative business ventures. These micro projects, by allowing villagers to target specific deficiencies in infrastructure or to create new sources of income, are essentially putting capital, in the form of infrastructure and money, into a SES as it undergoes reorganization. However, there is another notable benefit of the micro-project component: they can serve as nuclei for developing a formal system for collectively managing communal resources. Under the Soviet Union, all decisions regarding these issues were made at the scale of the regional, provincial technocrats and handed down to settlements. Following privatization, an expectation persisted that it was the responsibility of higher levels of government to resolve local problems, and there was very little capacity to self organize around these problems (World Bank 2003a). To address this deficiency, the *Village Investment Project* aimed to use the local committees, created to administer each micro-project, as the foundation for a permanent body that would persist beyond the implementation of its original project. The long-term objective for these local committees was that they assume managing control of all village services such as canal and road maintenance, water sanitization, and electricity provision. Indeed in 2010 in Kara-suu, several respondents mentioned such a committee of local farmers that was responsible for the creation and enforcement of the water-allocation schedule for irrigating crops. This committee had the power to collect user fees and apply them towards repairs. One respondent mentioned ARIS, an organization that contracts much of the World Bank's work in Kyrgyzstan, as responsible for organizing these committees. Thus it seems likely that this committee was indeed descendent from a micro-project from several years prior, and was continuing to operate autonomously.

As it relates to adaptability, it is notable that, for the first time since the 1930s, policies affecting livelihoods, resource allocation, and conflict resolution in Kyrgyz communities are increasingly made at the scale at which these policies actually operate. It was stated at the beginning of this study that a weakness in past resilience literature has been its focus on keeping a system bound within a particular regime, when true SES sustainability must take into account the potential need to transform or transition a SES into a radically different identity. Should such a need arise, when an existing system organization becomes untenable, a reorganization can occur in one of two ways: managed or unmanaged. Having a body already in place that has experience managing local resources and economic practices, and that is seen as legitimate by members of the community, ensures that there is an actor with enough authority to actually push for novel solutions to any crisis. The fact that these committees function on a local scale mean that they are able to react to conditions which are unique to their own settlement.

One final important component of the micro-project initiative is the funding of “exchange visits,” which fund members of micro-project committees to visit other villages and regions to learn about each other’s projects and management practices. One of the finding presented in section 5.2 is that within Kara-suu, residents are most likely to trust the advice of those who have demonstrated success in an activity, whether starting a business or raising animals. It follows that, by allowing villagers to actually see and experience the kind of work being done in each other’s villages, they would be more likely to actually consider introducing a similar practice into their home community. By maintaining this system of formal exchanges between communities in Kyrgyzstan, each

community should have access to a greater diversity of tested and proven ideas about village economic practices.

While the focus of each micro-project was largely determined by the beneficiary communities themselves, the *Agricultural Support Services* project was designed to increase communities' organizational capacity around the specific issue of pasture commons management (World Bank 2008a). To accomplish this, it finances in each settlement the creation of a democratically elected "pasture committee," whose eventual function would be the management of all pasture-related decisions within a community. This project coincided with the passing of national legislation that devolved all control over rangeland management to local communities. The establishment of pasture committees is promising, as it creates a legitimate acting body within the village that can present unified responses to changing SES conditions, while at the same time creating a forum where resource users can share and integrate their personal knowledge and experience regarding pasture use.

Within the field research period of this study in Kara-suu, the provisions of the pasture committee initiative were only just being put into action. A committee had been formed by elder members of each of the five villages in the settlement, and was in the process of conducting weekly meetings to draft a "pasture management plan" that covered access rights, fee collection and formalization of road maintenance. Though I did not specifically ask residents about the committees, three respondents independently brought up the issue of the new committees. In each case, they reported that they were encouraged by the pasture committee project. For example, one described how it meant that any concerns they had would no longer have to be voiced in a distant regional or

provincial capital. It appears that there currently there exists at least a modest degree of support for the new pasture committees among local residents.

In earlier in this study, there is a shared willingness among neighbors to cooperate when working on repair or development of village infrastructure. In the context of this sense of shared responsibility for common spaces, there is reason to believe that the pasture committees will be successful at managing shared pastures for the benefit of all users. In the discussion of animal raising practices, issues such as low-elevation animal crowding, appropriation of land for personal use, and the overuse of close-proximity pastures could all be characterized as problems resulting from the lack of a formal institution governing appropriate pasture use. Assuming that pasture committees in communities like Kara-suu are able to continue to maintain their legitimacy, then they should be a significant step towards giving a community the capacity to actually address such issues in a systematic way, with the full cooperation of local residents.

If there is one area of potential concern in the projects presented here, it would be the question of whether or not it is beneficial in the long run to tie certain projects so closely to one particular sector and one particular mode of production. The most egregious example of this is perhaps the 1996 *Wool and Sheep Improvement* and the 2000 *On-Farm Irrigation* projects (World Bank, 2003b, 2008b). In both cases, the World Bank gave money for the completion of specific pieces of large-scale infrastructure. In the Wool and Sheep project, the bank financed the construction of centralized breed improvement facilities and semen banks to facilitate the development of a fine wool industry. It furthermore paid for the creation of a wool marketing office to help increase the international marketability of Kyrgyz wool. Wool and Sheep improvement centers

collapsed soon after cessation of World Bank involvement. However, the large-scale wool operations that were to be the intended beneficiary of this project were by the mid 1990s rapidly being replaced by small-scale family operations that forwent wool production altogether in favor of more locally adapted meat-producing breeds (World Bank 2003b). The project serves as an example of a development objective that is too narrowly defined around the support of one specific SES regime. In the case of the *Wool and Sheep Improvement Project*, development objectives were selected based on the presumption that an industry that had been important in Soviet Kyrgyzstan, fine wool, would continue to be important after privatization. Had the World Bank instead worked to support a greater diversity of economic activities or land-use practices, it would have better been able to ensure that its efforts would be effective under a wide range of possible SES regimes.

The World Bank's five irrigation-specific projects, beginning in 1998, serve as examples of initiatives that are very much designed with a specific rural economy in mind. These projects targeted the repair of high-volume agricultural waterways of regional and provincial significance throughout Kyrgyzstan. These irrigation projects have been a success inasmuch as they accomplished their goals in terms of canals repaired and water provided, and they do indeed fulfill a genuine demand within rural communities. Irrigated agriculture, given a prevailing SES regime of small family farming and animal raising, is a vital component of current rural livelihood in Kyrgyzstan. In this regard, irrigation projects are highly effective at increasing the resilience of a particular SES regime in rural Kyrgyzstan. The question I pose here is

whether, given the unknown future effects of climate change, it is wise to target a single SES component so narrowly.

To put this concern of narrowly-focused projects in the context of the adaptive cycle, rural Kyrgyzstan was in 1996 and 2000 very much still in the early phases of social and economic reorganization (α, r). A system that has collapsed is by definition a system whose ability to self-organize has been compromised (Holling 2001). This is the moment at which external forces have the highest degree of influence on the development trajectory of the system (Anderies et al. 2006). If an aid project is thought of as an external force acting on the Kyrgyz rural SES, then to target a project so narrowly at a time of low self-organizing capacity risks “railroading” the SES into developing into a particular kind of resource-use regime. There is, in fact, nothing inherently wrong with attempting to influence the direction a recovering SES takes. The entire basis of this study is that learning how to accomplish exactly this feat, how to influence resilience, is critical for the long-term viability of ecosystems and the communities that rely on them. However, the point of departure here is that these irrigation measures were implemented from above, without input from any of the rural communities themselves. A more appropriate approach would have been to first attempt to establish what were the actual priorities of communities, and then devise projects to help achieve them.

By giving communities themselves more power to direct aid projects, on a nationwide scale there would be hundreds of unique communities applying their own ideas and vision towards a reorganizing SES. This decentralized approach is actually very much observable in pasture committees, micro projects and group lending, which by itself is quite commendable. However, it was at the time of lowest capacity for self organization

within the rural Kyrgyz SES that the World Bank implemented its narrowly-focused projects, and only later, beginning around 2005, did the decentralized approach assume a more prominent role. I propose that in its future work in Kyrgyzstan, or any country for that matter, that the order of these projects be reversed. Soon following a collapse is a more appropriate time to implement a diffuse strategy that allows communities to experiment and find new ways to structure their relationships with the land. Only once communities have established their own recovery trajectories and the SES has begun to develop towards a particular regime should aid organizations initiate more targeted development programs. By allowing for this experimentation, the Bank, and the Kyrgyz themselves, may discover that some of their preconceptions about the structure of the Kyrgyz rural economy and society are challenged. In the long run, allowing for a greater diversity of economic models from settlement to settlement simply creates more viable options for any individual community that finds itself in a later crisis.

6. DISCUSSION

It should go without question that the goal of any society, government or resource manager should be to maximize human livelihoods while also preserving biodiversity and the services that ecosystems provide society, from spiritual to biogeochemical. With the introduction and proliferation of resilience thinking (essentially complexity theory) in environmental science, there has been a trend to focus on identifying or engineering desirable social-ecological regimes, and subsequently maximizing their resilience. This study has been conducted on the premise that this is not always the most appropriate task for the researcher. When approaching a social-ecological system, a researcher is in the position of an outsider who must make an assessment of the significance of a huge array

of potential regime-defining variables, all of which may feed back into one another. While heuristics like the adaptive cycle, basins of attraction, multiple equilibria and thresholds help scientists to understand the nature of complex change, the fact is that social-ecological systems are highly diverse and encompass problems that are, as Ostrom (2007) points out, not amenable to panaceas.

I have not attempted to identify how the resilience of the Kyrgyzstani rural SES could be increased in relation to any one particular resource-use regime. Rather, I presume that even if researchers were somehow able to identify what constituted a desirable, ecologically resilient, regime, that the current rate of global social and environmental change renders dubious virtually all assessments of the future desirability or resilience of that regime. In conducting this research, I eschewed *a priori* judgments about the desirability of specific SES regimes. Instead, I focused on identifying local institutions that give a society the ability to continually innovate and implement new solutions to novel problems, or adaptability.

This study identified several contributions to Kara-suu's adaptability. Insofar as knowledge is the foundation of innovation, the residents of Kara-suu are both deficient and endowed. The community as a whole demonstrates an overall willingness to seek out new information about agricultural practices during times of crisis, and places a high value on the attainment of university level education. While these values show that the community is able to draw upon external knowledge, there is a lack of a capacity to generate and store knowledge within the settlement itself, especially related to ecological conditions. Herders generally accepted the connection between land use and ecosystem health, but were unable to put it in concrete terms or consistently cite past examples of a

connection. A further obstacle to the generation of new knowledge is the simple lack of alternate examples of enterprise in a community that is almost exclusively organized around the production of a small subset of agricultural products. To put it simply, it appears that the biggest area for potential improvement in Kara-suu, in terms of access to knowledge would be 1) the introduction of a greater diversity of economic activities, even on just a household scale and 2) the development of formal means of knowledge development, such as locally run ecological-monitoring efforts and the creation of standardized records of social and ecological variables. The introduction of a monitoring regime for even something as simple as annual precipitation or the number of animals owned in the community would be a large improvement.

Capitals are expended when a society attempts to enact an adaptation or a transformation from one regime to another. A regime by definition is a set of relationships that reinforce each other around an equilibrium (or equilibria). Altering a regime's identity invariably requires an initial investment of effort to overcome its natural self-organized structure. In this study, social and financial capital are two important currencies with which households in Kara-suu are able to procure necessary goods and services. I found that these two forms of capital are in fact linked. Social capital provides households with novel economic opportunities, and social networks themselves are highly monetized and typically exclude those who cannot afford to follow certain social customs such as providing feasts. I cannot say whether the net amount of capital in the community is sufficient to ensure adaptability under a range of future scenarios. Kara-suu is poor by international standards, as it is a rural community in a country that is itself not wealthy. Obviously a higher net amount of capital in the settlement would open up more

adaptation options, but the value of raising income levels is hardly novel or unique to resilience thinking. Just as the magnitude and nature of a future disturbance is unknowable, the exact forms and quantities of capitals needed to adapt or transform in response cannot be quantified in advance. Thus, the more pertinent question becomes the degree to which existing capitals, whatever they are, will be made available to support adaptations or transformations. If most of an SES's capital is controlled by a small number of households that benefit from the status quo, it is hard to imagine those households being willing to apply those capitals towards creating change. As it stands at the time of this study, I would not argue that Kara-suu qualifies as a society where too much capital is concentrated in the hand of too few: based only on livestock assets, in 2010 the top 10% of households possessed roughly 12 times the assets of the lowest 10%. However, given the interrelation between social and financial capital, the concern is that this disparity will increase as poorer households are unable to compete in the agricultural sector in light of lack of credit and the disinclination of neighbors to help.

Development aid has a place in helping to remedy some of these detractors to adaptability, whether it relates to the creation of knowledge or the availability of local capital for adaptations. Aid and development programs, such as those of the World Bank, have diverse missions. This does not mean that adaptability should be the exclusive paradigm guiding the selection of projects. However, without taking into account the possibility of unexpected futures, a development project cannot guarantee the longevity of any potential gains in human livelihoods. In the projects analyzed in this paper, several things stand out as initiatives that could potentially address the specific problems identified in Kara-suu. First, the preliminary implementation of pasture

committees, contemporaneous with this study, does indeed create the first formal venue where land-use concerns can be raised and deliberated. While it is too early to say how such committees will develop, this is exactly the kind of institution that would have the incentive and the authority to enact a district-wide system of monitoring and record keeping. Second, exchange trips with other communities provide residents an opportunity to share ideas about village governance. Third, the provision of credit based on social collateral ensures that households without significant physical assets can get loans. Finally, the combination of micro-project committees and pasture committees represent bodies that are capable of channeling community resources towards enacting adaptations or transformation.

Despite these positive steps, there are areas that so far have not been given adequate attention in the World Bank's Kyrgyzstan program. There has been no effort to ameliorate the exclusion of less wealthy families from social networks. A possible solution might be a program that offers a small subsidy to residents wishing to travel beyond Kara-suu for social reasons. Another possibility would be a project that creates a more formal system for the cooperative maintenance of village infrastructure, currently a spontaneous process that already is helping to link poor and wealthier households. After social capital, the second area of weakness is a tendency for some projects to be overly focused on developing one particular form of rural agriculture, i.e., one that looks very similar to today's, but that achieves higher output through intensification such as irrigation, fertilization, crop/stock selection and mechanization. A more adaptability-oriented program would place greater emphasis on developing the region in such a way that the benefits will continue to be realized under a diversity of future SES regimes.

While some degree and form of agriculture and pastoralism will clearly play a role in virtually any future regime, there does need to be greater emphasis on creating a diversity of enterprise within communities like Kara-suu. Not only do agriculture-only projects deprive communities of opportunities to explore other activities, but in a country like Kyrgyzstan with a strong pastoral heritage, such projects risk reinforcing ethnic stereotypes and stifling the imagination of Kyrgyz.

Altogether, communities like Kara-suu in Kyrgyzstan have a great deal of assets that support adaptability. Residents are generally open-minded when given access to new knowledge. They live in constant contact with an ecosystem that they very tangibly depend on, and they possess the authority to govern their own communities' use of those natural resources. The greatest challenge for future development work in rural Kyrgyzstan will be to diversify the range of village economic activity beyond strictly agriculture, while ensuring that all community members, regardless of wealth, are able to continue to have at least some degree of access to social and financial capital. A more diversified economy, and a more egalitarian society, should help ensure that communities like Kara-suu have the capacity to plan and implement their own solutions to whatever unexpected disturbances they might face in the future.

APPENDIX

List of interview questions:

Chaban Interviews

Access to Natural Capital

- 1) How do resource users perceive the state of this rangeland resource, and what are their perceptions of the causes of any identified changes?
 - Would you generally describe pasture conditions as good?
 - Have you noticed any changes?
 - Can you think of any years when there were poor conditions? How did you react?
- 2) Are resource users likely to attribute changes in pastures to human activity?
 - What do you think are the causes of any change in pasture quality?
 - Do you think there is a maximum level of use that a *jailoo* can accommodate? What is it?
- 3) How has the intensity of pasture exploitation changed, either in magnitude or distribution, over the past 20 years?
 - How many families come here to this *jailoo*?
 - How many animals do *chabans* commonly bring?
- 4) How is pasture governance handled by the community?
 - Who determines which user can enter a particular *jailoo* in a given year?
 - Are there ever conflicts between existing users and newcomers?
 - How do taxation and fees for use function?
- 5) How do *chabans* react to environmental change, and what is the role of mobility?
 - What do you do when there are particularly hard conditions in the *jailoo*, such as drought or cold weather?
 - What is your pattern of mobility in one year? What pasture areas do you utilize in different seasons?

Household Interviews

Diversity of Knowledge

- 1) What is the role of education in the community?
 - What is your level of education?
 - Why/how did you choose your specialization?
 - What advice or encouragement, if any, do you give your children regarding education?
- 2) What sources of information regarding land use do residents prefer
 - How do you decide to grow the particular kinds of crops, raise the particular animals that you do?
 - Where did you first learn about agricultural practices?

- Do you seek out new sources of information about agriculture/business opportunities? If so, what do you favor?
- 3) How do residents perceive the environment? Do they perceive change, and if so, what are their thoughts on the causes?
- How much time a year do you spend in jailoos?
 - Do you have any opinions about the quality of the natural resources in these areas?
 - Has there been any change in the past 20 years?
 - Is there a difference in quality based on the proximity of the pastures to the village?
 - How do you decide where to take your animals in the summer? Which jailoo?
- 4) What do residents perceive as the main problems facing the community?
- If you could propose a project to improve some aspect of your village, what would it be? Give respondents examples such as fixing roads, repairing irrigation, improving schools.

Access to Financial capital

- 1) What are the kinds of assets do households own?
- What are the types and amounts of animals that your family possesses?
 - How much land do you cultivate?
 - Do you own any other major assets, such as a tractor, automobile?
- 2) By what means do families convert their labors into livelihoods? How do they derive income from their agricultural products?
- What do you do with agricultural products? Sell them, use them at home? Change?
- 3) What kinds of non-agricultural sources of financial capital do families pursue?
- Do you produce any other products?
 - Do you ever make use of credit?

Access to Social capital

- 1) How do residents create social networks, and whom are they comprised of?
- If you ever need a favor or help from someone, who are you likely to pick?
 - Where do they live and how do you know them?
 - Why would you choose this person?
 - Is there anyone who earlier you might have asked, but now would not? Or someone earlier you wouldn't have asked, but now would? Why the change?
 - How often are you able to travel outside of Kara-suu?

2) What kind of value have they derived from these contacts, and what kind of value would they expect to derive in the future?

- Can you provide an example of times you have received help from a social contact, such as a loan or assistance with finding employment?
- If you received help from someone, do you anticipate that in the future they would again be willing to provide the same kind of assistance?

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