Mountain Research and Development

Volume 32, Number 3 August 2012

Special Issue: Central Asian Mountain Societies in Transition

Cover photo: At first light, farmers are on their way to fields in Mastchohi Kuhi, Tajikistan. The transition to independence in Tajikistan and other Central Asian countries after the collapse of the Soviet Union in 1991 nearly coincided with the watershed moment for the global sustainable development movement—the 1992 Earth Summit in Rio. As Central Asian countries opened up to the world, the ideas, structures, and actors of sustainable development gained increasing influence. The recent Rio+20 Summit and the 2011 celebrations of independence of Central Asian countries provide an opportunity to critically reflect on the transition of Central Asian mountain societies. (Photo by Mikhail Romanyuk)

Acknowledgments:

This Special Issue was generously supported by the University of Central Asia's Mountain Societies Research Centre (UCA/MSRC):

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Mountain Research and Development

Volume 32 Number 3 August 2012

Editorial

MountainDevelopment

MountainResearch

MountainPlatform

MountainNotes

MountainMedia

Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
www.mrd-journal.org

Publishers

Mountain Research and Development (MRD) (ISSN 0276-4741, online ISSN 1994-7151) is published by the International Mountain Society (IMS), c/o Centre for Development and Environment, University of Bern, Hallerstrasse 10, 3012 Bern, Switzerland.

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MRD collaborates with Mountain Forum (MF) and The Mountain Partnership (MP) to further the cause of mountains on the international development and research agendas.

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Mountain Research and Development is published quarterly by the International Mountain Society and is freely available online and open access in collaboration with BioOne (http://www.bioone.org/loi/mred).

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Mountain Research and Development (MRD)
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Special Issue: Central Asian Mountain Societies in Transition

Dear Readers,

Mountain societies in Central Asia have experienced systemic economic, political, social, and environmental changes since the collapse of the Soviet Union in 1991 and have demonstrated varying degrees of resilience and capacities to transition. Due to these changes, Central Asian mountain societies face accentuated development challenges as well as promising opportunities.

While there is growing recognition of the scope of challenges and opportunities that Central Asian mountain societies have before them, there is a lack of natural and social science analysis of current realities and of the impact of development practices. Rigorous research on Central Asia and analysis of existing and potential development practices are needed to both fill known gaps and explore blind spots in knowledge of Central Asian mountain societies. Such findings are essential for further developing options for sustainable livelihoods and sound ecosystems, together with the people of Central Asia's mountains (Kerven et al 2012, in this issue; Kreutzmann 2012).

In June 2011, the University of Central Asia's Mountain Societies Research Centre (UCA/MSRC) and the Swiss National Centre of Competence in Research (NCCR) North-South organized an international symposium on pastoralism in Central Asian mountain areas. This symposium and the subsequent development and publication of this special issue, including selected papers from the symposium, are targeted towards elevating the quality, usefulness, and profile of research in and on Central Asian mountain societies.

The MountainDevelopment section of the issue begins with Wibke Crewett's study of pasture governance practices in Naryn, Kyrgyzstan, and her finding that administrative hurdles are not the major cause of unsustainable practices. She suggests, therefore, that ongoing administrative reform efforts will not lead to the intended improvements. She points instead to the importance of designing effective local enforcement mechanisms for seasonal livestock migration. Dominic Stucker and co-authors focus on cooperative adaptation strategies in a small transboundary river basin in Kyrgyzstan and Tajikistan. Their work demonstrates that, despite transboundary tensions between the countries, local communities can find, and have found, solutions to water issues. Tatjana Rosen and co-authors explore the effectiveness of external interventions in a snow leopard conservation project in Gilgit-Baltistan, northern Pakistan, and find that efforts to address the consequences of the conservation–development conflict through a locally based insurance scheme and some support from externally funded projects have positively impacted mountain societies; but without local empowerment, the positive impact is limited. The final MountainDevelopment article by Christoph Wiedemann and co-authors demonstrates how thermal insulation measures financed through microloans and aimed at reducing use of biomass fuels in the Eastern Pamirs (Tajikistan) have successfully saved heating energy. However, the savings are not being realized by the main users of biomass fuels, ie poorer households, and the authors suggest an integrated strategy, including provision of alternative fuels and dissemination of energy-efficient technology, to better target these poorer households.

The MountainResearch section begins with Karina Liechti's examination of tensions between government and local community perceptions of pasture quality and degradation processes. Her findings illustrate the link between current practices and identities and the meanings associated with the Soviet period and the post-Soviet transformation. The 2 following articles—by Andrei Dörre and Peter Borchardt, and by Kim André Vanselow and co-authors—also show the multidimensional nature of factors influencing pasture use. The former examines how historical, socioeconomic, legal, and management factors influence pasture use strategies and challenges in Kyrgyzstan's walnut-fruit forest region. The latter examines the spatial and temporal variability of current pasture use and associated livestock numbers in Tajikistan's Eastern Pamir region.

In her analysis of the diversity of agropastoral systems in the Chuy region, Kyrgyzstan, Raphaële de la Martinière develops a typology of household farming systems and demonstrates the link between each system type and the corresponding households' ability to seize economic opportunities, especially in relation to the production of milk and beef. Adam Pain and Paula Kantor's article explores the livelihood pathways of households in Badakhshan in northeastern Afghanistan. Their findings illuminate the "corporate nature" of villages and the ways in which relative richness of the resource base and the degree of social differentiation impact the capacity of villages to provide village-level public goods. In the final MountainResearch article, Nazneen Kanji and co-authors explore how physical remoteness influences the quality of life of people living in Afghanistan's Badakhshan province. They argue that remoteness is an important barrier to improving health and well-being and that holistic approaches are more suitable than purely market-led approaches for improving quality of life.

The MountainNotes section presents a synthesis of a longer review of mountain agro-pastoralism completed by Carol Kerven and co-authors. The review concludes that the focus of policies, programs, and projects in the past 20 years has been driven by 2 unproven orthodoxies about the extent and causes of pasture degradation and the need for decentralization and pastureland privatization. The authors argue that there is a need for long-term, field-based, empirical research to critically assess these orthodoxies and to provide useful findings for practical application.

 http://dx.doi.org/10.1659/mrd.3203

Kerven and co-authors' challenge to researchers—and the projects and organizations that fund them—is explicitly or implicitly addressed by several of the articles in this special issue. In addition, Hermann Kreutzmann's recently published collection entitled Pastoral Practices in High Asia *(2012) similarly elevates the profile of field-based, empirical research that challenges development orthodoxies. In Kreutzmann's case, the challenge is to the revival of development orthodoxies based on modernization theory. Together,* Pastoral Practices in High Asia *and this special issue of* MRD *are filling recognized gaps and exposing blind spots in knowledge and sustainable development practice for Central Asian mountain societies.*

It has been a privilege for the Mountain Societies Research Centre of the University of Central Asia to serve as guest editor to this special issue; to bring focus to important research and development concerns of relevance to Central Asian mountain societies; to highlight existing and emerging needs; and to prepare a Russian translation of the issue which should be available online and in print before the end of the year. We hope you will find this issue informative and useful.

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ACKNOWLEDGMENTS

This Special Issue was generously supported by the University of Central Asia's Mountain Societies Research Centre (UCA/MSRC).

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Improving the Sustainability of Pasture Use in Kyrgyzstan

The Impact of Pasture Governance Reforms on Livestock Migration

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This article reports on a qualitative case study about pasture governance practices in Naryn oblast *in Kyrgyzstan. It investigates the relationship between shifts in pasture legislation and herders' mobility. The article describes a study of the outcomes of 2002 pasture management legislation that introduced pasture lease agreements. It specifically looks at the implications of dispersed administrative responsibility for livestock mobility. Contrary to what other studies have found, results of this study suggest that, in the case study, municipality, administrative hurdles were not a major cause of the abandonment of seasonal migration. Based on this finding, the results of the study suggest that a second reform approach, which started in 2009 and replaced the previous administrative arrangement with community-based pasture management would not necessarily improve the sustainable use of pastures and boost livestock mobility. The author points to the importance of designing effective local enforcement mechanisms for seasonal migration.*

Keywords: *Community-based natural resource management; governance reform; pasture; Naryn; Kyrgyzstan; Central Asia.*

Peer-reviewed: *May 2012* ***Accepted:*** *June 2012*

Introduction

Agropastoralism is a key agricultural activity in Kyrgyzstan (41°00′N; 75°00′E). An average altitude of 2750 m (Fitzherbert 2000: 2.2) and about 9.1 million ha of natural pastures make transhumance the most important livestock production system in the country. Over the past 50 years, the procedures and responsibilities for the allocation of usufruct rights to pastures have experienced considerable modifications. As a consequence, herders' migration patterns changed. Before independence in 1991, large-scale livestock production was managed by *kolkhoz* (collective farms) and *sovkhoz* (state farms), which organized annual migratory livestock movements. Winter grazing locations were pastures or harvested crop fields close to settlements at lower altitudes. Between May and October, herders travelled to summer pastures at altitudes of about 1500–2500 masl (Farrington 2005) or higher (Fitzherbert 2000). On their journey during spring and autumn, they passed pastures at intermediary altitudes. Migration of livestock was compulsory and strictly enforced by kolkhoz management (Wenzel 2004). After independence in 1991, the *kolkhozes* and *sovkhozes* were dissolved, and the pasture-use management structure became fundamentally altered.

In the post-Soviet era, formal procedures for allocation of usufruct rights to pastures have significantly changed twice. In 2002, reform legislation introduced individual pasture lease rights. This reform was influenced by classical property rights theory (Demsetz 1967), according to which the commons are considered open-access areas and are subject to inevitable overexploitation by free riders (Hardin 1968). In 2009, a new law introduced a system of community-based natural resource management, under which pasture access is to be managed by local user groups. This reform followed a new "policy consensus" (Mosse 1997; see also Agrawal 2001; Pincus 2001; Blakie 2006), which builds on common-pool resource theory influenced by the works of Wade (1988) and Ostrom (1990). This theory acknowledges the possibility of sustainable self-governance of common-pool resources by user groups if specific success factors that prevent free riding and allow for community participation are met (Ostrom 1990; Agrawal 2001; Dietz et al 2003; Gruber 2010).

The debate on migration

Different legislation can have different effects on the mobility of agropastoral households. The post-Soviet pasture legislation in Central Asia has had different impacts on households' migration decisions. Important factors were found to be local conditions, such as grazing pressure, household economic status (Kerven et al 2004;

FIGURE 1 Location of case study. (Map by Thomas Breu)

Farrington 2005; Robinson et al 2010; Steimann 2011; Steimann 2012), and local administrative practices (Behnke 2005; Dörre 2012). However, post-Soviet pasture management reforms are generally seen as having limited livestock mobility (Robinson et al 2003). In particular, privatized pasture use has been discussed as an obstacle to migratory movements because it is seen to lead to a permanent fragmentation of pastures that is inconsistent with the flexible use patterns of mobile herders (Robinson et al 2010). This argument has also influenced the debate on the Kyrgyz pasture legislation.

During the debate on the second pasture reform in Kyrgyzstan, international policy advisers and the Kyrgyz government held the view that the 2002 legislation had hindered sustainable pasture use. Since independence, decreasing number and range of seasonal livestock movements, along with overstocking near villages and underuse of pastures located at greater distance from the settlements, have been reported (Schillhorn van Veen 1995; Fitzherbert 2000; Wenzel 2004; World Bank 2004). According to official data from the Ministry of Agriculture, Water Resources and Processing Industry, this has led to worrying conditions in the pastures: severe degradation was registered on 25% of all pastures (MAWRPI et al 2008: 9). Data for 2005–2006 from the state property registry office (GosRegistr) indicate that 27% of the pastures contain large amounts of inedible species, 19% is eroded, and 33% is substantially degraded (USAID 2007: 3).

Administrative procedures are believed to be complicated and to cause high transaction costs for potential leaseholders. International policy advisers and the government have identified the formal pasture law with its fragmentation of administrative control over pastures as the "root of the degradation problem" (World Bank 2007b: 53; MAWRPI et al 2008: 6; see also World Bank 2007a). Impractical and slow administrative procedures, unclear administrative responsibilities, and expensive fees have been discussed as the main causes for abandonment of summer pasture use (World Bank 2007a: 61). However, the case study reported here does not support this view.

This article has 2 objectives: First, it studies the impact of the 2002 lease-based pasture law on migration decisions. Second, in consideration of those findings, it discusses the likely effects of the 2009 community-based reform approach on migration.

Methods and case study selection

An exploratory single case study (Yin 1993) was conducted in Akmuz village in Naryn *oblast* (district) to assess the linkage between administrative practices, working rules for pasture access, and herders' mobility (Figure 1). The case study location was selected from a set of 5 municipalities in which focus groups were held and municipality data were collected during a preliminary study in 2008. Two of the communities had a comparatively strong focus on agropastoral livestock production and a large pasture area endowed with all 3 pasture types (winter, intensive, and summer pastures). Of these, Akmuz was selected because its remote summer pastures were not located near big roads, which was assumed to affect migration decisions (eg by reducing income opportunities from trade), and roads to the remote pasture areas were traversable. Akmuz, located at approximately 2300 masl, is part of the Northern Mountain region of Kyrgyzstan, which is characterized by high altitude, remote location, and high livestock numbers (Schuler et al 2004: 2–6). One third of the Kyrgyz pasture area (30.4%) is located in Naryn *oblast*; due to a low population density, the pasture availability per

FIGURE 2 (A) Intensive pastures near Akmuz village and the Naryn Too range, September 2009; (B) Sheep pen and yurt on summer pasture. (Photos by Wibke Crewett)

pastoralist is 44.86 ha (Kulov 2007: 4), the highest in the country.

The grazing area of Akmuz municipality includes 17,369 ha of village-adjacent pasture and 39,710 ha of remote pasture (Figure 2A, B). Of this area, 89 ha of village-adjacent pasture and 3980 ha of remote pasture were officially rented out in 2009 (At Bashi GosRegistr data and municipality statistics 2009). In addition, 2147 ha of intensive pasture were rented out by the *leskhoz* (State Agency for Forest and Environment) as part of the state forest fund. Focus group data and individual interviews indicate high livestock dependency, because crop production is particularly limited because of unfavorable climatic conditions, a lack of agricultural machinery, and a collapsed irrigation system.

TABLE 1 Case study data.[a,b]

Population in 2008	Statistics
Total population	3504
No. of households	740
Average size of households	4.9
Average livestock ownership (heads/household) in 2008	
Yaks	2.3
Cattle	3.2
Small ruminants	15.0
Horses	0.2
Pasture endowment (ha) in 2009	
Village-adjacent	17,368
Intensive	n/a
Remote	39,710

[a]n/a, not available.

[b]Sources: municipality statistics 2008, GosRegistr data 2009, own calculations.

Livestock mobility in Akmuz follows the same rotational migration principles that have been described for other livestock-dependent communities in Kyrgyzstan (Farrington 2005; Schoch et al 2010; Steimann 2011). In 2008, the village had 3504 inhabitants in 740 households, of which 36% were officially classified as poor (Table 1). The analysis builds on triangulated data from a content analysis of transcripts of interviews and focus group data, documents obtained from municipality administrations and GosRegist offices, and maps produced by *goskartografia* (the state cartographic institute). Between June 2008 and October 2009, 29 semistructured interviews were conducted with livestock owners ($N = 25$) and administrators from the municipality, *leskhoz*, and GosRegist ($N = 4$). The semistructured questionnaires focused on effective working rules for pasture use and access under the 2002 legislation, that is, rules that are "actually used, monitored, and enforced when individuals make choices about the actions they will take" (Ostrom 1990: 51). Interviews were conducted by the author and simultaneously translated into the Kyrgyz language. The transcripts of the interviews were analyzed by means of qualitative content analysis with inductive and deductive coding (Mayring 1993). The data analysis technique was a stepwise constant comparison method used for analysis of and comparison between interviews and documents (Glaser 1965, Strauss and Corbin 1998; for a detailed description of the method applied, see Boeije 2002). Examples for code assignment during the analytical coding process are presented in Table 2.

The first pasture reform approach: 1999–2009

According to the Land Code (1999) and the Law on Management of Agricultural Land (2001), pastures are the property of the Kyrgyz state. Pasture rental became possible under the Law on Procedures of Allocating Pastures for Lease and Use, which was adopted by the Government of the Kyrgyz Republic on 4 June 2002. The law introduced a new administrative management scheme for pastures based on functional categories. Winter pastures were classified as village-adjacent pastures, spring and autumn pastures as intensive pastures, and summer pastures as remote pastures. Administrative control for each pasture category was assigned to a different state body: village-adjacent pastures to municipality administrations, intensive pastures to district administrations, and remote pastures to regional state administrations. In addition, larger parts of the pasture fell under the authority of the state agency for environment and forestry (*leskhoz*).

Working rules for pasture use and access since 2002

In the Kyrgyz pasture sector, common practice or working rules regularly deviate from formal administrative rules (Steimann 2011; Dörre 2012; Steimann 2012). The following section therefore looks at effective pasture use and access rules under the 2002 pasture governance reform and their impact on migration decisions. The analysis shows that administrative hurdles were not the main reason for the abandonment of long-distance migration.

In effect, 2 types of pasture existed, each with a different access mechanism:

1. Heavily used village-adjacent winter pastures, relatively close autumn–spring pastures, and relatively close summer pastures, the use of which required a formal lease contract.
2. More sparsely used remote summer pastures and relatively distant intensive pastures, which did not require a lease contract.

In practice, formal pasture lease was not a general precondition for pasture use, because rent payments were not systematically enforced on all pastures; particularly on remote pastures, no systematic effective administrative enforcement of the legislation was in place. Therefore, herders were not forced to carry out difficult administrative procedures to get access to pasture land. Intensive use of pastures near the village was preferred to migration to remote summer pastures. Although variations existed in the chosen livestock migration strategy, herders expressed a strong preference for summer grazing as close to the municipality as possible. Instead of the seasonally differentiated pasture selection of the Soviet period, many herders chose pastures for their proximity to the settlement. The prescribed

TABLE 2 Coding examples for text segments from interview transcripts.

Statement made by respondent	Coding categories
Quote 1. *"In the past, we had our animals in [the summer pasture] Zhany Zher but when this [closer spring/autumn] pasture was available, it was much better to take this."* (contract holder)	• Contraction of amplitude of migration • Preference for closer pastures
Quote 2. *"After the collapse [of the Soviet Union] everyone started to try to get [pasture] land near the village."* (contract holder)	• Preference for closer pastures • Rush for lease
Quote 3. *"Now you cannot use this pasture without a lease agreement anymore."* (non–contract holder)	• Access depends upon possession of lease contract • High demand for pasture contract/rush for lease • Preference for closer pastures
Quote 4. *"All the closer pastures are rented. Not everyone can use these pastures. But there are enough other places where you can go."* (non–contract holder)	• Access depends upon lease contract • High demand for contracts • Preference for closer pastures • Choice between contracting and not contracting
Quote 5. *"Why did you choose that remote section of the pasture when you made the contract"?* Respondent: *"Because it was the only part that was still available for rent. All the rest was already rented to someone else."* (contract holder)	• Choice between contracting and not contracting • High demand for lease contracts/rush for lease • Preference for closer pastures • Remote pasture use as second-best option
Quote 6. *"Actually everything is rented on our pasture. We tell everyone not to come [to our pasture]"* (contract holder)	• Self-enforcement of maximum stocking rate • High demand for lease contracts • Pasture in high demand
Quote 7. *"Rich people [who were described as contract owners earlier during the interview] use some part of the pasture and say: 'This is our pasture. Go away!' Sometimes they beat our animals."* (non–contract holder)	• "The wealthy occupy pastures" • Self-enforcement of maximum stocking rate
Quote 8. *"It is better to make a lease agreement for a pasture that is closer to the village, such as [the relatively closer intensive pasture] Itchké, than to go to [the relatively far summer pasture] Ak-Say for free. Ak-Say does not cost any rent. I was a herdsmen at Ak-Say for 40 years on that pasture. But I think Itchké is better, also with respect to quality. The pasture can easily be reached by car and is only 2 hours away by horse."* (contract holder)	• Preference for closer pastures • Abandonment of migration • Summer pasture use abandoned in favor of intensive pasture use • Preference, pasture quality • Preference, convenient access
Quote 9. *"We came to Zhany Zher because of my father's health problems. It is not so high as Ak-Say."* (contract holder)	• Preference, access medical services • Preference, lower altitude • Preference for closer pastures

migration dates, which were annually announced by the municipality administration, were not being followed by many herders. As a result, many of the areas that were spring and autumn pastures during the Soviet period had become summer grazing locations. Thus, there was a high demand for nearby pastures. Most intensive pastures were reported to be fully used, and herders perceived all intensive pastures to be rented out. Although pastures in low demand were often accessible without an agreement, access to pastures in high demand depended on the ability to obtain a lease.

The interest in pasture leases increased over time. Although the demand for pasture leasing was very low shortly after introduction of the reform, and only a few rich herders aimed to secure pasture rights for the best grazing locations, the observation of a growing number of contract holders and the common practice of excluding non–contract holders has led to the perception that a contract is necessary to get access to a pasture and has increased demand for pasture leases.

The impact of administrative practices

Contracting for pasture was considered rather complicated. It involved, depending on whether responsible staff were present, which was not always the case, two or more visits to administrative bodies in the district capital. The conclusion of a lease was in one case described as having taken up to 6 months. However, none of the interviewees mentioned difficulties during the administrative process as a reason for not concluding a pasture lease. Also, respondents were aware of the official leasing procedure. The district administration seemed to follow a uniform procedure. There were no differences in descriptions of the lease application procedure by contract holders in Akmuz, GosRegist staff in At Bashi, and a discussion by Steimann (2011) in a case study in the

same district. Hence, no difficulties in locating the leasing authority were mentioned.

None of the interviewed leaseholders considered rental fees, which are fixed by a state commission, to be expensive and a reason for not concluding a lease. In 2009, official fees in the study area were US$ 0.06 per hectare per year for remote pastures and for village-adjacent pastures. For intensive pastures, respondents reported paying from US$ 0.2 to US$ 0.4. The pasture allocation rules that emerged under the 2002 law were only quasi–lease based, because the rental fee was set by the administration. The low fees did not reflect demand. Hence, in one case, a herder chose to abandon the use of a remote pasture free of charge in favor of nearer pasture plots that required lease payments. The cost of using the closer pastures was preferred to the cost and inconvenience of long-distance migration.

Even the small yearly rent payments were not strictly enforced, due to the insufficient staff capacity of GosRegistr. Many herders did not pay their rent regularly or paid only part of it. Rent payment on *leskhoz* lands was also sporadically enforced, because several respondents who used what they believed were *leskhoz* pastures neither had a lease nor paid a fee. Given the low lease fees and sporadic enforcement, the administrative lease procedure did not constrain use of highly desired pasture plots. Rental and administrative fees and procedures did not prevent herders from concluding a lease. Instead, interviewees discussed 2 reasons for not concluding a contract. First, a pasture lease was sometimes not considered necessary. This was the case on most remote pastures and on some of the more distant intensive pastures, which could be used without a formal rental agreement due to the lack of competition for pasture use and the low degree of administrative enforcement. Second, a desired pasture lease was sometimes unavailable because the pasture already was (or was perceived to be) rented. This occurred because GosRegist staff limited the number of leases issued for each pasture area according to a predefined official stocking rate. Hence, many herders were not able to establish a formal lease for their preferred pasture plot and were forced to use or rent a plot farther away from the village.

It is noteworthy that leases were mainly discussed as a means to defend pasture-use rights against other pasture users, whereas establishment of pasture leases by administrative order was rarely mentioned. Many respondents reported that leaseholders actively excluded non–contract holders from access to their rented plot. The respondents, therefore, shared the view that only contract holders could access pastures near the village and that this had increased the demand for pasture leases.

In the case study municipality, the contract was a mandatory means to increase the probability of uncontested use rights to a pasture in high demand. It was not required to establish legal rights to the use of pasture in general, because state administrative bodies did not systematically enforce rent payment on all pastures. Pasture leasing was an optional means to establish access rights to relatively nearby pastures. Leases had become an important means of securing usufruct rights to intensive pasture plots.

In the case study area, nonadministrative factors were the main reasons for herders to abandon long-distance migration. Herders were strongly interested in keeping travel distances to the grazing areas short. The case study revealed that factors that affected migration decisions included a lack of access to services; high individual migration costs, which were further increased by a decay of infrastructure; perceptions of sufficient pasture quality on nearer pastures; and the breakdown of formal and informal enforcement mechanisms for long-distance migration. In addition, the lease of intensive pastures limited motivation for summer migration by those who held contracts or felt secure in their use rights to specific plots. Because no effective seasonal use restrictions for the different pasture types existed, renters, mainly those with smaller herds, remained stationary throughout the grazing season.

The second reform approach: community-based management

The analysis of the Akmuz case showed no direct relationship between high administrative costs that accrue to pasture users and the abandonment of herders' long-distance mobility. Although this finding needs to be confirmed by further research, including multiple case studies and additional quantitative studies, one might develop a hypothesis on the effectiveness of the community-based pasture governance reform that is currently being implemented. On 26 January 2009, the government of Kyrgyzstan issued the Law on Pasture (N 30), which shifted responsibility for managing pastures to new community-based user organizations and abandoned the earlier fragmented system of state authority. According to the new law, all pasture users are to form pasture user unions (PUU, which elects its own executive body, called a pasture user committee [PUC]). These bodies are authorized to govern the use of pastures independently from state administrative control. The PUUs hold a bundle of rights. Under article 6, section 5 of the new law, the PUCs have the right to (1) develop and implement a community pasture management plan and an annual pasture use plan, (2) issue pasture use right certificates (pasture tickets) and collect payments for pasture use, (3) resolve disputes among pasture users, and (4) carry out investments in pasture infrastructure and maintenance.

If fully implemented, the 2009 law could solve what has been identified as the administrative fragmentation problem. However, based on the case study, one might

hypothesize that the localization of pasture administration in municipal-level PUCs and the envisaged simplification of access procedures might not be sufficient to increase livestock mobility. Results of the case study suggest that administrative hurdles, including the need to travel to administrative offices outside of the municipality, were not among the key reasons for the contraction of seasonal livestock movements. It also showed that herders adhered neither to what can be considered traditional seasonal migration rules nor to pleas by the municipal administration.

The findings of this exploratory case study, therefore, suggest that to increase flock mobility under the 2009 reform legislation, investments in infrastructure are key. At the same time, specific migration rules with effective enforcement and sanction mechanisms might be needed. Unfortunately, the current legislation lacks provisions for enforcement of seasonal migration and does not include regulations that establish sanctions. This causes a particular challenge associated with the control function of PUCs.

Analysis of the case study suggests that herders have limited interest in traveling to remote pastures due to inconvenient access and the absence of services. Hence, PUCs might find it difficult to enforce migration rules and particularly to withstand pressure from local groups or individuals who might have an interest in avoiding migration (eg influential herders who prefer to use already secured pastures near settlements). Outside assistance might be needed to support the effective implementation and enforcement of migration rules and to prevent local pressure-group influence. Therefore, rule enforcement might better be backed by a body located outside of the village, such as an umbrella organization of PUUs at the district or regional level. It could serve as a control body, independent of municipality-level pressure group influence, that could effectively control seasonal migration rules. The mere shift of administrative responsibility to the municipal level, without the establishment of effective independent enforcement bodies, might be insufficient to increase flock mobility.

ACKNOWLEDGMENTS

This study was funded by the German Federal Ministry for Economic Cooperation and Development as part of the project Making Rural Services Work for the Poor, which was carried out by the International Food Policy Research Institute, Washington, in cooperation with the Humboldt-University, Berlin, and the National Academy of Science, Bishkek. The author is grateful for technical and personal support by staff of the nongovernmental organization CAMP Ala-Too, Bishkek, and colleagues at the Social Research Center at the American University of Central Asia, Bishkek. Extremely helpful critical comments came from 3 reviewers for this journal and from participants in a research colloquium on 7 February 2012 at the Division of Resource Economics at Humboldt-University Berlin. The author acknowledges support from the University of Central Asia's Mountain Societies Research Centre for the publication of this article.

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Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
www.mrd-journal.org

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Climate Change in a Small Transboundary Tributary of the Syr Darya Calls for Effective Cooperation and Adaptation

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This article focuses on cooperative adaptation strategies at the community, water user association, district, and national levels along the Khojabakirgansai, a small transboundary tributary of the Syr Darya in Kyrgyzstan and Tajikistan. Data were collected in the basin through in-depth expert interviews, site visits, and household surveys, and were triangulated with climate change data from the available literature. Basin inhabitants cooperate on extreme events that are exacerbated by climate change, including water scarcity, droughts, and flash floods. Water demand and efficiency are key issues driven by population growth, expansion of croplands, and deteriorating canal infrastructure. Lessons learned can be considered in other small transboundary tributaries in the Ferghana Valley and Central Asia, which demonstrate how, despite the international level of tension on water issues in the region, local communities can find solutions. Cooperation, however, does not always improve the basin environment or living standards, and is likely to be strained in the coming decades by climate and population trends, among other issues.

Keywords: *Water management; transboundary; climate change; extreme events; cooperation; adaptation; water user association; Kyrgyzstan; Tajikistan; Syr Darya Basin.*

Peer-reviewed: *April 2012* ***Accepted:*** *June 2012*

Introduction

Since the collapse of the Soviet Union in 1991, interstate initiatives and research on water in Central Asia have focused on the shrinking Aral Sea and the main rivers, the Amu Darya and Syr Darya (see Sharma et al 2004 and De Martino et al 2005). Even though there are more than 20 small transboundary tributaries (STT) that flow into the Syr Darya in the Ferghana Valley, water sharing in these subcatchments is considered a local, bilateral issue (Wegerich et al 2012a; Wegerich et al 2012b). By addressing this gap in the research, our case study focused on one such STT and sought to inform other similar settings on possible actions and adaptation strategies in the face of emerging climate change threats.

Predicting climate change impacts, especially in Central Asia where regional models are less well developed than for other regions (Westphal 2008) remains difficult because of the inherent complexities and associated nonlinear responses of socioenvironmental systems. Although more regional data are required to unequivocally demonstrate the links between climate change and extreme events in the Syr Darya basin, a growing body of historical meteorological and hydrological evidence indicates that climate change is happening and impacting the water supply (Savoskul et al 2003; IPCC 2007; Kokorin 2008; Westphal 2008; Bernauer and Siegfried 2012).

In addition to factors that already complicate water management in Central Asia, such as deteriorated water infrastructure, degraded basin environments, population pressure, ongoing land reforms, and lack of cross-border cooperation (Weiss and Yakovlev 2012), experts expect climate impacts to become more severe over the next 20 (Westphal 2008) to 40 years (Bernauer and Siegfried 2012), but they also point out that people in the region are already being impacted. Indeed, there has been a significant increase in the number of droughts and floods in Central Asia in the past 20 years, and this trend is projected to continue (Fay et al 2010).

Although tensions about water exist at the international level, for example, between Uzbekistan and Tajikistan regarding the construction of the upstream Rogun hydroelectric dam or between Uzbekistan and Kyrgyzstan regarding exchanges of water and natural gas (see Allouche 2007), results of our research showed that cooperation on water management and sharing exists at the local level within and among water user associations (WUA), districts, and provinces, and across national and ethnic boundaries. Such cooperation is both threatened by and an essential foundation for coping with the basin-wide impacts of climate change.

FIGURE 1 Irrigated fields along the Khojabakirgansai in the Khozho-Bakyrgan WUA, Kyrgyzstan. The basin is arid, so the vast majority of crops are irrigated. (Photo by Dominic Stucker, 2011)

After introductions about the Syr Darya and Khojabakirgansai basins, our article provides insight into climate change and its local impacts, presents current cooperative adaptation strategies, assesses the long-term effectiveness of these strategies, and offers recommendations for consideration. Our core research questions were the following:

- What are the key climate change-related extreme events that are impacting the basin?
- How are local communities, WUAs, and district and province managers cooperating and adapting to these impacts?
- Do current adaptation strategies regenerate natural capital and improve living standards?

Methodology

In addition to conducting a literature review on regional climate change for the first question, we addressed all 3 questions through field research in the basin, including 20 in-depth structured interviews with water experts at the provincial, district, and WUA levels, site visits to 3 upstream and 3 downstream WUAs (Kyrk-Bulak, Khozho-Bakyrgan, and Kulunda-Razzakov upstream, and Obi Ravoni Ovchi Kalacha, Madaniyat, and Gulakandoz downstream), and 49 household surveys in the same WUAs. We ensured participation of women and men at all levels. Our interview questions focused on trends in population, water resources quality and quantity, water decision-making and cooperation, and extreme events and climate change, whereas our household surveys focused on household demographics and livelihoods and on extreme events and climate change. To validate initial findings, we presented our research at a stakeholder workshop that involved 31 participants from throughout the basin and integrated the feedback we received.

Our approach is based on the assumption that the future is not negatively determined and that there is potential for change through development. Paraphrasing Allan and Karshenas (1996), 3 future scenarios are possible: conventional, precautionary, and regenerative. Although the conventional scenario raises living standards in the short term, it is predicated on natural capital depletion; the precautionary scenario first reduces natural capital but then stabilizes it, maintaining living standards; and the regenerative scenario, taking a longer view, improves natural capital and living standards. In an arid, agrarian context such as our case study (Figure 1), the Khojabakirgansai basin, where water and land are essential for livelihoods, Allan and Karshenas' framework applies well. At the end of our article, we apply it to assess the effectiveness of adaptive strategies.

The Syr Darya Basin

The Syr Darya, at 2212 km, is the longest river in Central Asia, starting at the confluence of the Kara Darya and Naryn rivers in the Ferghana Valley in Uzbekistan (when including the Naryn, its length is 3019 km). The Khojabakirgansai is one of more than 20 STTs of the Syr Darya in the valley. The sources of these tributaries are glaciers in Kyrgyzstan. Before flowing out of the Ferghana Valley, the Syr Darya enters Tajikistan and fills the

BOX 1: Water user associations in the Khojabakirgansai Basin

Water user associations (WUA) emerged recently in the basin to manage water in the territories of former collective and state farms, dismantled as a result of agricultural restructuring reforms in Central Asia. Land reforms and formation of WUAs were promoted by external donors and international organizations, based on models applied previously in developing countries. WUAs are supposed to be noncommercial and nonprofit member organizations, formed by water users (in our case, farmers) to manage and deliver water equitably, efficiently, and in a timely manner.

WUAs in the Kyrgyz part of the basin were established starting in 1998 as part of a World Bank–financed project, whereas, in the Tajik part of the basin, the International Water Management Institute (IWMI) started to promote them in 2005. All WUAs are now operating similarly, as the IWMI continued to work in the basin through their Integrated Water Resource Management in the Ferghana Valley project.

Members of WUAs are supposed to meet annually to make key governance decisions on operations, development plans, and strategy. Elected at the annual meeting, each WUA has a council that gives operational guidance to the directorate, audits accounts, and resolves conflicts, usually meeting on a monthly basis. The directorate, consisting of a director, head *mirob*, accountant, and other technical staff, carries out daily maintenance and water distribution. Members pay for their share of water to cover staff and infrastructure maintenance costs.

The question of an uneven level of development and sustainability (organizational and financial) of WUAs in the basin is still open and related to the welfare of farmers and the effectiveness of relevant agricultural reforms. These are not complete downstream, with WUAs covering approximately 75% of irrigated lands in 2010. At that time, there were 14 WUAs in the Tajik part of the basin and 3 in the Kyrgyz part (Figure 3).

(Sources: Schaap and Pavey 2003; Narain 2004; Kazbekov and Yakubov 2010)

Kairakkum Reservoir. Tajikistan lifts water from the reservoir and the river for supplying agriculture in Sughd Province. These lift stations and canals interact with the STTs that come from the Kyrgyz mountains (Wegerich et al 2012c). Thereafter, the river flows again into Uzbekistan and across southern Kazakhstan, before reaching the Aral Sea.

During Soviet times, there was a preference for crops in the downstream plains and more limited crops and animal husbandry in the upstream mountains. Although an extensive network of water management infrastructure exists downstream, there is little water management control in most upstream parts of STTs. The large upstream dams that are found in a half dozen STTs are often poorly maintained, because their primary purpose was usually to provide water for downstream agriculture (De Martino et al 2005).

Agriculture is essential for the economy in the Syr Darya basin and is almost entirely dependent on irrigation (De Martino et al 2005). Yet nearly 79% of water is lost due to infrastructure deterioration compared with an average of 60% in developing countries (Sharma et al 2004). Such water losses have led to a higher water table, with significant increases in waterlogging and salinization of arable lands (Savoskul et al 2003).

The Khojabakirgansai Basin

The Khojabakirgansai is approximately 117 km long and has a catchment area of 1740 km^2, the vast majority of which lies in the upstream Leylek District of Kyrgyzstan (Kazbekov and Yakubov 2010). The upper reaches of the basin are at 5000 m and the lower reaches are at 300 m. Upon flowing into Tajikistan, the river encounters the largest structure on its course, the Plotina Dam. The dam is used from March through October to divert almost all water into the large Khojabakirgan Canal for irrigation in the B. Gafurov and J. Rasulov Districts (Figure 2).

In 1992, the 5 newly independent Central Asian states (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan; a riparian of the Amu Darya, Afghanistan, was not included) formed the Interstate Commission for Water Coordination for the Aral Sea basin, and reaffirmed all Soviet-era water agreements. The Khojabakirgansai agreement, signed in 1962, stipulates that the annual flow of the river be divided 79% for the Tajik and 21% for the Kyrgyz part of the basin.

The basin is arid, with 5427 ha of land dedicated to irrigated crops upstream and 14,205 ha downstream (Kazbekov and Yakubov 2010). A large reservoir at Ak Took, Kyrgyzstan, has been discussed since the 1970s but lacks funding. Data about the dam is hard to obtain, but plans apparently exist and, if implemented, would reportedly more than double irrigated lands upstream (interview with district-level water managers, Kulundu, Kyrgyzstan, 19 May 2011).

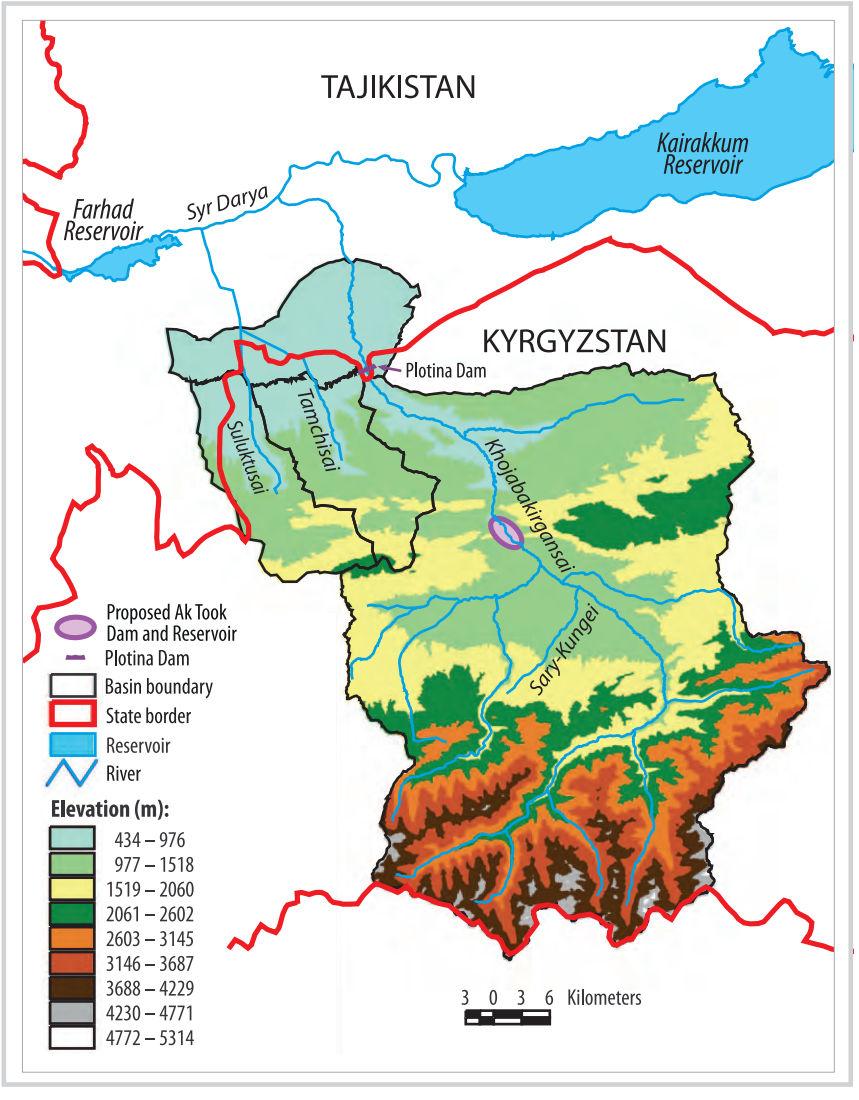
The steadily increasing population of the basin is overwhelmingly rural, with approximately 34,000 people living in the Kyrgyz part and 114,000 in the Tajik part (Kazbekov and Yakubov 2010). A mix of ethnicities coexists in the basin, predominantly Kyrgyz, Tajiks, and Uzbeks. Any mention, therefore, to the "Tajik" or "Kyrgyz" part of the basin refers to political, not ethnic boundaries.

Families who live in the basin are dependent on agriculture as a source of sustenance and income, with every household surveyed having cropland and/or a home garden. Orchards are also prevalent, and animal husbandry, especially upstream, is widely practiced. A reliance on agrarian livelihoods makes basin inhabitants especially susceptible to water variability. Learn more about basin WUAs in Box 1 and Figure 3.

Climate change impacts in Central Asia

Data from official Tajik and Kyrgyz government reports show that increases in temperature range from 0.3–1.2°C

FIGURE 2 Khojabakirgansai Basin. (Map by Alexander Platonov, 2011; courtesy of The International Water Management Institute)



from 1950 to 2005, depending on the weather station. Given the higher temperatures, glaciers have been melting in Central Asia at a rate of 0.2–1% per year since the late 1950s. This has resulted in an overall 15% decrease in glacier volume in Tajikistan and Kyrgyzstan (Tajikistan 2008; Kyrgyzstan 2009). Modeling projects that glaciers will continue to retreat at least through the middle of the century, and will leave unstable terminal moraines filled with meltwater that have the potential to burst and cause catastrophic flooding (Bernauer and Siegfried 2012). Snow cover has decreased by as much as 15% in the past 20 years and reduced seasonal water storage (ZEN 2009).

Based on climate and water modeling in the Syr Darya basin, changes in river flow patterns are expected, with the flow pattern peaking more sharply, higher, and earlier in the year, before tapering off below baseline levels (Figure 4) (Savoskul et al 2003) or peaking lower and earlier in the year before tapering off below baseline levels for most of the growing season (Bernauer and Siegfried 2012). Models concur on an increase of precipitation intensity, but a decrease in overall runoff, estimated at a loss of 20% over the next 50 years (Westphal 2008; Kokorin 2008).

Climate change impacts in the Khojabakirgansai Basin

In paralleling some of the runoff factors described in Kohler and Maselli (2009), our field research on local stakeholder perception of climate phenomena and their impact on seasonal water supply, droughts, and flash floods in the Khojabakirgansai basin is summarized in Table 1. We found that such processes and impacts are

FIGURE 3 Water User Associations and Farmers' Associations in Khojabakirgansai Basin in 2010. (Map by Alexander Platonov, 2011; courtesy of The International Water Management Institute)

FIGURE 4 River flow projections from 2 models for the Charvak Basin, 2010–2039 and 2070–2099, compared with 1961–1990 baseline average. (Redrawn based on Savoskul et al 2003, with kind permission from the publisher)

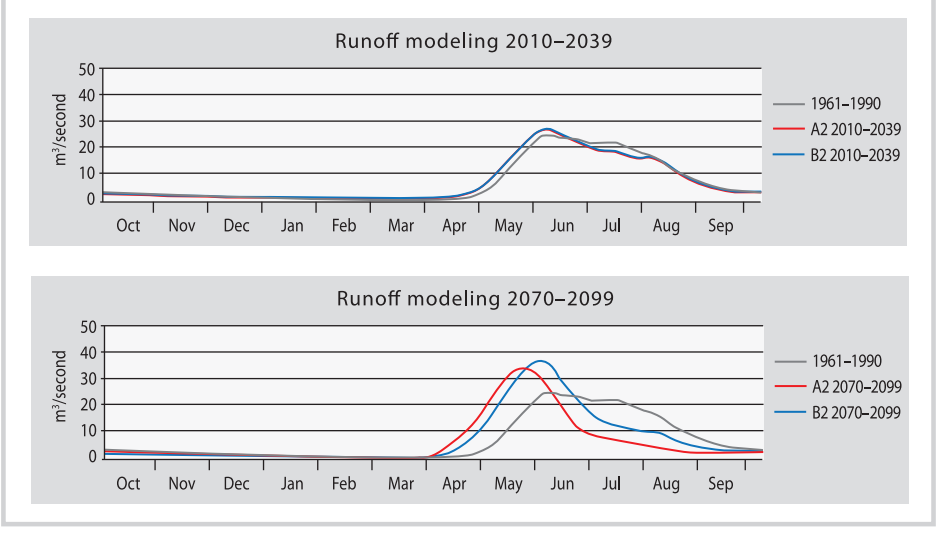


TABLE 1 Local stakeholders' perception of climate change-related phenomena and impacts.

Season	Climate change phenomena	Impacts
Winter	Warmer; decreased snowfall and snowpack	Decreased river flow in growing season; decreased water for crops
Spring	Warmer; precipitation that used to fall as snow falls as rain; increased intense rainfall; peak number of flash floods and increased number of flash floods	Increased variability of beginning of growing season; flash floods erode streambed and cause siltation, damage canal infrastructure, bridges, and home gardens, and sweep away livestock; fear of damage to homes and Plotina Dam; delays in ability to repair canals and access water; decreased water for crops
Summer	Warmer; continued flash floods; decreased and more variable rainfall; decreased and more variable river volume; highest temperatures and lowest monthly rainfall; increased frequency of droughts; increased evapotranspiration from water bodies and soil	Continued damage from flash floods to canal infrastructure, bridges, and home gardens; livestock swept away; fear of damage to homes and Plotina Dam; delays in ability to repair canals and access water; increased frequency of droughts; parched earth no longer absorbs rains well, increasing severity of flash floods but decreasing soil moisture; decreased water for crops
Autumn	Warmer; decreased runoff; high temperatures and low rainfall	Low river flow; continued evapotranspiration; decreased water for crops

most commonly attributed to the weather, water supply, water accessibility, and/or Allah's will, but rarely to "climate change" as such.

Concurring with the modeling in the section above, data collected upstream at Andarkhan, Kyrgyzstan, indicates that average annual river volume of the Khojabakirgansai decreased from 340 million m^3 in 1945 to less than 300 million m^3 in 1995 (Figure 5, blue trend line). If this trend continued, then the 2012 annual volume would be approximately 286 million m^3, more than a 15% loss since 1945.

Upon closer examination of decadal averages, the river volume did decrease steadily from 1946–1985, with the lowest period being 1976–1985, at 300 million m^3. For 1986–1995, however, it increased to 311 million m^3. Given the lack of hydrological and meteorological data from the mid 1990s onward, we can only conjecture that this change may be due to accelerated glacial melt and/or changes in precipitation patterns.

What is clear from the historical hydrological data is that the variability of annual river volume has been increasing, with the 2 highest and 2 lowest years all within the final recorded decade, 1986–1995. High-volume years are as much as 29% above the average flow of 315 million m^3 and low-volume years as much as 39% below average, representing a potential range of 213 million m^3 in any

FIGURE 5 Trends in Khojabakirgansai annual volume, 1945–1995. (Graph based on data from Rysbekov 2008)

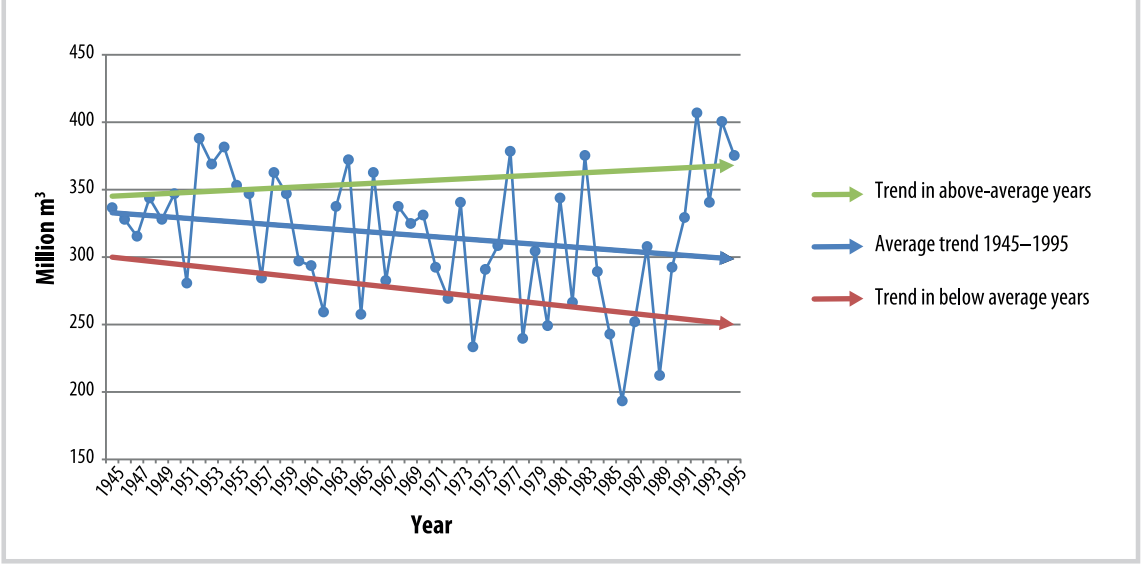
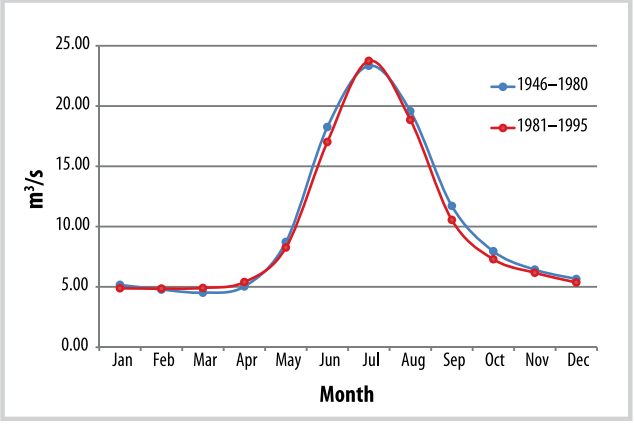


FIGURE 6 Changes in monthly Khojabakirgan river flow. (Graph based on data from Rysbekov 2008)



given year. The green line in Figure 5 shows the trend in above-average volume years and the red line shows the trend in below-average years. According to our household surveys, variability has continued to increase from the early 1990s to the present.

Changes in monthly river-flow averages are not statistically significant for the period 1946–1995. The direction of changes, however, is consistent with a sharpening of the seasonal river-flow pattern in the basin (Figure 6). For similar results regarding the neighboring Zeravshan basin, see Olsson et al (2010).

Our basin household surveys, consistent with the regional meteorological data and model projections, pointed to greater precipitation intensity and variability, with increases in both dry periods and heavy rains. Households reported that snowfall has been decreasing over the past 20 years, whereas rainfall has been increasing during the winter months and into the early spring.

Expert interviewees unequivocally identified heavy rains as the primary cause of flash floods, with severe ones reported over the past 20 years in 1992, 1993, 1998, 2003–2005, and 2007–2011. By reinforcing models and household observations, data collected in the parallel Isfana river from 1987–2010 demonstrate that the annual number of flash floods is steadily increasing, particularly in March, April, and May (Solijonov and Karimov 2011). Mismanagement of upstream pastures and deforestation may also be contributing factors to increased severity of flash floods and erosion.

In addition to increases in floods, all interviewees reported severe droughts across the basin over the past 20 years, in 2000, 2001, and 2008. Interviewees also reported droughts in 2003, 2007, and 2011. These droughts tend to be felt most acutely during the growing season, with June, July, and August as the hottest months and July, August, and September as the driest. In addition to the lack of rainfall, an increase in temperature leads to greater evapotranspiration from the river, canals, and soil.

Increasing water demand

In addition to the "natural" impacts of climate change on the water supply, several important social and technical processes cause an increase in demand for water in the basin combined with inefficient water usage and decreased accessibility. Our household surveys and expert interviews show that, over the past 20 years, demand for water has increased due to population growth and expansion of croplands upstream. Interviewees indicated that water losses occur due to increased subdivision of existing croplands and related inefficiencies across the basin, including more earthen canals and increased numbers of inexperienced farmers. The area of irrigated lands in the Tajik part of the basin has remained constant since independence, at approximately 14,205 ha, whereas, in the Kyrgyz part of the basin, it has increased from 4732 to 5031 ha.

Although flash floods may bring a lot of water down the riverbed, it is of little use to farmers, because they cannot channel it to their fields. On the contrary, canals that are built to divert water directly from the river, especially in upstream Kyrgyzstan, are susceptible to being damaged and often remain in a state of disrepair due to a lack of funding. Diversions during maintenance work are not possible. Furthermore, livestock can be swept away and fields near the river damaged. Canals that rely on a pump are susceptible to technical malfunction and electricity outages.

The situation is a bit different at the Plotina Dam, where the river enters Tajik territory. If Tajik personnel are warned, then the dam is opened to allow flash floods to flow through instead of damaging the water infrastructure. With little water in the lower reaches of the river, however, flash floods that are let through have washed out the riverbed and destroyed bridges. In sum, trends show a decreasing and more variable supply of water, increased occurrence of flash floods, an increasing demand for water, and significant water losses, which results in mounting pressures on agriculture, basin inhabitants, and the environment.

Adaptation through cropping and orchard choices

Due to land reforms and the cessation of the state order of crops in Kyrgyzstan and recently to some extent in Tajikistan, farmers have a greater say in what they plant, which has contributed to changes in cropping patterns (Schaap and Pavey 2003). Our household surveys suggest that cotton, wheat, corn, and onions are currently the main crops downstream and that wheat, corn, sunflowers, and potatoes are the main ones upstream.

In the households we surveyed in Tajikistan, there was a drop over the past 20 years in the planting of cotton and an increase in onions. In the households in Kyrgyzstan, sunflowers decreased, whereas wheat increased;

TABLE 2 Overview of cooperative climate change adaptation strategies.

Impact	Category[a)]	Adaptation strategy
Water scarcity	Conventional	Allocate water according to 1962 basin water-sharing agreement
		Rotate water between districts, WUAs
		Ration water within WUAs
		Clean and repair canals
	Precautionary	Plant less water-intensive crops
	Regenerative	Expand orchards
		Integrate IWRM principles into institutions, practices
Drought	Conventional	Use drought-resistant seed varieties
		Plant less water-intensive crops
		Do not plant a second crop
Flash floods	Conventional	Clean and repair canals
		Early warning calls

[a)]Allan and Karshenas (1996).

furthermore, upstream interviewees reported that rice production decreased significantly since its peak in 1999. Although multiple factors contribute to planting decisions, these initial findings suggest a shift away from water-intensive crops. Reasons for these changes may include market prices for crops, preference for subsistence crops, and/or adaptation to reduced availability and access to water.

The most widespread orchard tree varieties in surveyed downstream households are apricot, cherry, apple, and persimmon and, in upstream households, are apricot, apple, cherry, and walnut. Orchard yields seem to be faring better than crop yields over the past 20 years, with 45% of households reporting increases (compared with 30% for crops), and 21% of households reporting decreases (compared with 38% for crops). Orchards themselves appear to be expanding, with a 6% increase in the number of trees downstream and 17% upstream; the latter likely in part due to expansion of irrigated upstream lands. Given their deeper root system and their capacity to regenerate the soil, fruit trees may have a better capacity to withstand water scarcity and processes that would otherwise decrease soil fertility. On one farm we visited downstream, a half hectare of land had been reportedly reclaimed from the washed-out riverbed by methodically planting advancing rows of trees over a 50-year period.

Cooperation strategies for adaptation to extreme events in the Khojabakirgansai Basin

We heard consistent reports in both Tajikistan and Kyrgyzstan of good cooperation on water management within and between communities, WUAs, districts, and nations, including across ethnic identities. What appears to be a clear upstream–downstream riparian relationship, however, is actually more nuanced. There is a small portion of downstream Kyrgyz territory that receives water from the Khojabakirgan Canal (after it has passed through Tajikistan), and another that receives water from the Kairakkum Reservoir in Tajikistan. This might already create an incentive for cooperation across the national boundary, as tit-for-tat measures are reportedly taken. This situation also occurs in other STTs in the Ferghana Valley, but more research and comparative studies are necessary to improve understanding.

Although it is important to acknowledge and build on cooperation, it will likely be put to the test in the coming decades by the population growth and climate change trends described above. We must also not take for granted that cooperation always leads to regenerative or even precautionary adaptive strategies. This section, therefore, assesses cooperative strategies according to Allan and Karshenas' framework (1996) of whether they take a conventional, precautionary, or regenerative approach. An overview is provided in Table 2.

At the transnational level, working groups of the respective Ministry-appointed National Water Commissions meet each winter and make water allocation decisions that seek to uphold the 1962 water-sharing agreement. This agreement is inherently conventional, which leaves little to no water for the environment during the cropping season (21% for the Kyrgyz part of the basin and 79% for the Tajik part annually). In periods of extended water scarcity, especially during March, April, May, and the rest of the cropping season, water managers from the Tajik part of the basin go across the border to

FIGURE 7 In the upper part of the watershed, stonewalls have been constructed to protect homes close to the riverbank from flash floods. Khozho-Bakyrgan WUA, Kyrgyzstan. (Photo by Dominic Stucker, 2011)

their Kyrgyz counterparts and request that more water be allowed to flow to their fields for 3 days at a time. Although their counterparts have reportedly always complied with downstream demand, this type of water use ensures that as much water as possible is directed toward agriculture.

Similarly, water rotation occurs among the 3 WUAs in Kyrgyzstan as well as between the B. Gafurov and J. Rasulov districts in Tajikistan, alternating every 3 days during the cropping season. A water rotation agreement also exists between the densely populated Gulakandoz WUA and those further up the Khojabakirgan Canal, in which half of the water flows to Gulakandoz. Within WUAs, irrigation water is carefully rationed, with *mirobs* (water masters) enforcing agreements.

Both upstream and downstream at the WUA level, community members prepare for water scarcity by cleaning out and repairing canals through *hashar* (community volunteer projects). Maintenance work is rarely sufficient, however, partly due to the long conveyance canals from the river to the fields. If properly maintained, benefits would include more efficient water delivery to crops and avoidance of waterlogging, which decreases soil fertility and can cause salinization. Whereas maintenance would otherwise be a precautionary approach, under the current paradigm the irrigation infrastructure is meant to channel as much water as possible to agriculture, which leaves little to help regenerate the basin's environment.

In drought years, farmers in the basin often plant less water-intensive crops, such as clover or wheat, in addition to using drought-resistant seed varieties. When a drought is severe, the farmers often refrain from planting a second crop, which usually consists of vegetables, after they harvest their main crops. Farmers then have to rely more heavily on their livestock and orchards for sustenance. Under other circumstances, these strategies could be considered precautionary, but, during times of drought,

households are focused on survival, not regenerating natural capital.

Flash floods occur most frequently in the basin in April, May, and June. As above, preparation for flash floods in both Tajikistan and Kyrgyzstan includes using *hashar* in the months of November–March, when the canals are empty to clean and repair them. In this case, repair is meant to fortify the canals from damage that they may incur from stones and debris carried by the next floodwaters. Repair also includes clearing and repairing existing offtakes. Sometimes, it is possible to borrow machinery from other WUAs and private individuals to reinforce the riverbanks and to dig runoff canals.

When heavy rains start, transboundary early warning calls are made from water managers in the Kyrgyz part of the basin to colleagues, mayors, farm managers, and/or friends downstream. Local governments have provided some phones for this purpose. The early warning calls give downstream WUAs approximately 2–4 hours to prepare by opening side or parallel canals and by opening the Plotina Dam. The early warning calls allow disaster support groups, especially in the upstream Khozho-Bakyrgan WUA to warn households near the river.

After the intensity of a flash flood subsides, it is sometimes possible to borrow machinery and/or get financial support from individuals, the local government, international aid agencies or the respective Ministry of Emergency Situations to help clean out and repair canals. Tajiks have responded to requests to come upstream with their machinery to help clean out and repair nearby canals and numerous micro dams after flash floods. On the Kyrgyz side of the basin, one WUA reported that they have set aside a reserve fund for these situations, which can help cover fuel and driver costs. Also, the Ministry of Emergency Situations and the French Agency for Technical Cooperation and Development have provided 1-m^2 wire cages that are filled with river stones and are used to reinforce weak riverbanks and protect nearby homes (Figure 7). On the Tajik side, the Gulakandoz WUA reported that Mercy Corps helped them restore damaged canals after a 2005 flood.

Discussion and conclusions

Given climate change and population trends, the conventional approach is untenable, demonstrating little adaptive capacity. The focus is on survival from year to year, an understandable preference for ensuring short-term human wellbeing over long-term regeneration of the environment. A precautionary approach espouses behavioral change and/or technical fixes to improve water-usage efficiency, seeking to bring consumption and supply into balance. A precautionary strategy that we identified is planting less water-intensive crops when there is no drought. If adopted widely, then this could decrease agricultural demand for water. As mentioned above, canal repair and maintenance also has the goal of improved water usage efficiency, but, if not accompanied by a paradigm shift in how water should be used, then this remains a conventional approach.

A regenerative approach goes beyond adaptation, mitigating some of the impacts on the basin through, for example, expanding orchards and applying integrated water resources management principles in water institutions. The former increases soil fertility, decreases erosion, and, if adopted widely, could improve the basin's environment. The latter promotes bottom-up participation of water users in governance and management, which can lead to more efficient and equitable water use, and improve system performance (Uphoff and Wijayaratna 2000). Unless a paradigm shift from conventional to regenerative, or at least precautionary, approaches is achieved, natural capital, especially water and land, will degrade, living standards will decrease, and/or people will have to leave agriculture, often migrating for work (Stucker 2009). For long-term sustainability, this paradigm shift needs to happen at the local and global levels by ensuring both adaptation to and mitigation of climate change.

In the Khojabakirgansai basin, climate change contributes to a decreasing and more variable water supply, subdivision of agricultural lands and deteriorating infrastructure have increased inefficiencies, and population growth and upstream expansion of irrigated crops have increased demand. These developments have increased pressure on water resources, basin inhabitants, and the environment. Analysis of our research shows that communities, WUAs, districts, provinces, and national water bodies cooperate locally and across national and ethnic boundaries in response to water scarcity, droughts, and flash floods. The outcomes of cooperation, however, do not always improve the basin environment or living standards, and cooperation is likely to be strained in the coming decades by climate and population trends, among other issues.

Recommendations

Based on our research, we offer the following recommendations. First, future studies and projects in the Khojabakirgansai should build on current cooperation and local perceptions of climate change. Second, the purpose of the proposed upstream dam and reservoir should be jointly revisited. Although the reservoir was originally anticipated to create additional irrigated land in Kyrgyzstan, a *conventional* approach to water management, the primary purpose of the reservoir, if it is constructed, should be to enable more water control of the increasingly variable basin hydrology, a *precautionary* approach. This could simultaneously assist in mitigating flash floods and storing water for periods of scarcity, which benefit both riparian states. In parallel, *regenerative* measures aimed at

improving the basin environment should be jointly envisioned and undertaken, for example, further expansion of orchards and large-scale afforestation. Third, we encourage the establishment of a permanent basinwide institution or platform, representing diverse upstream and downstream stakeholders, and making it easier to agree upon, plan, and implement local development priorities. Such an institution could help improve data collection and sharing, build trust, and work effectively to expand cooperation on extreme events and regenerate the environment. The respective processes toward this are currently underway at both local and national levels, with support and facilitation from a number of donors and implementing agencies.

ACKNOWLEDGMENTS

Our research was conducted within the framework of the on-going Integrated Water Resources Management in the Ferghana Valley Project. The International Water Management Institute (IWMI) is implementing the project in partnership with the Scientific Information Center of the Interstate Commission for Water Coordination. The United States Agency for International Development, the Swiss Agency for Development and Cooperation, and the Brown International Advanced Research Institute funded this research. We are very grateful to all research participants for responding to our survey and engaging in interviews. Contacts in the field, especially Mamurjon Saidahmadov and Abduhakim Abdusaminov in Tajikistan and Salimjon Jalilov and Akjol Holbekov in Kyrgyzstan, were essential for helping arrange interviews and our stakeholder workshop. We thank talented field interpreter Umedjon Gufranov and the local families in Tashkent, Yova, Kulundu, and Katran who generously hosted us.

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Mountain Research and Development (MRD)
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Reconciling Sustainable Development of Mountain Communities With Large Carnivore Conservation

Lessons From Pakistan

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While the world is becoming increasingly interconnected and interdependent, physically and culturally, the wildlife of remote mountain regions is being affected both positively and negatively by such interconnectedness. In the case of snow leopards, the conservation impact has been largely, and rather unexpectedly, positive: Species-focused conservation projects, such as Project Snow Leopard (PSL) in Gilgit-Baltistan, remain mainly externally driven initiatives. PSL, initiated as a small pilot project in 1998, has relied on an approach that includes the use of an insurance scheme, the deployment of mitigation measures, and the empowerment of local governance. This approach has been successful in reducing the conflict with snow leopards and has built greater tolerance toward them. PSL is managed by local communities and cofinanced by them. PSL communities throughout the region are bearing the burden of carnivore conservation, and they are unwittingly subsidizing their populations by "feeding" them their livestock even though they are an economic threat to them. In this article, we argue that external intervention in the form of efforts that help alleviate the consequences of conflict through local empowerment have had a positive impact on the local mountain societies. We also show that such interventions have resulted in tangible conservation results, with the number of snow leopards staying at least stable. Our experience also shows that while the incentive component is critical, it is also part of a larger approach—one that includes developing and supporting local governance structures, improving access to education, and offering a range of tools to reduce the conflict that can be implemented locally. Finally, we suggest that investing in this approach—one that recognizes the species and local-context complexities surrounding the implementation of conservation incentives—can continue to inform international practices and guidelines for reducing human–wildlife conflicts worldwide.

Keywords: *Carnivores; conflict; conservation; incentives; livestock; insurance scheme; community empowerment; Pakistan.*

Peer-reviewed: *April 2012* **Accepted:** *June 2012*

A geography of conflicts

In a region where three of the world's highest mountain ranges—the Himalayas, the Karakorams, and the Hindu Kush—collide, in Gilgit-Baltistan of northern Pakistan, small independent communities eke out a living. The incredible geographic variation found there has led to an equally diverse assemblage of biodiversity, ethnicities, and languages due to the region's isolating mountains and remote location. Because of the importance of natural resources to small mountain communities in this region, it is also a critically important conservation landscape. These small mountain communities are faced with many challenges: the severity of the geography, their isolation, the absence of access to external markets, and the threat of natural disasters that strike with little or no warning (Kreutzmann 1993; Uhlig and Kreutzmann 1995; Edwards 2006).

Compounding some of these effects, the mountains and valleys where these communities live are also home to two carnivores, snow leopard and wolf, which prey upon domestic livestock, often causing economic damage and threatening village-level food security. For these communities, livestock is an important component of their livelihoods and in many cases the major one (Figure 1). Retaliatory killing often occurs in response to the depredations that herders suffer. A decline in the availability of wild ungulates, a key component of the snow leopard diet, due to extensive hunting practices has caused a significant shift in predation pressure toward

FIGURE 1 Yak on one of the summer pastures of Hushey. (Photo by Tanya Rosen)

domestic stock. While Himalayan ibex *(Capra sibirica)* and in some areas *markhor (Capra falconeri)* remain important food staples, along with other small mammals and birds, snow leopards feed to a large degree on domestic livestock, including yak, goat, and sheep (Mishra 1997; Anwar et al 2011).

Depredations occur mostly in the winter, when snow leopards break into corrals and barns, and in June, when livestock's arrival on the high summer pastures coincides with the increasing dietary demands of a snow leopard feeding cubs. A heavy government penalty for killing snow leopards makes farmers reluctant to tell outsiders about any killings, thus making it hard to determine how many snow leopards are actually being killed due to human–wildlife conflict. However, in many situations snow leopards have been caught alive and local farmers have specifically sought the assistance of local conservation organizations to help release the leopards back into the wild.

Based on interviews (Hussain 2003), many farmers and communities have understood that they could benefit from protecting the snow leopard rather than killing it. The loss of livestock to snow leopards is a random risk: a snow leopard does not choose the owner of the animals it kills. Therefore, over the years, the probability of being hit by such a loss is randomly but evenly distributed among the farmers, a pattern that is most pronounced on summer pastures where the livestock herds are managed communally by a pool of men or women.

This has emerged as a powerful argument in favor of collective coverage of farmers' individual risk, which led to the launch in 1998 of a pilot project in Skoyo, in the Rondu valley, called Project Snow Leopard (PSL). PSL's approach relied on the idea of setting aside a collective pool of money equal to the value of the average annual loss rate. This would allow the community to spread the risk and reduce the impact of losses. The project also increasingly relied on a broader approach extending beyond an insurance scheme to the deployment of mitigation measures, such as the use of predator-proof corrals, and community empowerment, through the establishment of Snow Leopard Conservation Committees that effectively manage the project.

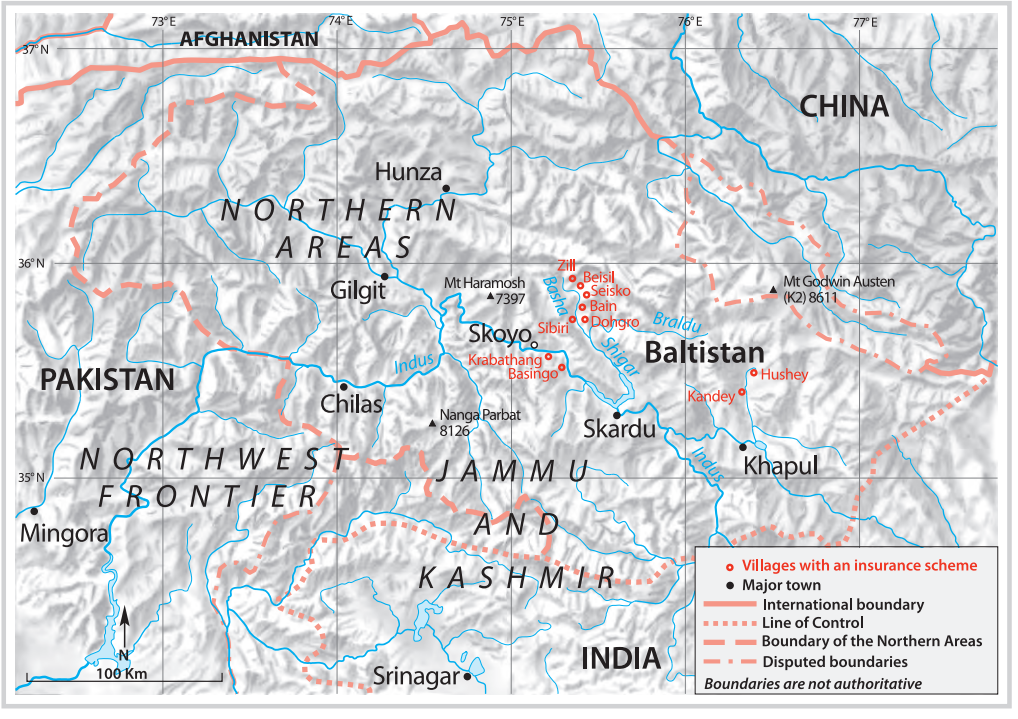
Thirteen years later, the project has expanded into 10 villages in 3 valleys (Figure 2) and has enjoyed a good share of success in reducing conflicts with snow leopards by building greater tolerance toward them. The affected communities of Gilgit-Baltistan have understood the value the international community places on snow leopard; they have adapted by largely accepting the presence of snow leopards and are now participating in a mutually respectful partnership that merges local and global worldviews of conservation and more harmonious coexistence with carnivores.

In this article, we briefly discuss the literature on the incentives deployed as a tool for building support for carnivore conservation; we also describe the evolution of PSL, its expansion and impact on the local snow leopard population, and socioeconomic changes in the villages. We discuss challenges faced, limitations of the current approach, and opportunities for further improvement. Finally, we highlight the influence of PSL on carnivore conservation efforts in mountain communities worldwide.

Human–wildlife conflicts: Are incentive measures effective?

Conflicts between humans and wildlife are escalating, as human activities and wildlife increasingly encroach upon each other. Conflict arises when wildlife species,

FIGURE 2 Map of the region, with location of villages with an insurance scheme. (Map based on original map by Andreas Brodbeck published in Hussain 2000: 227)



particularly carnivores, pose a real or perceived threat to life and property. Myth, folklore, religious, and economic convictions create a powerful incentive among humans to resolve this conflict by eliminating the species in question. Wolf eradication in the United States is a prime example of this (Coleman 2004). Attitudinal studies show that people with negative attitudes toward certain wildlife species are more likely to respond to future damage by retributive killing or supporting killing by others (Don Carlos et al 2009; Liu et al 2010); as a result, they may contribute to the decline of these populations (Kellert et al 1996; Ogada et al 2003). That makes human–wildlife conflicts one of the key drivers of biodiversity loss, along with illegal trade in endangered species parts (World Bank 2005; Simms et al 2011) and ongoing habitat loss. Policies and laws seeking to address conservation by creating protected areas and conservation corridors have occasionally exacerbated such conflict, often by ignoring the needs of local people and the impacts on livelihoods by proposed measures aimed at exclusively protecting wildlife.

As the Convention on Biological Diversity, at its 10th Conference of the Parties in 2011, has come to recognize, there is a need to develop best practices to address conflicts among biodiversity conservation, sustainable use, pastoralism, and agriculture.

In developing these best practices, there is ample literature on incentives devised to promote carnivore conservation (Ciucci and Boitani 1998; Ferraro and Kiss 2002; Cilliers 2003; Hussain 2003; Mishra et al 2003; Agarwala et al 2010). However, reducing conflict with carnivores and increasing their acceptance by pastoralists rests not only on implementing the right set of incentives but also on identifying the appropriate local context-relevant incentives in combination with empowering local decision-making processes. Initiatives and lessons that put conservation more in the hands of those people negatively affected by human–wildlife conflicts empower them and thus are more likely to have beneficial and lasting conservation impact.

However, a tacit aversion to compensation as an incentive for reducing human–wildlife conflict remains entrenched within many conservation institutions, both nationally and internationally. This is due to the poor performance of some compensation programs that either inadequately compensate people for losses or do not sufficiently protect wildlife. For instance, in government-run programs, the typical lengthy and time-consuming procedures for payouts make it difficult to file claims, and governments have little capacity to verify claims. In addition, the low amounts paid to claims make most compensation programs ineffective (Mishra 1997; Jackson and Wangchuk 2001) and may result in intensified human–wildlife conflict.

Criticism of compensation schemes does not change the basic fact that conservation costs and benefits are unevenly distributed and that such discrepancy must be resolved if wildlife are to be conserved. Verdale and

Campos argue that compensation should be seen as a subsidy that society should pay for "keeping the wildlife alive" (2004: 3). Nyhus and Tilson, reporting on tiger–human conflict from the Sumatra region in Indonesia, suggest that "If carried out effectively, compensation can shift the economic responsibility for carnivore conservation away from farmers toward the supporters of carnivore conservation" (2004: 72).

Madhusudan noted that in rural southern India, villagers "seem willing to make small investments to protect their livestock and crops from wildlife" (2003: 474). Studies also indicate that small farmers' tolerance toward wildlife increases as their losses are compensated (Ogada et al 2003; Holmern et al 2007). In contrast, Lamarque et al (2009) wrote that the International Union for Conservation of Nature's African Elephant Specialist Group and Human–Elephant Conflict Task Force also advise against using compensation for elephant damage and argue that it can only at best address the symptoms and not the cause of the problem. Similarly, Naughton-Treves et al (2003) noted that farmers in the western United States who were compensated by the federal or state government for their losses were not entirely satisfied. They report no difference in attitudes toward wolves among ranchers who had received compensation and those who did not.

Beyond the recognition that the dynamics of addressing conflicts in the United States bear many differences with those in Central Asia, what makes the conflict more intractable in parts of the United States and incentive measures likely less effective is the possibility that such conflict has been heavily litigated in the courts, rather than on the ground by working closely with ranchers, engaging them as stakeholders, and recognizing that their livelihoods are deeply affected by the wildlife that such laws seek to protect. The US compensation programs—implemented to correct economic losses suffered by ranchers from wolf and bear depredation of cattle and intended as incentives for coexistence—were not perceived as such by some ranchers, who viewed the compensation program as offending the value of ranching. Rather than seeing the survival of these species at risk, ranchers are angered by regulations and the protection offered brown bears and wolves under the Endangered Species Act.

Finally, many studies of human–wildlife conflict focus on local people's attitudes toward wildlife. Perhaps an equally insightful study would be to assess local people's attitudes toward conservationists and the role of conservation institutions. Such a change in focus would highlight the dissonance between the meaning and significance of wildness to local societies and to outside conservationists. Nowhere is this disjuncture more prominent than in the debate over how to resolve the conflict between rural herders and snow leopards.

PSL, started as a species-focused conservation project, was mainly externally initiated. It was driven by the desire to help local communities adapt to living and raising livestock in the presence of snow leopards. However, participating communities rapidly took ownership of the project and recognized the value of conserving the species as a way of improving their livelihoods. While the financial incentives provided under the insurance scheme play a critical role, the increased exposure to exchanges and interactions with foreign visitors and organizations have not changed the way local farmers in Baltistan view snow leopards but at least shed light on how the rest of the world sees them: not as a nuisance but as a highly charismatic species. This gradual awareness by the local communities of how snow leopards are perceived worldwide, coupled with a sense of ownership of the project, has created a new dynamic of acceptance of the presence of this carnivore.

PSL: Assessing progress 13 years later

In Pakistan, snow leopards occur throughout the mountains of the Northern Area, with an estimated population totaling around 400 individuals (Hussain 2003). As already mentioned, snow leopards often kill domestic livestock, thereby threatening livelihoods of local farmers who generally retaliate by killing the suspected predator. The typical local farmer in northern Pakistan is poor, with an average annual per capita income around US$ 400. A large majority of the local community are agropastoralists, and their livestock represents a significant asset in their overall economic holdings (Ives 2001; Kreutzmann 2005). In addition, livestock plays a key role in the household economy of local people by insulating them against unexpected times of scarcity. These farmers demand that those calling for protection of the snow leopard provide the means to compensate them for any financial loss they have to bear because of these predators. Consequently, they look to state, national, and international conservation institutions and to private entities for such support. Given that there are legal prohibitions against killing of wildlife, even though the laws are hard to enforce, the demands of the villagers are genuine. Retaliatory killing of snow leopards often results from a rational choice by local farmers: They are unwilling to subsidize the well-being of a rare animal because it causes economic losses to them. This kind of scenario sets the incentive structure within which the human–wildlife conflict is framed. The farmers have a strong incentive to kill a snow leopard and thus safeguard their livelihoods yet have no incentive to conserve it.

The main component of PSL is a community-managed and community-operated village-based livestock insurance scheme against losses arising from snow leopard predation. PSL's approach and design of the insurance scheme has been described in detail by Hussain (2000; Box 1).

BOX 1: How the insurance scheme works

All households in the participating village take out an insurance policy on their livestock; this is how it works:

- The premium rate is set at 1% of the small livestock's (ie sheep and goats) current market value. The justification for this rate is based on surveys conducted by PSL that show average annual livestock loss to snow leopard in conflict areas is about 2% of the total herd size, or 2% of the financial value of an animal.
- The villagers' own premium payment covers about 50% of the costs of the average annual losses from snow leopard depredation.
- The remaining 50% cost is covered by PSL.
- Insurance premiums by villagers are paid annually by each livestock owner into Fund 1, which is managed solely by the villagers.
- A second monetary corpus, Fund 2, is established to help cover the remaining costs of any livestock losses to predators. This is financed through proceeds from grants solicited from various national and international donors.
- Fund 2 is kept in a separate account at the local bank and jointly managed by PSL and villagers.
- Premium payments deposited in Fund 1 are held collectively in a bank, with records of individual payments maintained separately within the village.
- The total premium amount of each member contributed through Fund 1 is based on the number of livestock owned.
- The model assumes that the average rate of loss will remain at 2% and that PSL will continue to generate funds to finance compensation payments, as well as the corpus for Fund 2 (Hussain 2000).

In addition to the insurance scheme, PSL implements—through separate funding—small-scale, community-based infrastructure initiatives and provides financial contributions for predator-proofing communal corrals, remote camera-trap monitoring of the snow leopard population, snow leopard diet and population studies using DNA, and improved access to education in the Basha valley as part of a broader incentive package for snow leopard conservation.

PSL expanded in 2004 into 6 villages, mainly in the Shigar and Basha valleys, and in 2006 into a total of 10 villages, the current number supported (Figure 2). Since 2007, PSL has paid out compensation for 184 animals, totaling PKR 360,000, or about US$ 4000 (January 2012 exchange rate). Since 2010, PSL has provided insurance to more than 400 households in 8 villages, insuring more than 3000 head of livestock. Local communities have paid more than PKR 160,000 (US$ 1695) in premium payments in 2010. Since 2006, some US$ 13,000 have been spent on corral improvement and small-scale infrastructure projects, with another US$ 4200 spent on education. The total area of snow leopard habitat in the PSL's project area is about 5000 km^2, whereas the total habitat of snow leopards in Pakistan is about 40,000 km^2.

Our research on population estimates based on extraction of DNA from fecal material (Anwar et al 2011) showed that at least 19 individual cats were represented in 49 confirmed snow leopard scat samples. This is a strong indication that the density of snow leopards in the area is approximately 0.38 snow leopards per 100 km^2. The research also showed that most of the biomass consumed (70%) was domestic livestock, including sheep (23%), goat (16%), cattle (10%), yak (7%), and cattle–yak hybrids (14%). Only 30% of the biomass consumed consisted of wild species, namely Siberian ibex (21%), *markhor* (7%), and birds (2%).

Participating communities responded positively to PSL's efforts. During 2010, we conducted a survey in the Basha valley (the villages of Sibiri, Zill, Bain, Seisko, and Beisil). We interviewed 79 individuals (mostly farmers, one hunter, and two porters)—all members of the Snow Leopard Conservation Committees of the participating villages. In the questionnaire administered, we asked 36 questions, including questions on the villages' livestock, the level of conflict experienced with snow leopards, their knowledge of killed snow leopards, and the impact of PSL on reduction in conflict and attitudes toward snow leopards.

Participants indicated that, over a period of 20 years before PSL started working in the valley, 205 snow leopards had been killed; 50% of them described current snow leopard conservation status as "good," with an additional 35% describing it as "satisfactory." In particular, 27 respondents indicated that this outcome resulted from the conservation efforts and that the cooperation with PSL "are good." Asked whether they "feel that the present snow leopard conservation efforts are better than the ones made earlier," 83.5% responded "yes." Specifically, 82.2% of the respondents noted that the ibex population had increased, and 79.8% indicated the snow leopard kills had decreased (PSL surveys, unpublished data 2010, available from corresponding author of this article).

During the summer of 2011, we followed up with a series of in-depth dialogues with the Snow Leopard Conservation Committees in the participating communities to understand their level of satisfaction with the insurance scheme and PSL's conservation efforts (Figure 3). We took ethnographic notes of the conversations and views expressed. Participating communities consider the project as their own and appreciate the support provided by PSL, now brought under the umbrella of the Baltistan Wildlife Conservation and Development Organization. One of the most tangible outcomes is the existence of an internal oversight mechanism, where the community acts to prevent fraudulent depredation reports or suspected violations of the core conditions for project participation, including a ban on illegal hunting of wildlife. Communities are becoming more proactive and increasingly assertive in influencing outcomes, and they take responsibility for these. In one instance, in the village of Beisil in the Basha valley, snow leopard conservation helped serve as a

FIGURE 3 Meeting with the Snow Leopard Conservation Committee in Hushey, Ganche Valley. (Photo by Tanya Rosen)

catalyst for bridging cultural and economic differences among factions within the community.

Snow leopards are no longer trapped, as used to be the case. A Swiss photographer who travelled to Hushey in 1987 to look for snow leopards wrote the following: "We were extremely disappointed to find a number of sliding-door traps, which the poachers used to trap and kill snow leopards. In fact, we later learnt that several snow leopards had been killed in these traps over the previous few years" (Eric Dragesco, unpublished paper April 2012, available from corresponding author of this article).

In socioeconomic terms, since livestock constitutes a great part of households' income, a reduction in conflict has translated into a decreased loss of income. The introduction of an education component in 2010, as an additional incentive for communities to accept the presence of snow leopards and allowing all girls in Sibiri, Seisko, and Beisil to have access to primary education, is likely to have a profound impact on these communities. Over the years, the hope is that these young, educated girls will promote a conservation ethic in their villages and beyond.

Challenges

A number of challenges have emerged over the years; PSL is trying to address them. While support for PSL activities remains strong, as highlighted previously, discussions with the Snow Leopard Conservation Committees have confirmed that some difficulties persist.

First, there is a shared view with the communities that conflicts between people and snow leopards can be reduced but never eliminated, because communities will continue to lose livestock to this predator. For the local people, their positive change in attitude toward a predator so that they view it as worthy of protection does not alter the reality that this species continues to negatively impact the domestic economy of livestock producers.

Second, with mountain communities becoming more accessible, herders may have easier access to potent tools for eliminating predators, such as poison and agricultural pesticides. Based on our 2010 survey, 20 snow leopards are known to have been poisoned around Beisil in the Basha valley. In the villages where PSL operates, there has not been an instance of a snow leopard being subject to chemical poisoning, although such poisons and pesticides have been intercepted by members of the local Snow Leopard Conservation Committees. The threat is thus real.

Third, some communities in the region have a trophy hunting program. In Skoyo, Basingo, and Krabathang, the stakes are high for the local conservancy because they can sell the trophy hunting permit for the prized and endangered *markhor* for several tens of thousands of dollars. With *markhor* being a prey item, the village of

 http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00008.1

Skoyo lost interest in conserving snow leopards and backed out of participation in the insurance scheme program. Such concerns about the effect snow leopards may have on populations of valued trophy species are not uncommon: in September 2011, similar negative feelings regarding snow leopard predation on *markhor* were expressed by a conservancy in Zighar, Tajikistan. The approach followed to reconcile snow leopard conservation goals with the sustainable use of a highly valued ungulate species involves educating the local communities on the ecosystem health role that predators like snow leopards play. There is also no proof in the concerned areas that snow leopard predation on *markhor* may affect the population to the point where the current quota for trophy hunting would be challenged.

Fourth, PSL has pursued a single-species approach centered on snow leopards. But wolves are increasingly if not, more than snow leopards, intensively preying on livestock. Accessing funding for wolf-related conservation or conflict-mitigation work is difficult, because the wolf does not carry the same conservation significance as the snow leopard does. According to the 2010 survey, four participants said the snow leopard's improved conservation status developed because the communities were united in their efforts. Asked specifically what they were proud of, 35% of them talked about "unity, peace, and absence of conflict" in the villages. However in a situation where livestock can only be insured against snow leopard losses and not against wolf-induced losses, divisions have emerged within the community, thereby potentially eroding support for snow leopard conservation. In Hushey in February 2011, one part of the livestock herd that escaped from a corral was killed by a snow leopard and the other by a wolf pack. In September 2011, in Zill, Basha Valley, 170 sheep and goats died as a result of such interaction with wolves. Finding ways to broaden the focus of the insurance program and obtain funding to support other incentive-based activities may have to be considered over the long term as a strategy for ensuring that all community members are participating in the conservation programs and that divisions do not compromise them.

Fifth, PSL has an ecotourism arm: a local trekking company called Full Moon Night Trekking (FMNT) (Hussain 2000) started to attract tourists willing to trek where snow leopards are and visit the villages where PSL is active. When established, the goal was for profit from ecotourism to be 100% devoted to subsidizing the insurance fund and for FMNT to hire guides from the project villages to generate local income. Unfortunately, because of the often more perceived than real security concerns in Gilgit-Baltistan, logistical difficulties in accessing the region (irregular flights from Islamabad to Skardu as an alternative to a 31-hour-long drive on the Karakorum Highway), FMNT so far has attracted few trekking tourists. The situation slightly improved during the summer of 2011. In the wake of the recent sectarian tensions in Gilgit-Baltistan, the outlook for the summer of 2012 remains unclear.

Conclusion

While the introduction of the insurance scheme has generated the goodwill of the local communities not to take retaliatory measures against predating snow leopards, not to kill the snow leopard prey illegally, and to be proactive about mitigating potential conflict, it is the use of mitigation measures, such as predator-proof corrals, that has contributed to a reduction of conflict (PSL surveys, unpublished data 2010, available from corresponding author of this article), especially in the winter in villages where such predator-proof corrals have been built. This leads to the assumption that the combined use of incentive schemes with the establishment of a sound governance and oversight body and of mitigation measures constitutes the most viable option for establishing the grounds for the coexistence of people and carnivores like snow leopards. While no baseline information exists on the status of snow leopards in the project areas prior to PSL's intervention, based on local knowledge, the population of snow leopards and its prey have increased.

PSL's innovative approach has inspired similar efforts in other regions (Gurung et al 2011). The Wildlife Conservation Society (WCS) launched a pilot insurance scheme project in the Wakhan corridor of Afghanistan (Simms et al 2011). Similarly, in western Montana, WCS and its partners are looking into ways of implementing modified versions of the insurance scheme to increase rancher tolerance for wolves.

The PSL's philosophy shows that cost-effective methods of compensating local farmers can be developed that are partly financed by the villagers and run efficiently with no reported frauds. The willingness of most farmers to share in the cost is reflective of their genuine intention to resolve conflict without having to eliminate wildlife. Human–wildlife conflict for many small farmers like those in northern Pakistan is essentially an economic issue, and one that can be effectively resolved through developing durable funding channels and local institutions for disbursing funds in a fair and inexpensive manner.

More importantly, what PSL's experience shows is that while the incentive component is critical, it is also part of a larger approach—one that includes developing and supporting local governance structures, improving access to education, and offering a range of tools to reduce the conflict that can be implemented locally. International practices and guidelines developed with a view of reducing human–wildlife conflict should recognize the species and local-context complexities surrounding the implementation of conservation incentives and broader initiatives and should promote local participatory approaches that seek to empower communities to coexist with wildlife.

ACKNOWLEDGMENTS

We thank the PSL villages for their tireless dedication to conserving snow leopards. We also thank the Snow Leopard Conservancy and Texas A&M University, which provided support for the food habits study and genetic monitoring work, and C. Dear, the anonymous reviewers, and S. Wymann for their critical comments, which helped improve the quality of this manuscript.

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Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
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Thermal Insulation in High Mountainous Regions

A Case Study of Ecological and Socioeconomic Impacts in the Eastern Pamirs, Tajikistan

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As in many other high mountainous regions, local people in the Eastern Pamirs (Tajikistan) use biomass fuels, mainly teresken *shrubs, to heat their houses during the winter months. This overuse of already scarce natural resources results in serious land degradation. Since 2006, thermal insulation measures have been disseminated and financed through microloans. This case study analyzes the impacts of thermal insulation in Murgab, the main town in the Eastern Pamirs, where thermal insulation measures have been implemented in 159 households since 2008. Although clients are more interested in increased comfort than in fuel savings, according to quantitative data collected in 2010 and 2011, thermal insulation measures led to a 20 to 30% savings in heating energy on average. However, it is mainly better-off households that are aware of energy efficiency issues and willing to invest in thermal insulation. In contrast, poorer households are the main* teresken *users, but they rarely have their houses insulated due to a lack of awareness and a low ability to repay loans. Therefore, the approach to introducing thermal insulation has only had a small effect on* teresken *consumption until now.*

Keywords: *Energy efficiency; thermal insulation; biomass fuel;* teresken*; rebound effect; microloans; impact monitoring; Murgab; Pamirs; Tajikistan.*

Peer-reviewed: *May 2012* ***Accepted:*** *June 2012*

Introduction

The overuse of biomass fuel as a source of energy is considered one of the main reasons for land degradation. However, in many rural regions, households have limited access to electricity and fossil fuels, and, therefore, are dependent on biomass fuels to satisfy their urgent needs for energy for cooking and heating (OECD/IEA 2006: 419). In the scientific and development discussion about household energy efficiency, the improvement of cooking stoves has been widely addressed as a way to reduce indoor air pollution and the consumption of biomass fuel (Mäkelä 2008, World Bank 2011).

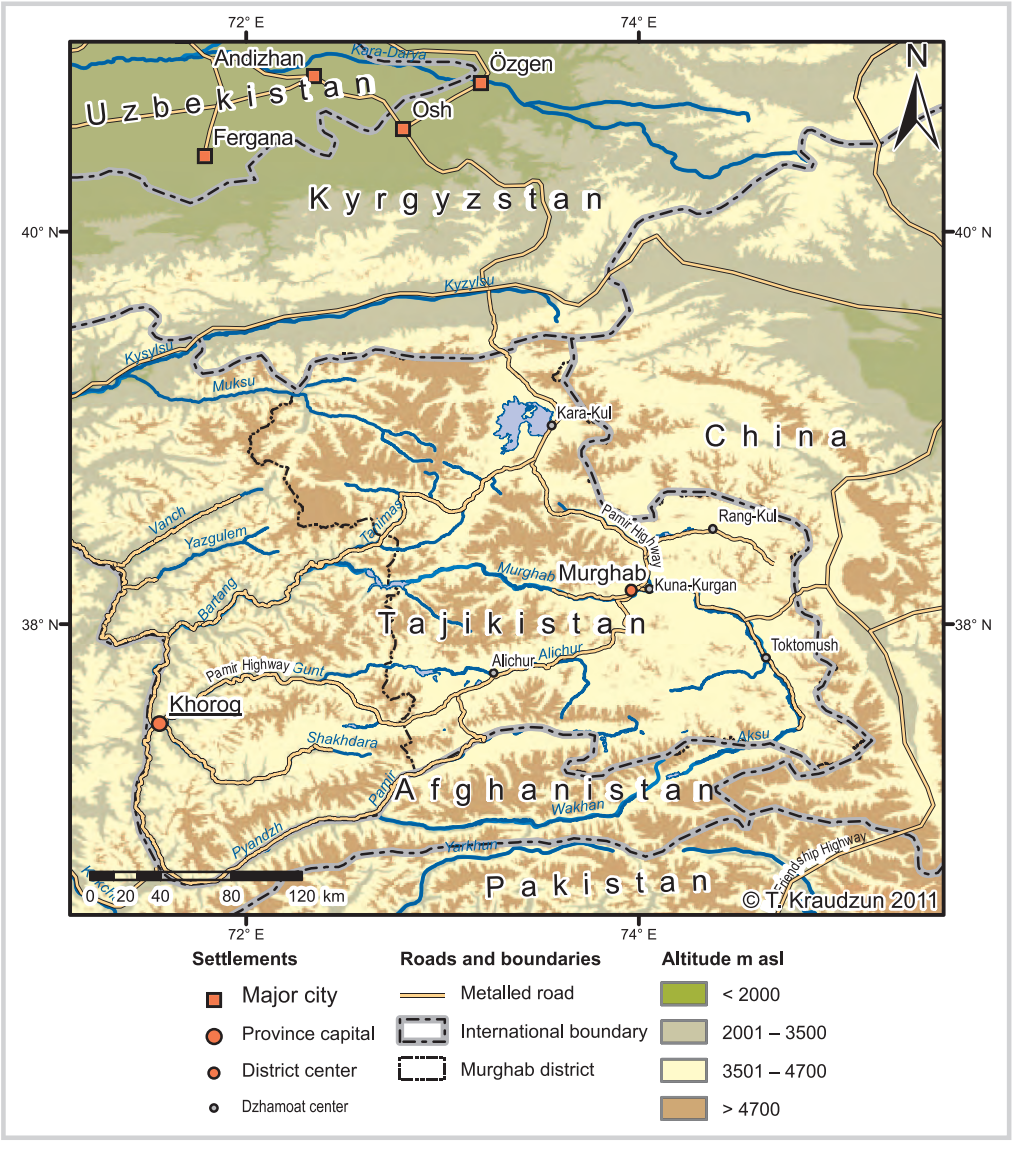
High mountainous regions with long, cold winters face an additional challenge, because most of the energy is used for heating rather than for cooking. With a warm winter room being a crucial livelihood asset, households spend a high percentage of their financial and time budget to acquire fuel for heating. Under such conditions, thermal insulation is considered to be the priority measure to reduce the loss of heat and the consumption of biomass fuel (Nienhuys 2012: 32).

This article presents a case study in Gorno Badakhshan Autonomous Region (GBAO) of Tajikistan, where the thermal insulation of private houses financed through microloans has been introduced by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, commissioned by the German Ministry for Economic Cooperation and Development. To convey important lessons learned that are relevant to the transfer of this approach to other high mountainous regions, the article outlines some of its strengths and shortcomings. It analyzes the demand for thermal insulation, the saving of heating energy, and the impact on the consumption of biomass fuel. The study focuses on Murgab, a town in the eastern part of GBAO at an altitude of 3600 masl (Figure 1), which is characterized by a high concentration of households that are clients of the thermal insulation program.

Thermal insulation in Murgab

Murgab (38°10′6″N; 73°57′51″E) has approximately 7000 inhabitants and 1500 households (Kreczi 2009). The landscape is characterized by wide, flat valleys. The climate is extremely arid and cold, and the short growing period and lack of water enable only sparse vegetation. Mainly *teresken* shrubs (*Krascheninnikovia ceratoides*) survive these difficult conditions and stabilize the soil and serve as fodder for wild animals and livestock (Domeisen 2002: 19–21; Hergarten 2004: 5–6). In Soviet times, the growth of the town was driven by the supply of fossil fuels almost free of charge, which encouraged inhabitants to build large houses without paying any attention to energy efficiency. This

FIGURE 1 Murgab with its about 7000 inhabitants is the only major settlement on the high plains of the Eastern Pamirs. The urban centers of Khorog (Tajikistan), Osh (Kyrgyzstan), and Kashgar (China) are each more than 300 km away and accessible only via high mountain passes. (Map modified from Kraudzun 2012: 92)



supply came to an abrupt end with the breakdown of the Soviet Union in 1991. People had no other choice but to use the only locally available energy source, *teresken* shrubs (Figure 2), which has led to significant land degradation around human settlements (Droux and Hoeck 2004) in addition to overgrazing of winter pastures (see the article by Vanselow et al in this issue).

GIZ started to work in the field of thermal insulation by insulating a school in the village of Chechekty (20 km north of Murgab) in 2006. In 2007, a handful of private houses were insulated in Chechekty and Murgab by focusing on the insulation of ceilings and floors with locally available natural materials. Since then, thermal insulation measures have been implemented in 407 houses all over GBAO, including 159 in Murgab. Four key innovations have taken place:

1. It soon became clear that interested households rarely had sufficient financial resources for an investment such as thermal insulation. Therefore, in 2007, a microloan organization was involved and started offering financing to interested households for the necessary materials.
2. Carpenters in the province capital of Khorog have been trained in producing double-glazed wood-frame windows and hermetic doors since 2009. A craft workers' cooperative was established in 2010.
3. Because most heat is lost through thermal radiation, reflective foil has been used in addition to natural insulation materials since 2010.
4. There were significant problems with clients who used the microloan for other purposes than thermal insulation or who poorly implemented the thermal

FIGURE 2 On the arid high plains of the Eastern Pamirs around Murgab, dwarf shrubs form the only vegetation. (Photo by Christoph Wiedemann)

insulation measures. Therefore, a new system of in-kind loans was introduced in 2010. The microloan organization provides wooden construction elements and insulation materials, and coordinates trained construction workers and transport. Clients reimburse the equivalent of these products and services in cash as they would a standard loan.

By 2011, the production of double-glazed wood-frame windows and hermetic wooden doors was managed by the crafts cooperative Zindagi, based in the provincial capital, Khorog. The microloan organization Madina va Hamkoron offered technical consultation and provided in-kind loans of up to US$ 500 for thermal insulation, and required reimbursement within 1 year, at a comparatively low interest rate of 2.5% per month. Two teams of construction workers trained in properly installing wooden constructions and insulating ceilings, floors, and walls were working in Murgab and received orders from Madina va Hamkoron (see Fabian et al 2010) (Figure 3).

Methodology

The following study is based on quantitative and qualitative data. In spring 2010 and 2011, the impact of thermal insulation on fuel consumption and living comfort was investigated by staff of the GIZ project (Dmitrieva 2010; Salzmann 2011). Quantitative interviews were conducted in households that had insulated their winter room the year before (13 of 33 households in 2010, 10 of 54 households in 2011) to compare the situation before and after insulation. The household heads drew seasonal calendars and estimated or measured the amounts of different types of fuel (coal, manure, *teresken*, and firewood), which were then translated into energy units (megajoules). Results may be biased by subjective assessments of the interviewees, who often could not exactly remember the amount of fuel and used nonstandardized measurement units. Apart from this, varying climatic factors make it difficult to isolate the influence of thermal insulation on energy consumption. Therefore, in 2011, the monitoring also included a control group that consisted of one randomly selected neighbor household per interviewed client household.

To gain a better understanding of some unexpected results, in August 2011, nonstructured qualitative interviews were conducted by the authors of this study with 9 client and 9 nonclient households in Murgab and Chechekty, which focused on socioeconomic aspects, fuel consumption patterns, and attitudes toward thermal

FIGURE 3 Construction workers in Murgab are installing a hermetically closing wooden door produced by carpenters in Khorog. (Photo by Rustam Zevarshoev 2010)

 http://dx.doi.org/10.1659/MRD-JOURNAL-D-11-00093.1

insulation. In addition, key informants (staff of the GIZ project and of the microloan organization, craft workers, and officials in Murgab) were interviewed.

Demand for thermal insulation

According to the microloan organization Madina va Hamkoron, the number of households in Murgab that took a microloan for thermal insulation steadily increased: 26 in 2008, 33 in 2009, 54 in 2010, and 40 in 2011. In 2011, the number of applications (102) was much higher than the number of actual clients. The demand is no longer the result of direct marketing efforts but rather of self-sustaining dissemination of information. Usually, satisfied clients create interest among neighbors and relatives by showing the insulation measures to them and telling them about the positive effects.

The maximum amount of the microloan (US$ 500) often does not allow complete insulation of the winter room. Therefore, decisions about the measures to be implemented are driven not only by technical but also by financial feasibility. However, some clients take additional microloans in subsequent years and insulate their winter rooms in several steps. Clients perceive the increase in inside temperature during winter as the primary advantage of thermal insulation and fuel savings as secondary. In 2010, 12 of 13 interviewees answered that it had become warmer inside their winter room, whereas only 6 interviewees highlighted that they had consumed less fuel.

Many clients are particularly enthusiastic about the double-glazed wood-frame windows (Figure 4). They are considered to make the room brighter, give the house a more beautiful outward appearance, and prevent dust passing through. As the only thermal insulation measure that is visible from the outside, the wooden windows also play a role as an "eye-catcher": when applying for a microloan, new clients usually want to buy a new window. Only during further consultation they are persuaded to implement more comprehensive thermal insulation measures.

A mapping of client households by key informants has clearly demonstrated that neither geography nor ethnicity has a significant influence on the demand for thermal insulation. Instead, socioeconomic status appears to be the main influencing factor. An analysis of data collected by Madina va Hamkoron about its clients in 2009 shows that they had an average monthly income of US$ 255, which is significantly above the average income of Murgab households of US$ 183 (Kreczi 2009: 50). The mapping of client households by the local representative of Madina va Hamkoron also indicates that, in 2010, they mostly belonged to the middle and upper strata of Murgab society, which can easily be explained:

1. When selecting clients, the microloan organization has to consider the ability of the clients to repay the loan, which makes households without sufficient income ineligible.
2. Many poorer households fear the obligations related to microloans and do not even consider applying.
3. Poorer households also usually have little awareness of energy efficiency and thermal insulation (see also Mirshakarov et al 2009).

The project approach has made it possible to reach households that have enough income to repay a microloan. Several applicants, clients, and key informants have highlighted the fact that the offer is particularly attractive due to its comprehensiveness, which combines quality wooden constructions ready for immediate installation, insulation materials, and a qualified workforce with a financing mechanism. However, because the approach is based on market mechanisms, it fails to attract poorer households.

By 2011, some 10% of households in Murgab town had taken a microloan for thermal insulation. The demand is much higher than in the Western Pamirs (1.5% in 3 districts) for 2 reasons:

1. When considering the high altitude, long heating season, and extremely cold winters, keeping the winter room warm is a survival issue, and thermal insulation makes a huge difference in living comfort.
2. Due to the remoteness of the region and the sparse vegetation, households in Murgab spend a high percentage of their household income on fuel (imported coal, *teresken,* and manure transported over long distances). In contrast, villages in the Western Pamirs are close to floodplain forests (providing firewood) and pastures (providing manure). Therefore, the financial incentive for saving energy is stronger in Murgab.

Key informants estimated that 30 to 60% of Murgab households were both willing and able to finance thermal insulation measures. Some households from villages in Murgab district (14,000 inhabitants, Kreczi 2009: 17) started applying for microloans to implement thermal insulation measures in 2011. However, the microloan organization is not yet ready to respond to this demand due to difficult logistics in the remote area and limitations in its organizational capacity and microloan portfolio.

Results of thermal insulation

In the framework of the project Habitat Improvement in the Hindu Kush, the Mountain Societies Development Support Program (MSDSP) comprehensively insulated corridors and classrooms in several schools in Murgab district in 2010 by using technologies similar to those disseminated by Madina va Hamkoron. Comparisons of an insulated and a noninsulated classroom of the same

FIGURE 4 The new wooden windows are double glazed and hermetic. In the past, many windows were only single glazed, had broken glass, and were covered with plastic foil during winter to reduce the loss of heat. (Photo by Stefan Salzmann, 2010)

 http://dx.doi.org/10.1659/MRD-JOURNAL-D-11-00093.1

size showed that, under experimental conditions, approximately 40% of the heating energy was saved (MSDSP Murgab 2011).

On average, the 13 client households interviewed in 2010 had saved 26% on heating energy compared with the season before thermal insulation, whereas the 10 client households interviewed in 2011 had saved 22%. A comparison with the control group interviewed in 2011 gives a similar result. The 10 households with thermal insulation had consumed on average 31% less heating energy than the 10 households without thermal insulation. All in all, the available data indicate that the thermal insulation measures led to a reduction of energy consumption by 20 to 30%, which is significantly less than the 40% recorded in the MSDSP test, which can be explained by several factors. First, due to the maximum amount of the microloan, winter rooms usually had only been partly insulated. Second, the so-called rebound effect played a significant role, which has often been observed in similar contexts: "Many energy efficiency improvements do not reduce energy consumption by the amount predicted by simple engineering models. Such improvements make energy services cheaper, so consumption of those services increases" (Sorrel 2007: V). Almost all interviewed clients recognized that, after thermal insulation, it was warmer in their winter room than before. Obviously, the gains in energy efficiency were not completely invested in a reduction of energy consumption but also were used to reach a more comfortable living room temperature.

Finally, one household in Murgab in 2010 took an exceptionally large loan to install 2 double-glazed windows and to insulate the floor and the ceiling. In spite of the almost comprehensive insulation, energy savings remained relatively low (11%). Asked about the reasons, the family answered: "It was so warm in the room—we had the windows open every morning until noon, otherwise it would have been too hot" (Salzmann 2011: 8). In spite of thermal insulation, they had not changed their habits but had overheated the room and consumed almost the same amount of fuel as before. Insufficient awareness, a slow change of behavior, or insufficiently adjustable stoves may also contribute to low savings in heating energy in other cases.

There are clear indications that the above-mentioned household is a rather extreme case. Before thermal insulation, 9 of 10 client households interviewed in 2011 had heated continuously during daytime. After thermal insulation, 8 of these households had reduced heating frequency and used the stove only 2 or 3 times a day. This is certainly due to the increased stability of temperature. The client households interviewed in 2010 and 2011 clearly indicated that heat was kept inside the room for a much longer time after firing the stove (an average of 1.3 hours before thermal insulation and 3.3 hours after thermal insulation).

Teresken consumption

The role of *teresken* as the main energy source, and the negative effect on pastures of its overuse, has often been highlighted in academic literature (Domeisen 2002; Zibung 2002; Droux and Hoeck 2004; Breckle and Wucherer 2006; Hoeck et al 2007). The average annual *teresken* consumption per household in Murgab district has been estimated at 7900 kg (Droux and Hoeck 2004: 149).

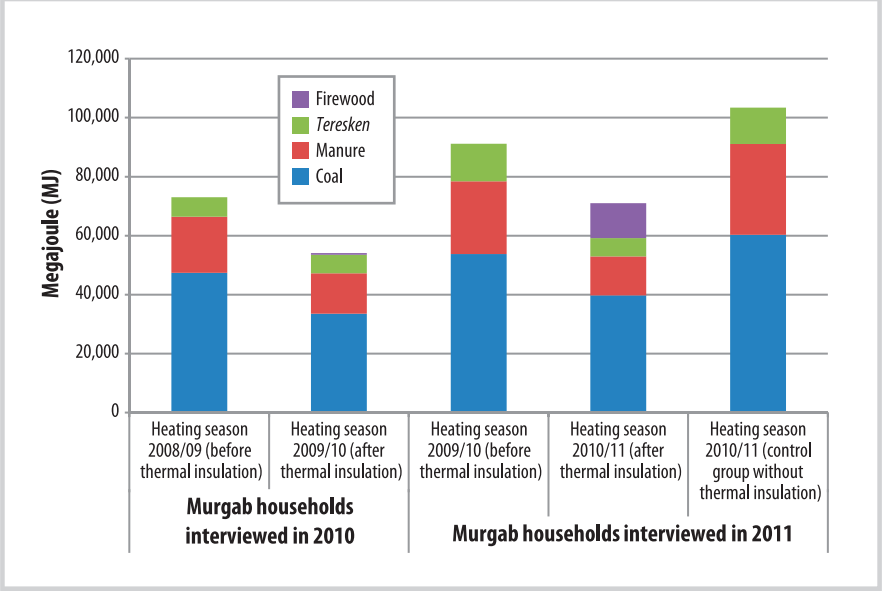
When it comes to the client households in Murgab town, the monitoring data show that on average they consumed only 1150 kg of *teresken* per heating season before thermal insulation (Figure 5). Significant quantities of coal imported from Kyrgyzstan and China had become available around 2005. Murgab inhabitants consider coal to be a much better heating fuel than *teresken*. However, coal has to be bought on the market and is perceived as expensive. *Teresken*, in contrast, can easily, although illegally, be harvested by the family members themselves, which requires financial outlays only for transport. Therefore, contemporary fuel consumption patterns in Murgab are closely related to the socioeconomic situation of households.

During the qualitative interviews and the drawing of seasonal calendars in August 2011, a clear picture of this interdependency emerged (see also Mirshakarov et al 2009; Förster et al 2011: 311–312):

1. **Better-off households** with sufficient financial resources buy most of their fuel on the local market. For heating in winter, they prefer long-burning fuels such as coal (US$ 0.15 per kg) and manure (US$ 0.04 per kg). The quickly burning *teresken* (US$ 0.15 per kg) is used only for lighting the fire. In summer, however, all households primarily use *teresken* and manure for cooking and baking. For this purpose, coal is not an economic option because it provides a long-sustained heat, which is unnecessary in summer. A small but increasing percentage of these households uses electric or gas stoves for cooking in summer.
2. **Poorer households** usually cannot afford to buy fuel (Figure 6). Members of these households spend every second or third day harvesting *teresken*, either in the mountains close to the settlement (individually) or in the high plains at a distance of some 30–70 km (in groups with a truck). To pay for fuel for the truck, they sell part of their harvest at the local market. If they own livestock, they also have manure available at low cost. They buy coal on the local market only when extra money is available.

According to rough estimations by key informants, approximately 50% of households in Murgab town have enough financial resources to buy most of their fuel at the local market. The other households mostly depend on *teresken*, which they harvest themselves. In the village of Chechekty, only some 10 to 20% of the households get

FIGURE 5 The average energy mix of client households before and after thermal insulation. In addition, a control group of households without thermal insulation was interviewed in 2011. (Graph based on monitoring data from Dmitrieva 2010 and Salzmann 2011)



sufficient manure from their own livestock or can afford to buy coal.

Almost all client households can afford to buy higher-quality fuel and are less dependent on *teresken*. Because they mainly save on expensive heating fuels (coal and manure) through thermal insulation, their investment quickly pays off. In contrast, poorer households use mostly *teresken* because they cannot afford higher-quality fuel. Because they do not spend much money ("only" their time) to acquire fuel, thermal insulation would hardly pay off for them financially. Client households use *teresken* mostly for lighting the fire rather than for heating. In winter 2010–2011, 9 client households in Murgab were each provided with an energy-efficient heating stove and 3 m^3 of firewood from sustainably managed floodplain forests in the Western Pamirs. In these households, *teresken* consumption decreased significantly and was compensated by the additional firewood (see Figure 5). This indicates that firewood is regarded as a substitute for *teresken*, which has been confirmed by several interviewees. If dry firewood were delivered to Murgab and the prices were similar to those for *teresken*, then these households would clearly prefer firewood both in winter and in summer, and thereby reduce their *teresken* consumption. However, they belong to the medium and upper strata of Murgab society, and paying for firewood would hardly be an option for poorer households.

Conclusion

The story of thermal insulation in Murgab is far from finished, but it has already provided important conclusions and lessons learned:

- Demand depends heavily on climatic conditions and fuel consumption patterns. The more people suffer from long, cold winters, and the more financial resources they spend on heating fuel, the more interested they are likely to be in thermal insulation.
- The effect on energy savings is lower than under ideal experimental conditions due to additional influential factors. However, thermal insulation does yield significant energy savings (20–30%) and does increase comfort, effects that can be increased by using improved cooking and heating stoves.
- The use of microloans as a market mechanism for dissemination, the focus on high quality, and the design of a comprehensive service package have triggered a self-sustaining demand for thermal insulation in Murgab, which is expected to involve about half of the households in the town during the coming years.
- The impact of thermal insulation on *teresken* consumption is rather small, because the main *teresken* users have not participated due to a lack of awareness and financial resources. This poses a dilemma for development agencies. To reduce *teresken* consumption, the main *teresken* users, the poorer households, need to be involved. But, in the short term, this is only possible by subsidizing thermal insulation, which might disturb the successfully established market mechanisms. The low awareness of poorer households and the low financial benefits for *teresken* users are additional challenges.

Recommendations

Further research is desirable on fuel consumption patterns and the potential demand for thermal insulation

FIGURE 6 In Murgab town, it is mainly poor households that dig out *teresken* shrubs and fire them in the stoves for heating and cooking. (Photo by Stefan Salzmann, 2010)

by poorer households and households in the villages that surround Murgab. Thermal insulation can only be part of an integrated strategy to solve the energy crisis in the Eastern Pamirs. In addition, the provision of alternative fuels (firewood, coal, gas, solar energy, and hydropower) and the dissemination of energy-efficient technology (heating and cooking stoves for winter, cooking stoves for summer) are necessary.

In the end, the problem of overusing *teresken* is mainly related to poverty. It can only be solved if the poorer households are able and willing to spend money on alternative fuels and/or invest in energy efficiency. Any comprehensive strategy needs to tackle the root causes by investing in rural development, social infrastructure, and poverty reduction. Once awareness about energy efficiency has sufficiently grown, incentives for poorer households to invest in thermal insulation might be developed and piloted, for example, a public investment program or subsidized microloans for households defined by participatory poverty assessment, but care should be taken not to distort market mechanisms. Mere enforcement of the legal prohibition of *teresken* harvesting is unrealistic under the socioeconomic, political, and geographic conditions of the Eastern Pamirs.

The case of Murgab shows that it is possible to create self-sustaining and increasing demand for thermal insulation through market mechanisms, even if a complex approach with 4 complementary elements, technical consultation, supply of material, installation and insulation services, and a financing mechanism, has proved to be necessary. This approach may be transferable to other high mountainous regions with long, cold winters and fuel scarcity. In such cases, dissemination strategies should not only focus on saving fuel resources but also should use the arguments of increased living comfort and better aesthetics. Dissemination should be initiated in regional centers due to their higher potential demand and lower transaction costs. Awareness building on efficient heating, use of fuel, and ventilation should not be forgotten, in addition to the technical measures.

This approach has the potential to significantly reduce natural resource use. However, at least in the short term, market mechanisms insufficiently involve poorer households, which tend to be the main users of natural resources. To what extent they can succeed in doing so, in the long term, still needs to be investigated.

ACKNOWLEDGMENTS

Research for this article was funded by the regional program Sustainable Use of Natural Resources in Central Asia of the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH. Special thanks to Gulnara Apandieva for interpretation during the interviews in Murgab and to the team of the GIZ regional program for reviewing the manuscript and making invaluable contributions to its improvement.

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Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
www.mrd-journal.org

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The Meanings of Pasture in Resource Degradation Negotiations: Evidence From Post-Socialist Rural Kyrgyzstan

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Pasture use in the Kyrgyz Republic has changed significantly as a result of fundamental political, economic, and societal changes following the collapse of the Soviet Union and the subsequent changes in people's livelihoods. Government institutions criticize current land use patterns as unsustainable and the cause of degradation. But at the local level, pasture quality is rarely seen as a major problem. This article uses a qualitative approach to examine the tension between these views and addresses current land use practices and related narratives about pasture degradation in rural Kyrgyzstan. By focusing on meanings ascribed to pastures, it shows how people closely relate current practices to the experiences and value systems of the Soviet period and to changing identities emerging in the post-Soviet transformation process. It argues that proper understanding of resource degradation issues requires adequate consideration of the context of meaning constructed by local resource users when they make sense of their environment.

Keywords: *Pastures; construction of meaning; resource degradation; negotiation; Kyrgyzstan.*

Peer-reviewed: *January 2012* ***Accepted:*** *March 2012*

Introduction

National and international discussions on pasture-related issues in the Kyrgyz Republic are predominantly shaped by perceptions of increasing overgrazing, degradation, and nonsustainable management of the resources concerned (e.g., Comprehensive Development Framework Council 2002: 50; Kyrgyz Republic UNCCD National Working Group 2005: 22; Ludi 2003: 121; Shigaeva et al 2007; Wilson 1997: 67). In comparison to this external view, the internal views of direct users about the condition of pastures are less easily accessible and frequently not congruent with such external evaluations.

In the case of the present study, areas of tension surfaced on the occasion of a natural resource management workshop involving local people and national pasture experts. Whereas the national experts observed decreased productivity and growing degradation on pastures close to villages and attributed it to nonrational grazing patterns and lack of inputs, local participants denied a change for the worse; some even maintained that pasture quality was improving. The objective of the research presented here was to address these differing "claims to truth" (Blaikie 2001: 136) about pastures and put them in a wider context of meaning. Without favoring one perspective or the other—both are vital for prospective negotiations—the focus of this article is on the local view of the issue. It attempts to address researchers' and policy makers' lack of knowledge about this perspective.

This article presents different contextual factors that influence the current meanings ascribed to pastures and thus to views on whether pastures have undergone degradation or not. It argues that only by considering the meanings that pastures have for direct and indirect users does an understanding of the complexities of pasture use and degradation become possible.

The construction of meaning

By focusing on the construction of meaning, this article draws on a social constructivist and symbolic interactionist perspective (Berger and Luckmann 1966; Blumer 1969), and relates it to the post-Soviet context of the Kyrgyz Republic. It builds on the principle that we can only understand a contested phenomenon such as pasture degradation if we also understand what the people affected believe about it and how this belief fits with their larger view of the world. In this regard, natural phenomena become sociocultural phenomena in the sense that they are constructed through social interactions among members of a culture as they negotiate the meanings of nature and the environment (Greider and Garkovich 1994: 5).

These continuous interactions reflect the importance of the time dimension in the construction of people's worldviews: indeed, even though action takes place in the

present and is determined by the definition of the present situation, the past provides the tools to define the present (Charon 2004 [1992]: 129f). They also imply a constant redefinition of the involved persons themselves. As values cannot be investigated by abstracting them from people's specific, contextual, and temporally resonant patterns of life (Macnaghten and Urry 1998: 250), specific worldviews are closely related to the view of what a human being is and therefore also to the identity of the person in question. In the context of the transformation of an entire political, economic, and societal system, such as that experienced by the countries of the former Soviet Union, the redefinition of the meaning of the self and the environment assumes central importance.

The legacy of transformation

Pastures represent one of the most important natural resources in the Kyrgyz Republic. They occupy more than 85 percent of the country's agricultural land (Wilson 1997: 57). Livestock herding has been an integral part of Kyrgyz life for centuries, and the use of pastures has therefore always been a reflection of the existing political orders and social systems. The fundamental transformation of the social, political, and economic system during the establishment and collapse of the Soviet Union caused severe changes (see, e.g., Akiner 1998; Herbers 2006; Howell 1996; Jones Luong 2004; Mearns 1996; Pandey and Misnikov 2001; Schmidt 2001; Schmidt 2006; Steimann 2010). Touching all levels of society, these transformations resulted in a loss of established securities and meanings related to people's everyday world and a need for their renegotiation and reestablishment on another basis.

Attempts to relate resources to the implicit meanings ascribed to them in the post-Soviet context have barely been made in scientific studies. Based on this and the assumption that people's life histories and the Soviet heritage are of major importance in the construction of current meanings, the following discussion aims to trace the historical aspects of human–resource relationships.

The pre-Soviet system of pasture management can be characterized as transhumant, reflected in: herders' substantial knowledge of how to select grazing locations by taking account of climatic zones; the lack of individual rights to pasture lands; and highly decentralized decision-making about grazing rights on pastures (Shamsiev 2006: 55). The collectivization process under Soviet rule in the 1920s and 1930s caused a major restructuring of society, with the creation of large-scale collective and state farms, division of labor, and limitations on individual ownership of land and livestock. As the primary goal of Soviet economic policy beginning with the First Five Year Plan (1928–1932) was economic growth (DeBardeleben 1985: 175), collectivization was followed by massive intensification in agriculture and livestock farming. Stalin even coined the expression "to remake nature after the needs of man" (Libert 1995: 11). The Kyrgyz Soviet Socialist Republic became the third most important wool- and meat-producing republic in the Soviet Union, surpassed only by the much larger republics of Russia and Kazakhstan. Total livestock numbers peaked in 1991, the year of the collapse of the Soviet Union, after having increased continuously since 1916 (Wilson 1997: 58).

Current research indicates that by the early 1960s, permanent overstocking had already become the norm at almost all locations in the seasonal grazing cycle, exceeding the natural carrying capacity of the mountain pastures by a factor of 2 to 2.5 during the grazing season, in many cases causing pasture degradation (Shamsiev 2006: 56). From a Soviet scientific perspective, degradation was, however, considered largely as a temporary phenomenon that could be remedied with adequate inputs, for example, by finding technological solutions for environmental problems (Pryde 1972: 165). Furthermore, due to the low variability of ecological factors such as rainfall, the application of the concept of carrying capacity was much more prominent in the Soviet Union than continuous monitoring of pasture conditions or land degradation. This may have led to the use of carrying capacity not to limit damage but only to predict it (Robinson et al. 2003: 423).

The mainstream approaches of material determinism, anthropocentrism, scientific-technical domination of nature, and ecological optimism (DeBardeleben 1985: 99) were also reflected in several key features of pasture management in the Soviet period (see Shamsiev 2006):

1. All land was owned by the state. While some aspects of transhumant herding were retained, state control over pastures meant that essential traditions of communal grazing were destroyed.
2. Decisions about the rights to use different pastures were nominally made by rural councils, but since livestock production was the responsibility of the collective farms, it was their management which in fact made all decisions, based on detailed parameters provided by central state agencies.
3. Centralized mapping, measurement, and monitoring of pasture quality and carrying capacity by the State Land Management Committee ensured relatively balanced but extremely intensive use.
4. The objective of maximizing livestock production overshadowed that of sustainable use of pasture resources (after Shamsiev 2006: 56).
5. In addition, in order to diminish overgrazing and pasture degradation, supplemental measures such as winter feeding, inputs of mineral fertilizers and pesticides, and enhanced sowing on pastures were applied.

The work of seasonal transhumance was done by appointed herders. High stocking rates led to a characteristic management regime, with winter housing based on external feeding inputs on the valley floors,

intermediate spring and autumn grazing periods, and summer grazing on high mountain pastures. The practice of commonly herding collective and private livestock and the division of labor resulted in a loss of livestock and pasture management skills for the majority of the population, as only a few were directly involved in this work within the livestock collectives (Liechti 2002: 53ff; Shamsiev 2006: 56).

Changing living conditions after the collapse of the Soviet system brought about a need to renegotiate people's everyday world. Fundamental to the post-independence reforms for rural people was the dissolution of the state and collective farms (see Steimann 2010: 62ff). The subsidies paid by socialist governments to the farms were the first to fall victim to the new logic of the market economy (Hann 2003: 11). Livestock were privatized, while pastures remained under state ownership. Pasture leasing procedures have subsequently changed several times. In the course of all these changes, rural households have struggled with loss of employment, a new self-reliance with their own plots and livestock, and a loss of political, economic, and social security (Liechti 2002: 99ff).

Due to the absence of wages and state support, livestock numbers dropped dramatically in the first five years of independence and only afterward stabilized more or less at a low level (Shamsiev 2006: 3, after Natstatcom). Due to lower livestock numbers, the new individualized form of livestock keeping, and the lack of money and facilities, pasture use was in many cases restricted to former winter, spring, and autumn pastures at low and middle altitudes (Ludi 2003: 121; Farrington 2005: 190f).

Research context and methods

The empirical material presented in this paper is based on my research in two mountain villages in Chuy Oblast in the Kyrgyz Republic. The study was part of a long-term research project of the Swiss National Centre of Competence in Research North-South in this region that has involved researchers from different disciplines over a 5-year period. The villages selected for study are located at 1200 m and 1054 m above sea level in a river basin on the northern slope of the Kyrgyz range in the vicinity of the capital city of Bishkek. Land use is characterized by rain-fed and irrigated agriculture on the valley floors and pastures on the valley slopes in the foothill zones and in the high mountains (Figures 1 and 2). During the Soviet era, each of the two villages formed a *kolkhoz* (a Soviet collective farm); one specialized in breeding livestock (sheep, horses, cattle, goats), the other in both livestock breeding and agriculture. Due to their structure and history, the two villages can be considered representative of the living conditions in many rural areas of the Kyrgyz Republic.

As previously stated, a workshop with local people and national pasture experts in one of the villages revealed inconsistent views on whether the pastures adjacent to the village were degraded. To learn more about this discrepancy, I spent several weeks in the study area several times over a half-year period. An in-depth analysis of the narratives regarding these contested views on pastures compiled during this time should put them in a wider context of meaning.

The main part of the investigation was composed of semistructured qualitative interviews that had aspects of narrative and focused interviews (Flick et al. 2004). By combining open questions at the beginning with an increasing focus on specific issues toward the end of the interview, it was possible not only to acquire new and unexpected insights but also to get specific responses on certain topics, making it possible to establish comparisons with similar kinds of answers from other respondents. The respondents were selected by theoretical sampling, a process of data collection based on grounded theory whereby the researcher collects, codes, and analyzes data and then decides what data to collect next and where, in order to develop a theory as it emerges (Glaser and Strauss 2006 [1967]: 45). In order to get a broad range of perspectives, ages, professional backgrounds, and functions in the former kolkhoz, current occupation, recent changes to livestock breeding habits, and number of livestock currently owned on a private basis turned out to be the most relevant attributes for sampling.

The empirical data presented here are based on narratives supplied by 41 people (23 males, 18 females) in 34 interviews. The interviews ranged from 1 to 2.5 hours in length and were recorded, translated, and transcribed verbatim. The topics addressed included personal life history, description of the environment and how it has changed, former and current pasture use practices, changes in livestock breeding strategies, and perception and evaluation of pasture conditions. The transcribed interviews were analyzed with the assistance of AtlasTi software: after a coding process, the emergent categories were regrouped into broad thematic complexes, which are discussed below.

Putting pastures into context

The contextual factors that influence the construction of meaning regarding pasture degradation at the local level include growing dependency on livestock due to changing economic conditions, persistent alienation from pastures as a resource, and differences between outside experts and local people in how they measure pasture quality.

Growing dependency on livestock

Changes in livelihoods during the post-Soviet transformation had a significant impact on the importance of livestock for local people. Whereas during the Soviet era private livestock keeping was a welcome form of additional income, it has now become the main source of livelihood for many people. The shift to a

FIGURE 1 View of the study region. (Photo by Karina Liechti)

subsistence economy and the consequent new dependence on livestock products gave livestock a completely new meaning in daily life. After a time of economic decline, many households recovered thanks only to livestock keeping.

From year to year the people keep more animals. When I started here, I didn't have as many animals as today. […]. The people live from the animals, nobody could survive without animals. […]. You can sell the animals, get meat, get milk from the cows or sell milk. (Male, 50, former veterinarian)

Loss of employment with the dissolution of the kolkhoz has undermined people's self-concept as professionals, a fact that many deeply regret. Animal husbandry is thus frequently not seen as proper work, but only as something necessary to make a living.

And today we have much more [private animals], because we have nothing to do anymore, we don't work anymore. This is another reason why we keep animals, because we live from them. (Female, 36, former librarian)

Former professional expertise is thus frequently no longer seen as applicable in the current situation. Even the continued existence of herding as a professional function is now questioned by some people. The profession of herder is linked to the kolkhoz system. Therefore, despite the growing dependency of many people on livestock herding, construction of a new self-concept as a herder will probably be a slow process.

Herders don't exist anymore. There were herders in the kolkhoz, these were the real herders. Today some private people, who keep their animals, call themselves herders. We have to forget the word "herder," because they don't exist anymore. (Male, 63, former agronomist)

For some people, especially those who are successful, confidence in one's own abilities is said to have improved

FIGURE 2 Pasture adjacent to the village. (Photo by Karina Liechti)

due to livestock. They enjoy freedom from dependency, which was not possible under the strict rules of the kolkhoz system. In this regard, their new occupation can be seen more positively as they continue to get used to it.

> *It is like this, that I now like my work. The reason for this is that I am not guided by anybody; nobody is reproaching or controlling me. If the animal dies, it dies, if it reproduces, I am happy. It is good to decide everything on your own, to be on your own. No dependency on anybody. (Male, 49, former teacher)*

In their narratives about their ways of life, people reflect on personal feelings and describe their current situation in accordance with their conception of their former livelihoods. When making comparisons with earlier times, many respondents express deep preoccupation with the difficulties of earning a decent income, insecurity, increased dependency on livestock, and a loss of professional identity. There is little evidence of adoption of a new identity as a farmer, herder, or the like, especially among people who came from other professions. This might also be related to the fact that members of collective farms were considered part of the working class in Soviet theory (Lane 1985: 168f) and thus were not classified as farmers, peasants, or the like and therefore not related to the whole farming production cycle.

People's forced and growing economic dependency on livestock might suggest a reason for their rather hesitant reaction to concerns about the degradation of pastures. These concerns would, in spite of people's dependence on good quality pastures, call into question their struggle to improve their living conditions and their initial successes, thanks to the increased amount of privately owned livestock. Furthermore, their rather reluctant commitment to their new source of income and their lack of identity as herders or farmers may prevent them from considering the production cycle and its enabling factors as a whole. Pastures, in this context, have only a subordinate meaning.

Continuing alienation from pastures

Differing livestock numbers, knowledge bases, and personal relationships have been responsible for the current variety of pasture use systems, which range from individual to collective herding and from migratory to more stationary patterns. Arrangements are frequently flexible and prone to change. Nevertheless, livestock owners share a common goal in herding: seeing their animals gain weight, stay healthy, and reproduce. A well-nurtured sheep is the result of good work.

Especially for nonspecialists in herding, the only indicator of adequate use of pastures is the well-fed animal. The fattening of animals currently seems achievable even without taking special pasture management measures into account (for example, by using remote mountain pastures in summer). For this reason, pasture condition is not a factor about which people show concern.

Presumably, the emphasis on the physical condition of the animals relates to the kolkhoz system of labor division

during Soviet times. The herders' main responsibility was the fattening and (in a related matter) the reproduction rate of animals. The condition of the animals, not of the pastures, was the visible outcome of good work and was rewarded accordingly.

If the herder didn't do his job well, the animals return emaciated [from the pastures]. If he did his job well, they return fat. You can see it in that. (Male, 48, former veterinarian)

Decisions on the "rational use of pastures," a precondition of this outcome, were outside the herders' influence, because the pastures were the responsibility of agrarian specialists, who determined the time and place for livestock grazing. Pastures were designated for seasonal rotation by the State Land Management Committee, according to their botanical composition and estimated carrying capacity. Pasture improvement measures such as seeding, weed control, and fertilization were planned and executed by the agrarian specialists. These measures are still highly valued by the respondents, as they illustrate people's previous mastery over the land, which has now been lost, in their opinion.

Yes, those plants [weeds] are spreading. In Soviet times the weeds were destroyed. The seeds of good grass were distributed in the mountains. Today we don't get this done. In former times people from the Academy of Sciences came and analyzed and distributed the seeds of grasses. And fertilizing was done at that time as well. (Male, 47, former herder)

This kind of care of pastures, in terms of inputs, was generally viewed positively by the respondents. Due to their customary view of pasture inputs as coming from outside and their high respect for specialist knowledge, local people now consider that they have virtually no potential to deal with such problems. Another possible reason for people's alienation from pastures is that the condition of pastures had lower priority in the kolkhoz than keeping to a set time schedule.

One didn't take into account the pastures, whether they were sufficient. One needed the births of the sheep, one needed to shear the sheep, to treat them against illnesses. And after all these measures, the sheep were driven up to the jailoo *[high mountain summer pasture]. […]. Whether the grass was already grown or not, whether there was enough grass or not, was of no importance. The preparation played the decisive role. (Male, 80, former veterinarian)*

Also beyond people's influence were the kolkhoz stocking rates, which were decided at a higher administrative level. However, people still remember the severe damage to the grass cover after the animals had left a certain grazing place.

In the time of the kolkhozes we had a lot of animals. Until we went to jailoo *[high mountain summer pasture] nothing was left in the hills. Everything was trampled down, dusty and bare from the animals. (Male, 54, former tractor driver)*

In sum, human influence on pastures is contextualized in two lines of reasoning, which are not mutually exclusive. One line emphasizes care for pastures, often in relation to inputs such as seed and fertilizer. The other sees the system and its representatives as the cause of degradation. In both lines of reasoning, responsibility is located at a higher level, from the herder to the specialist, from the specialist to the prevailing economic requirements.

The attitude of people toward pastures could therefore be characterized as noninvolvement with the status of mere observers. When pastures are seen as beyond the influence of ordinary people, the issue of degradation also becomes characterized by alienation.

Different approaches to measuring pasture quality

External experts measured (and still measure) the quality of pastures based on forage productivity [kg/ha], which is calculated according to the botanical composition of plant communities and their energy content (Meierhans 2008). At the local level, these approaches are not prevalent at the moment. Many people, especially those with little experience in herding, assess pasture quality by comparing current conditions with conditions in the final decades of the Soviet period, during which lack of grass, dustiness, and bare soil were common.

Q: How do you evaluate the condition of the pastures?
A: How do we do that? We compare. By comparison with Soviet times, the condition of pastures is better nowadays. Then, we had 32,000 sheep here. Already in May it was dusty. Wherever we looked, we saw animal tracks, animal tracks. Today, the pastures are sufficient until autumn. Only because it is sunny this year, the grass is getting dry fast. Otherwise the condition of the pastures is improving. Some say that the pastures are degrading. We had that in Soviet times. Degradation was already at its highest level by that time. Today everything is recovering. (Male, 49, former teacher)

These degradation indicators (dustiness, bareness), as commonly remembered, are frequently compared with pasture conditions today. The absence of severe signs of degradation at any time in the current yearly grazing cycle is considered a sign of improvement. However, when all seasons are taken into account, people remember the most severe degradation as having occurred just before the herds left a certain grazing place. This was followed by a recovery period, which in many cases included massive inputs of seed and fertilizer.

Q: Were the pastures trampled down in a certain time of the year or all year round?

A1: How can I put that? During the time of the shearing.
A2: In spring.
[…]
Q: Did the pastures recover, when the animals had left?
A2: Yes, certainly.
A1: As soon as it rained, they recovered. (Female, 47, former milker; male, 54, former tractor driver)

When comparing current and previous conditions, people initially remember the most extreme situations. However, this position is relativized when they reflect on the whole year, i.e. when they add a broader time dimension.

Generally, appearance plays a prominent role in narratives about the current condition of pastures. Greenness (as opposed to bare soil) is an indicator of a good pasture in the view of many respondents. A few respondents did not describe former pasture conditions in terms of directly visible animal impacts (trampling, dust, lack of grass). Along with the view of national experts, who observed changes in species composition (Shigaeva 2007), this minority put pastures into the whole-year context and expressed concern about the resurgence of weeds. Weeds are commonly seen as the result of today's low stocking rates, lack of inputs, or poor management.

Apart from visual appearance, the better conditions commonly perceived nowadays are often described in terms of the abundance of fodder, which can be seen in the physical condition of animals. As the animal population is currently low, the availability of fodder is directly linked to presumably good pasture conditions.

Their [the pastures'] condition is good. There is enough grass, enough fodder for the animals. The quality of the grass is good, the animals get fat. (Male, 60, former herder)

In addition, the significantly reduced livestock population for many people supports the assumption of an endless availability of pasture resources. The changed herding pattern and the reduced means available for pasture improvement are frequently neglected in this view. This assumption might also be strengthened by impressions of the Soviet pasture use system, where everything seemed feasible, and where the signs of overuse could be reversed by people's will and potential.

The number of animals is not as big as in the kolkhoz time. Even if we had the same amount of animals like before… we by that time somehow managed with this large number. In the future as well, we will manage somehow, even if there are too many animals. We will think out something. (Female, 36, herder's wife)

Furthermore, the currently unused pastures in the high mountains are a sign of always having a way out, and always having enough pastures.

At that time one was not allowed to [privately] own more than 10 head of small livestock and 1–2 cattle or horses. Nowadays there are no limits. The more, the better. Because our pastures make it possible, the large number of animals. (Female, 50, administrator)

The widespread conception that there will always be enough pasture, and current adequate supplies of fodder, mean that degradation as the result of changing species composition is taken into account to a lesser extent. At the moment people emphasize indications related to ease of utilization and output. The main criterion is that animals gain weight. Factors that enable this are the availability of sufficient fodder, which is visible in the appearance of pastures (green, beautiful, long grass) and enhanced by adequate rainfall, the availability of water, flat terrain, absence of features that hinder visibility, absence of weeds or dust and trampled terrain, elevation above sea level, and cool climate. Additional emphasis is put on aspects such as access (close to the road, close to the village), protection against uncertainties or harm (theft, wolves, illness, bad weather), and the nearness of neighbors. With the abandonment of previous services on the remote pastures such as medical assistance, natural hazards and other risks are currently perceived as more of a threat, and the presence of neighbors provides a feeling of security. A summer pasture with high quality grass is of no value if there are no other people located nearby.

The assessment of pasture quality today thus involves interrelated ecological, economic, and sociocultural dimensions. As experts' indicators such as change in the botanical composition of plants are rarely accessible by the common user, their approach is to compare previous and current appearance and herd size. The reduced number of animals gives pastures a meaning of abundance.

Conclusions and outlook

When talking about pasture use, people communicate a meaning constructed within social interaction and interaction with the natural environment. The results of this study show that previous practices and value systems play a major role in peoples' narratives about the current land use system. On the one hand, the Soviet practice of "rational use of pastures," which included the temporary overuse of resources but also their possible recovery due to large inputs, shaped a view of people's mastery over nature. On the other hand, attributing responsibility for pastures to specialists reinforced local users' view that they were powerless to directly influence resources. Consequently, most people remained mere observers, with their own indications and approaches to pasture quality assessment.

The subsequent alienation of local herders from pastures was reinforced by a system that limited its criteria for appraising the quality of work to the

reproduction rate and physical condition of animals. Livestock quality was and is the indicator of successful work and therefore successful use of the pastures. This view is also reflected in the current approach to pasture quality that takes reduced numbers of livestock as an indicator of an abundance of pastures.

The primacy of livestock quality over pasture quality is also related to the new meaning that is now attributed to livestock. The keeping of animals, which was a source of additional income in Soviet times, has become the main source of livelihood for many people. It has to compensate for the loss of security and is very important in people's everyday lives. Additionally, the loss of structure, and the corresponding loss of employment in an ancestral profession, makes the keeping of livestock an important but ambivalently valued aspect in the construction of people's identities.

In summary, pastures must be understood within a context characterized by tension between different constructed meanings: pastures are considered less important than livestock quality and may suffer additional neglect due to reluctant identification with herding as a primary source of income; pastures are perceived by local people as beyond their influence because competences, responsibilities, and quality indicators were based on a clear division of labor during the Soviet era; and pastures are considered to be abundant, based on appearance and low livestock numbers as major factors to compare the past and the present. These prevalent meanings provide only a limited practical link between people and pastures. This leads to the following conclusion: Whereas livestock and pastures, and humans and livestock are narratively linked, the direct link from humans to pastures is rarely made by local users. Pastures might therefore become visible and negotiable only with reference to livestock.

This study has given insight into the local view on pastures and pasture degradation and how meanings related to the natural environment are constructed. It has highlighted one "claim to truth": in the words of Blaikie (2001: 133), the view from the *veld* (open rangeland, the local view), which differs significantly from the view from the *verandah* (policy makers or researchers). This difference of perspective is widespread globally on questions of resource degradation. When it comes to pastures and pasture degradation, research results from similar contexts—for example, from Mongolia (e.g., Sternberg 2008) or Inner Mongolia in China (e.g., Williams 2002)—confirm that research related to their more sustainable use requires a better understanding of the conflicting perceptions of ecological conditions and dynamics (see also Fernandez-Gimenez 2000: 1325).

By applying a social constructivist perspective to the environment, I do not deny that something out there, for example pasture degradation, is happening. What I want to show is that a successful negotiation of complex resource use and degradation issues requires in-depth reflection on those issues' ecological, economic, and sociocultural dimensions. It requires the willingness to take different people's ascribed meanings of the resource into account and to estimate their value accordingly. It therefore also requires a reflection on people's sociocultural identities and past experiences, which, as shown, are closely related to the meaning that is ascribed to the natural environment.

From a practical view of project planning or policy development for sustainable use of pastures, the results of this study suggest an engagement of local users, researchers, and policy makers in social learning processes that aim at both a deepened understanding of the different perspectives and joint knowledge production. This can eventually lead to comanagement of natural resources, a partnership between social actors who collectively negotiate, agree upon, guarantee, and implement a fair share of management functions, benefits, and responsibilities for a particular territory, area, or set of natural resources (Borrini-Feyerabend et al.: 69). As sustainability is a normative concept, it requires concretization through a reflexive, participatory, and deliberative dialogue between all actors involved (see Rist et al. 2007: 25). Only by doing this can meaningful common steps toward a more sustainable use of natural resources be found.

ACKNOWLEDGMENTS

The author wishes to acknowledge support from the Swiss National Centre of Competence in Research (NCCR) North–South: Research Partnerships for Mitigating Syndromes of Global Change, co-funded by the Swiss National Science Foundation (SNF), the Swiss Agency for Development and Cooperation (SDC), and the participating institutions. The valuable comments of two anonymous reviewers are also gratefully acknowledged.

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Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
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Changing Systems, Changing Effects—Pasture Utilization in the Post-Soviet Transition

Case Studies From Southwestern Kyrgyzstan

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Kyrgyzstan's vast grasslands are mountain ecosystems that provide many ecological services (such as water cycling and filtration, nutrient cycling, and soil formation) as well as economic services (such as fodder supply). During the post-Soviet transformation, pasture-related challenges arose in new forms and intensities and came to endanger the continued provision of these services. Degradation leads to a worsening shortage of grassland resources, and pasture-related conflicts jeopardize Kyrgyzstan's social integrity. Socioecological problems vary in type and intensity and cannot be explained solely in terms of excessive use by local people. This study looks at the ways in which historical preconditions, current socioeconomic conditions, laws and regulations, and administrative and management practices influence current pasture problems. We analyzed the social and ecological characteristics of diverse pastures in the walnut fruit forest region in southwestern Kyrgyzstan. This study offers an interdisciplinary approach to the establishment of socially and ecologically sustainable pasture management systems, combining social and historical research with ecological vegetation analyses.

Keywords: *Grassland; pasture; human–environment interaction; post-Soviet transition; resource management; vegetation ecology; Central Asia; Kyrgyzstan.*

Peer-reviewed: *January 2012* ***Accepted:*** *June 2012*

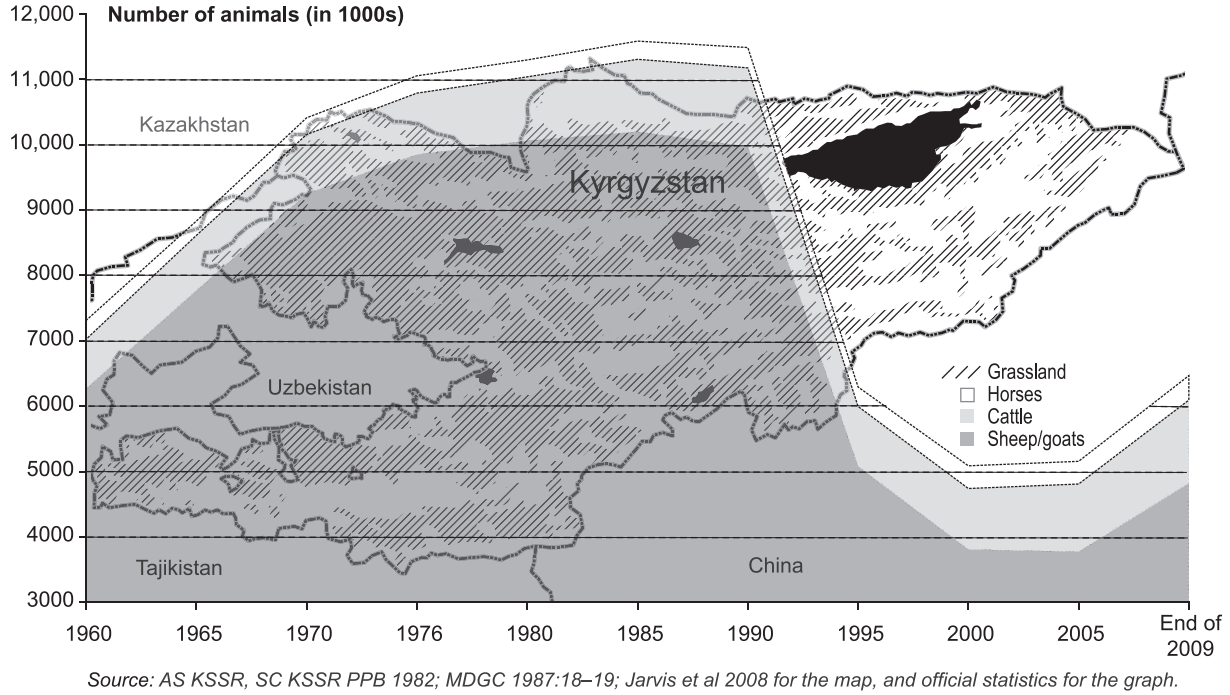
Introduction: Pasture-related challenges in Kyrgyzstan

Animal husbandry has long been important in Central Asia. Nomadic pastoralists used the ample grasslands for forage. During the Soviet era's forced sedentarization and collectivization campaigns, pasture use sharply intensified as part of socialist agro-industrial practices. As designated in the early 5 year plans, the Kyrgyz Socialist Soviet Republic became a wool, milk, and meat production center. Nomads, sedentary local communities, and settlers from European Russia were the main pastoralists during colonial times, but they were replaced by *sovkhoz*es (state-owned farms) and *kolkhoz*es (collective farms). Technical measures, such as pasture irrigation and fertilization and highly structured mobility patterns, were implemented in an attempt to mitigate the ecologically harmful impacts of the intensified exploitation of pastures (SPCPCC SSSR 1934: 243; Isakov 1974: 3–14; Ludi 2003: 119; Undeland 2005: 18–21).

Kyrgyzstan's first decade of independence was characterized by a steep economic decline, followed by deindustrialization and social disintegration. Many employees lost their jobs and wages due to the restructuring, retrenchment, or liquidation of numerous enterprises. The increased socioeconomic uncertainty led to a rising dependency on natural resources by both the national economy and individual households, especially in the countryside (IBRD 2001; Schmidt 2005; UNEP et al 2005: 19). The national economy is not very diversified and is characterized by a large primary sector. In 2008, livestock production added more than 40% to the whole sectoral value creation (NSCKR 2009: 89, 178–179; CIA 2011). This livestock production relies heavily on the relatively cheap natural fodder provided by grasslands, which cover more than 90,000 km^2 (nearly 90% of all agricultural lands). Pastures are central to animal husbandry and thus a vital economic resource (Figure 1). Furthermore, they have essential ecological importance. They prevent the high costs that could otherwise result from uncontrolled drainage, extreme runoff variations, soil transport, and erosion. They also provide habitat for broad biodiversity (Brylski et al 2001; Schmidt 2001: 109; Shamsiev et al 2007: 52–53).

In spite of the immensity of pasture lands and the reduction of livestock numbers in the 1990s, the scope and diversity of pasture-related socioecological challenges have increased markedly (Figure 1; Wilson 1997: 62–63; Undeland 2005: 22). Disputes about pasture access and use have occurred repeatedly throughout the country—

FIGURE 1 Grassland distribution and livestock numbers (1960–2009) in Kyrgyzstan. (Design and map by A. Dörre, 2012)



Source: AS KSSR, SC KSSR PPB 1982; MDGC 1987:18–19; Jarvis et al 2008 for the map, and official statistics for the graph.

for example, in border areas of the Fergana Valley, between local pasture users in the walnut fruit forest region in Jalalabad Province, and between Kyrgyz herders and a Chinese mining enterprise in Naryn Province (UNEP et al 2005: 19; Mamaraimov 2007; Anonymous 2010; Steimann 2011: 1, 205–206).

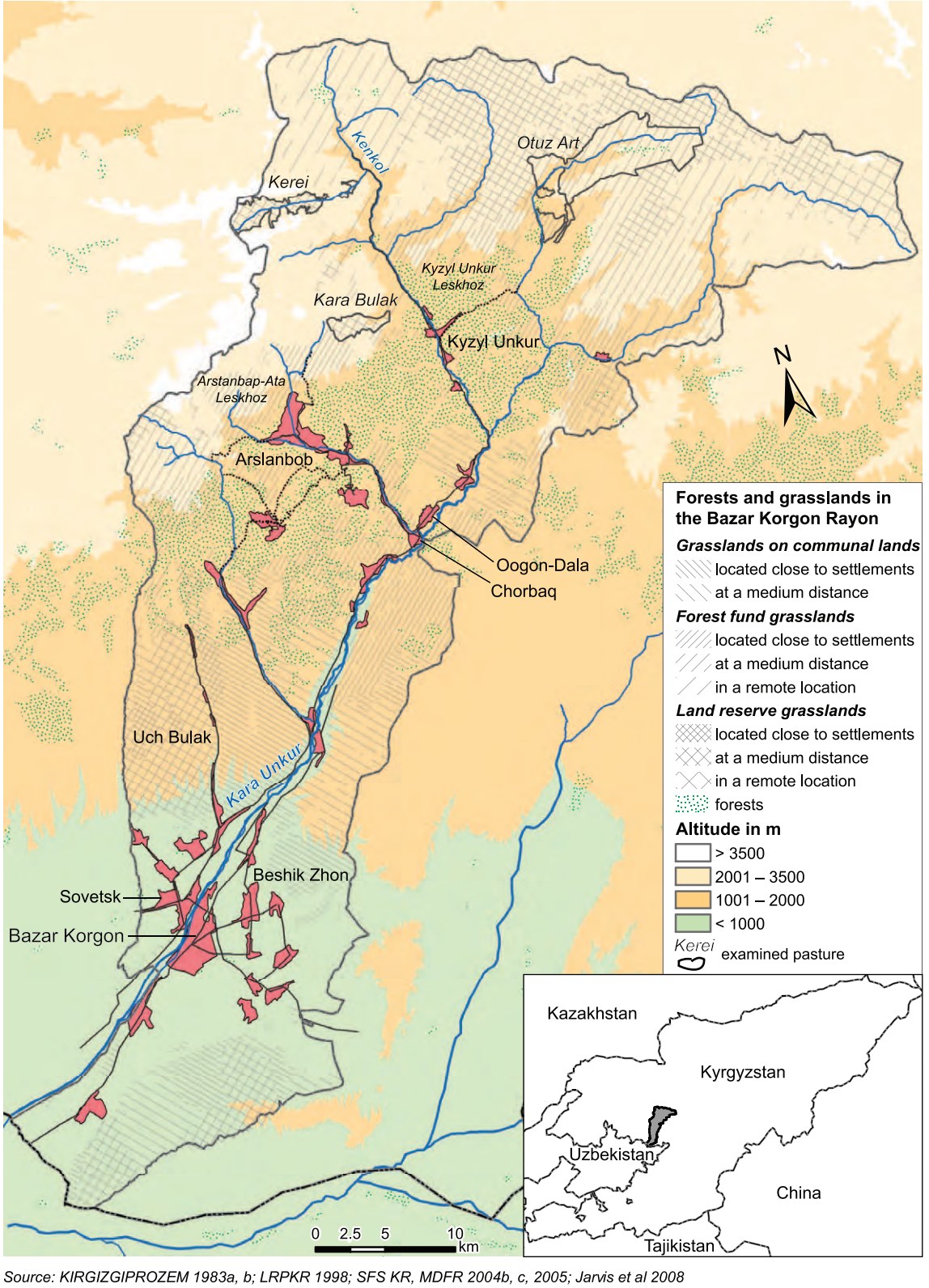
Other ecological problems that were already well known in Soviet times have persisted, including degradation, the "substantial decrease in either or both of an area's biological productivity or usefulness due to human interference" (Johnson and Lewis 1995: 2). The intensity and spatial pattern of pasture degradation changed after 1991 because of the changed resource exploitation and management regimes. Generally, degradation of *kishtoo*s (winter pastures), *jazdoo*s (spring pastures), and *kyzdoo*s (autumn pastures) increased, whereas degradation of *jailoo*s (summer pastures), which are located farther from settlements and at higher altitudes, decreased (Ludi 2003: 121; SAEPFUGKR/UNDPKR 2007: 23; Baibagushev 2011: 107–108). Degradation leads to a growing pasture shortage and potentially to a rise in conflicts with considerable negative impacts on the national economy (SAEPFUGKR/UNDPKR 2007: 20, 23–24). Therefore, ecological pasture problems are closely related to the social sphere, including the maintenance of individual incomes and the social integrity and political stability of the country.

Our aim in the present paper is to assess the ways in which both historical and more recent conditions have influenced pasture use and, subsequently, pasture vegetation patterns. By examining the social and ecological characteristics of three pastures in southwestern Kyrgyzstan, we show that the pasture-related challenges are considerably influenced by factors such as historical preconditions, current socioeconomic conditions, laws and regulations, and resource management practices. Our approach combines empirical social and historical research methods with ecological vegetation analysis.

Study area

Our study area is on the south-facing slopes of the Fergana Range within the Bazar Korgon district (41°N; 73°E), where vast mountain pastures form a vegetation zone above the walnut fruit forests, ranging in altitude from 1800 m to 3500 m (Figure 2). The forest zone receives a mean annual precipitation of 1090 mm. The mean annual temperature is 9°C, with relatively mild winters (average 1°C) and warm summers (average 20°C) (based on meteorological data recorded from 1983 to 2007 at the station Ak Terek, 1748 m, 41°17′20.0N; 72°49′41.8E). The region has mainly meadow and alpine meadow soils (similar to Cambisols and Leptosols), whereas meadow steppe soils (corresponding to

FIGURE 2 Forests and grassland of the Bazar Korgon Rayon. (Map by A. Dörre, 2012)



Source: KIRGIZGIPROZEM 1983a, b; LRPKR 1998; SFS KR, MDFR 2004b, c, 2005; Jarvis et al 2008

Kastanozems) only cover a marginal area (Borchardt et al 2011). The dominant vegetation types in the pastures examined for this study range from extensively grazed remote slopes (*Aconogonon–Prangos* community) to alpine meadows (*Phlomoides–Geranium* community) to intensively grazed and trampled areas, which are often located close to settlements (*Plantago–Polygonum* community) (Borchardt et al 2011). Today, over 50,000 people live within the forests and their surroundings. Their livelihoods depend significantly on local land and forest resources (Schmidt 2005: 93, 99–101; Grisa et al 2008: 46; Schmidt and Doerre 2011: 2).

Legal background

Another feature of the research area is the diversity of legal land categories, which are important for pasture management and allocation. Pastures, since Soviet time an exclusive state property, are located on communal lands that belong to the *ayil oktmotu* (Kyrgyz for local authority, since 2009 expressed in Russian as *aiylnyi okrug*) and on areas of the forest fund and the land reserve. They are categorized based on their distance from settlements (Figure 2). According to the legal requirements formulated in the Land Code of the Kyrgyz Republic and the Resolution "On Pasture Lease and Use" (ROPLU 2002), which was valid until 2009, local authorities were responsible for managing pastures located close to settlements. *Rayon* (district) and *oblast* (province) authorities were responsible for pastures located a middle distance from settlements and in remote areas, respectively. Precise distance values were not defined. Individual leases of 5 to 10 years were the norm and were to be obtained via auction (LCKR 1999: art. 4.2, 13, 15, 17; ROPLU 2002: par. 10, 15). For pastures located in forest fund areas, the State Agency on Environment Protection and Forestry (SAEPFUGKR) and local *leskhoz*es (forest enterprises) were responsible for resource management and allocation (ROPLU 2002: par. 4, 7, 10, 15, 39). The Forest Code also applied to these pastures.

Because most ROPLU regulations failed in practice, and because informal and unequal resource allocations became more widespread, a new law on pastures was established in 2009. Pasture auctions were abolished, and leasing was banned. Local administrations and committees of pasture users became responsible for managing and allocating grasslands located on communal land and land reserve territory, irrespective of their distance from settlements. This new approach has failed to have the intended effect on forest fund pastures, where the SAEPFUGKR and the forest enterprises remain responsible (LKROP 2009: art. 1, 4, 15). Therefore, different pasture-related regulations exist in the study area and influence the management and allocation regimes there.

Methods and material: Combining social and historical research with ecological vegetation analysis

This paper is based on a compilation of socioeconomic information and ecological data that were collected over 4 years (2007–2010).

Empirical social and historical research

Initially, we talked with representatives of governmental, nongovernmental, and international organizations, as well as with members of local public authorities. The aim was to assess the main pasture-related challenges and the laws and regulations governing pasture access, use, and management. Equipped with this initial knowledge, we visited several settlements and pastures in the study area to observe pasture use and management. We also conducted guided interviews with pasture users and representatives of the responsible management authorities. We asked about resource entitlements, management practices, allocation, and utilization practices in past and present, as well as individual assessments of the laws and regulations and their implications. Knowledge of historical preconditions was gained by archival research and analysis of historical documents from Soviet times.

Ecological vegetation analysis

Published information on plant communities in mountain pastures and their relationships with the environment and land use is very rare. Research on mountain grassland vegetation in the Tien Shan is still in its infancy (Wagner 2009; Borchardt et al 2011; Taft et al 2011). The ecological data for our study were sampled randomly on 5 m^2 plots by Borchardt et al (2011) on different pastures in the Bazar Korgon Rayon (Figure 2). The fieldwork and statistical analysis enabled us to give a detailed description of conditions (including vegetation, chemical and physical soil parameters, and relief) in the pastures under study. We also calculated the Normalized Difference Vegetation Index (NDVI) (Rouse et al 1973) using remotely sensed information (SPOT 5 image, acquisition date June 26, 2008). Satellite-derived vegetation indices, of which the NDVI is one of the most frequently used (Pettorelli et al 2005), are helpful for analyzing species richness and vegetation cover and vitality in remote mountain areas (Levin et al 2007). In our study, the NDVI was used to analyze the vegetation's vitality in SAGA-GIS (www.saga-gis.org). The index was calculated as follows:

$$\mathrm{NDVI} = (\mathrm{NIR} - \mathrm{R})/(\mathrm{NIR} + \mathrm{R}),$$

where NIR is the near-infrared band of an image pixel, and R is the red band of an image pixel. Positive values between 0 and 1 indicated vital vegetation.

TABLE 1 Pasture characteristics.

Feature/pasture	Kara Bulak	Kerei	Otuz Art
Elevation (m)	2100–2750	2800–3500	1700–2800
Predominant plant community	*Plantago–Polygonum* (central parts) and *Aconogonon–Prangos* (on steeper slopes)	*Phlomoides–Geranium*	*Aconogonon–Prangos* and *Plantago–Polygonum* (on flat sites near the camps)
Ecological parameters	• NDVI: 0.21 • Density of the herb cover layer: 51% • Mean species richness per plot: 18	• NDVI: 0.22 • Density of the herb cover layer: 55% • Mean species richness per plot: 22	• NDVI: 0.3 (western parts), 0.34 (eastern parts) • Density of the herb cover layer: 80% • Mean species richness per plot: 24 (western parts), 35 (eastern parts)
Distance from a settlement (km)	10	25	20
Land category	Land reserve territory	Land reserve territory	Forest fund land
Legal category (during the time of this research)	Intensive-use pasture	Intensive-use pasture	Village-adjacent pasture and intensive-use pasture
Official responsibility for pasture allocation and management (during the time of this research)	*Rayon* administration	*Rayon* administration	Forest enterprise and *rayon* administration

Borchardt et al (2011) classified the three most frequent and dominant plant communities according to their species composition using hierarchical β-flexible cluster analysis. In the *Aconogonon–Prangos* community, nongraminoid perennial species and tall perennial herbs occurred frequently. Several alpine and subalpine species were diagnostic for the *Phlomoides–Geranium* community. Small ruderal and/or widespread graminoid and forb species characterized the *Plantago–Polygonum* community.

Linking social and ecological research

The effects of altered utilization and management on pasture vegetation patterns and structures, and on pasture-related social challenges, were examined through analysis of the ecological conditions of three pastures and the vegetation analyses of Borchardt et al (2011) against the background of historical preconditions and post-Soviet socioeconomic and legal conditions of the study area.

Results: Social and ecological features of the pastures

Our research was conducted on the *jailoos* named Kara Bulak, Kerei, and Otuz Art. We chose these summer pastures because they differed in several features: elevation, distance from a settlement, land category, and the authority that was legally responsible (according to the laws in force during the time of research) for pasture management (Table 1). Local pasture users reported that the amount and quality of fodder plants on several pasture sections had decreased over the past few years. *Leskhoz* employees, several herders, and people who had been livestock experts in Soviet enterprises shared this view.

Kara Bulak *jailoo*

The Kara Bulak *jailoo* has the shortest distance to a settlement (less than 10 km) and is easily accessible. It is located at elevations between 2100 m and 2750 m and covers 5 km^2 (cf. Figure 3; KIRGIZGIPROZEM 1983a, 1983b). At the time of our research, the pasture was located on land reserve territory and classified as a pasture with a middle distance from settlements—a so-called intensively used pasture. Therefore, the *rayon* administration was responsible for its management (Figure 2). During our presence, 5 herders were using the pasture to graze relatively large herds of different species. All of them came from the settlement Chorbaq.

Most of the plots have experienced a high grazing impact. Because of constant disturbance, the 29 vegetation samples on Kara Bulak had the lowest density of herb cover layer (51%). Thus, Kara Bulak had the lowest NDVI (0.21) as well as the lowest species richness (mean = 18 species per plot). The central parts, where most of the users are concentrated, were characterized by the ruderal *Plantago–Polygonum* community, whereas the

FIGURE 3 Kara Bulak *jailoo*, located on land reserve territory. (Photo by the authors, 2008)

Aconogonon–Prangos community was found on steeper slopes at its margins.

Kerei *jailoo*

The closest settlement to this pasture is about 25 km away. Because the access paths are long, high, and in places very steep, the approach is difficult. Kerei lies on land reserve territory at elevations between 2800 m and 3500 m and covers nearly 20 km^2 (Figure 4; KIRGIZGIPROZEM 1983a, 1983b). Like Kara Bulak, Kerei was classified as an intensively used pasture and thus managed by the *rayon* (Figure 2). Despite the large area, only 4 to 6 herders—a farmer from Oogon-Dala and 3 to 5 shepherds from Uch Bulak (both about 50 km away)—grazed large herds of sheep, goats, cattle, and horses here.

The cover of the herb layer was only 55%. The grazing impact was the lowest of all surveyed pastures (II, medium). The species richness was higher than at Kara Bulak (22 species), but the NDVI was similar (0.22). The pasture is dominated by the alpine *Phlomoides–Geranium* community.

Otuz Art *jailoo*

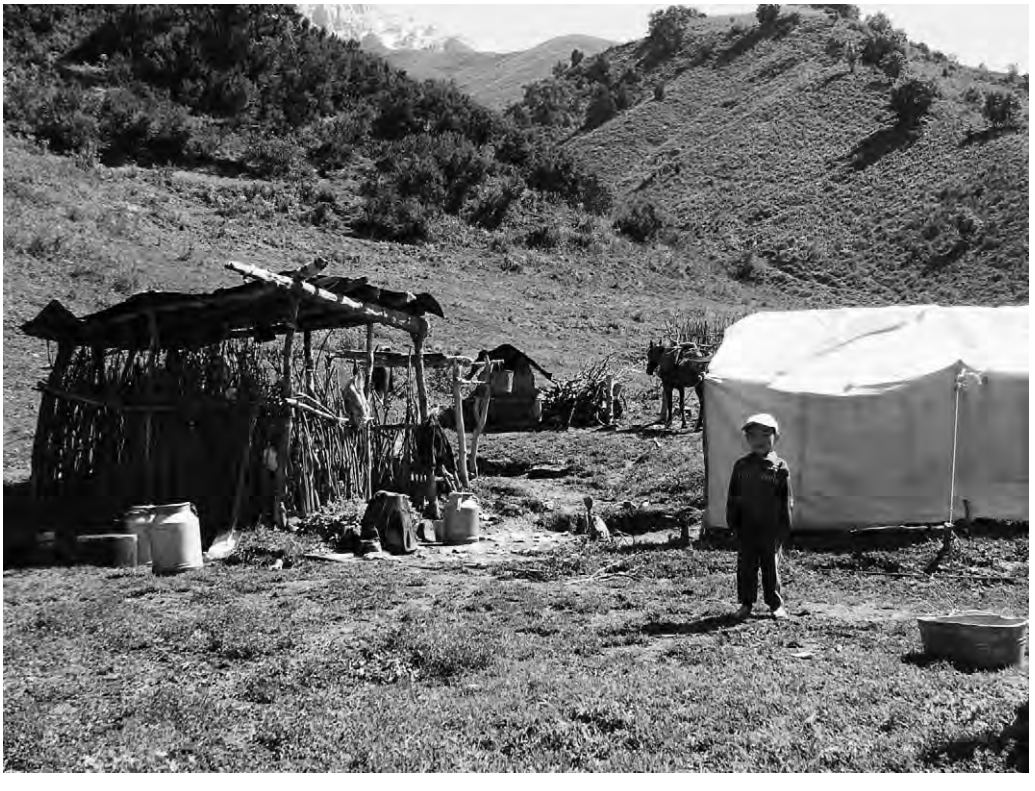
Otuz Art is officially divided into forest fund areas, located at elevations between 1700 m and 2800 m and covering more than 20 km^2, and land reserve territory, located at altitudes between 2000 m and 3300 m (Figure 5; SFS KR/MDFR 2004a: survey maps no. 1, 2, 3, 4, 6, 9; KIRGIZGIPROZEM 1983b). The distance to the nearest settlement is about 20 km. The approach is particularly difficult, as a river has to be crossed several times, and the road is often damaged by landslides and is at times very steep. The parts located at higher elevations and longer distances from the settlements were used by herders from Beshik Zhon (more than 75 km away) to graze large herds of cattle, sheep, goats, and horses.

We concentrated on the forest fund areas, where we observed about 30 users who practiced different uses. Locals were represented primarily by beekeepers working on behalf of the Kyzyl Unkur *leskhoz*. They also practiced subsistence-oriented animal grazing and rain-fed farming on small fields. Due to their distance from the next settlement, these parts of the pasture were classified as middle-distance pasture. The forest enterprise was (and still is) primarily responsible for their management (Figure 2).

Only a few cattle tracks and other traces of grazing and trampling were found there. Due to the moderate impact of livestock, vegetation samples on Otuz Art had the densest vegetation cover (80% of the herb layer). The western part showed an average species richness of 24 species per plot. The eastern part had the highest richness of the examined pastures with an average 35 species per plot. The NDVI was higher than in the other two *jailoo* (0.3 in western parts and 0.34 in eastern parts). The *Aconogonon–Prangos* community dominated here. In the

FIGURE 4 Kerei *jailoo*, located on land reserve territory. (Photo by the authors, 2008)

FIGURE 5 Otuz Art *jailoo*, located on forest fund territory. (Photo by the authors, 2007)



 http://dx.doi.org/10.1659/MRD-JOURNAL-D-11-00132.1

western parts, we also found the *Plantago–Polygonum* community on flat sites near the camps.

Discussion: Relations between historical and current conditions and the socioecological characteristics of the pastures

Kara Bulak: Intensified use, poor management, and informal allocation

Kara Bulak was used in Soviet times by the state-owned fattening farm Zhivprom solely as a *jailoo* for its own cattle. Grazing of private animals was banned. As was common in nearly every Soviet farm practicing animal husbandry, the grazing regime and the assumed carrying capacity of the pasture were derived from the average amount of natural fodder and its seasonal availability. These parameters were calculated by the State Design Institute for Land Management. The average summer grazing season on Kara Bulak lasted from the middle of May until the middle or end of August. The paid *kolkhoz* herders were obliged to safeguard the animals and to fulfill a weight gain plan for each animal. They were liable for losses and required to use the pasture in a gentle way (KIRGIZGIPROZEM 1983a, 1983b; pasture user information).

When the farm was dissolved in the early 1990s, all employees lost their jobs, but the herders from Chorbaq ensured their and their descendants' access to Kara Bulak and continued to visit the pasture. They started to apply a markedly changed usage regime and corporately leased an area of 150 ha. The herds were composed of sheep, goats, cattle, and horses belonging to Chorbaq inhabitants, and the herders were paid a set fee per animal for their services. The average grazing period on the *jailoo* became longer; it now lasts until September because the herders lost access to most of Zhivprom's spring and autumn pastures. In turn, the pasture's resilience to disturbances introduced by human use has decreased. Our ecological survey of the vegetation confirmed that Kara Bulak is heavily grazed. This has resulted in the lowest vegetation density, NDVI, and species richness of all of the examined pastures. The *Plantago–Polygonum* community is dominant here, which is an indicator of high grazing and trampling impact.

Neither users from neighboring districts nor those from elsewhere in the region aimed to use Kara Bulak, despite the disappearance of entry restrictions, pasture scarcity in other parts of the study area, and the fact that only a part of the pasture was officially leased. This is especially interesting considering the regulation, valid until 2009, that gave every legal entity (individual or body corporate) the chance to participate in pasture lease auctions (ROPLU 2002: par. 4). However, this procedure was never applied here. Use rights were allocated through informal agreements between the users and representatives of the *rayon* administration, excluding interested third parties. The *rayon* administration proved unable to fulfill its resource allocation and management duties properly (pasture user information; author's survey). A comparison of historical and current use suggests that the high impact, as evidenced by the low NDVI value, is the result of intense use and the almost complete absence of functioning pasture management.

Kerei: Extensive use and sustainable management by users

During the last Soviet decade, Kerei was one of the *jailoos* of the collective farm 60 Years of October, which specialized in breeding fine-fleeced sheep, such as merino, for the production of high-quality wool. Up to eight shepherds from Uch Bulak, located in the western part of the *rayon*, grazed flocks of about 500 animals from June through August. To avoid health threats and interbreeding with sheep of lesser quality, the *kolkhoz* management forbade the grazing of any species except fine-fleeced sheep and horses, and of animals privately owned by *kolkhoz* members, on this pasture.

As elsewhere, the herders had to fulfill ambitious production plans. From a total of 100 ewes, at least 120 lambs were expected. Every adult sheep was expected to produce an average of 6.5 kg of wool per year. An adult sheep had to provide 50 kg of mutton. To reach these goals, a resource-saving utilization strategy based on the average amount of natural fodder and its seasonal availability was applied. Seasonal mobility over long distances was enforced, and the shepherds were obliged to change campsites during a season to minimize damage to the pasture's vegetation cover and soil (KIRGIZGIPROZEM 1983a, 1983b; SAOJ 1997; pasture user information; author's survey).

When the *kolkhoz* was liquidated in the early 1990s, some of the herders continued to visit the pasture as private entrepreneurs. Shepherds leased pasture areas of up to 200 ha and offered herding services to their neighbors in Uch Bulak. With professional experience from the Soviet era and with herds of up to 500 sheep and goats, 20 cattle, and 20 horses, they still practice seasonal migration between spring and autumn pastures close to their settlement and the *jailoo*, as well as regular campsite changes within each pasture.

The average duration of the grazing period on Kerei has not changed. However, wool sheep breeding has been replaced with meat production of fat-tailed sheep (pasture user information; author's survey). Even if the NDVI value is low here, more sustainable land use and management practices performed by the shepherds themselves, such as extensive use and regular campsite changes, have made up for the lack of resource management by the *rayon* administration. This is mirrored by a relatively high diversity of species compared to the other pastures (pasture user information; author's survey). We think that the density of the *Phlomoides–Geranium* community and the NDVI are naturally low due to the immature soil, exposed rocks, and frequent rock falls.

Otuz Art: Diverse uses, poor management, but low degradation

The areas of the Otuz Art *jailoo* located on forest fund land were used by herders of the Felix Dzerzhinskii *kolkhoz* based in Bazar Korgon and by beekeepers of the Kyzyl Unkur *leskhoz*. The *kolkhoz* also specialized in breeding fine-fleeced sheep. Purebred cattle were kept in the lower parts of the *jailoo*. The farm's shepherds came mainly from the settlement Beshik Zhon, as they do today. They had nearly the same obligations as those on Kerei and practiced similar grazing strategies. The cattle herders were obliged to reach a specific weight increase for every animal or a specific amount of milk per cow. The grazing of other species, underbred species, and private animals was banned for the reasons mentioned above. Goat grazing was forbidden because the pasture was located on forest fund territory (CPC USSR 1945; KIRGIZGIPROZEM 1983a, 1983b; SAOJ n.d.; pasture user information).

After 1991, former farm members continued to use the *jailoo* for their private livestock. When they were obliged to conclude leases after 2002, many users from Beshik Zhon obtained mid- to long-term leases on areas up to 150 ha, not by auction but by direct purchase. For the beekeepers, such pasture leasing was not necessary. However, all users had and still have to buy special annual permits issued by the *leskhoz* (so-called forest tickets) because the area is located on forest fund territory. Nevertheless, many use the *jailoo* without a formal contract or registration. Goat grazing, although still forbidden, has increased.

Due to its difficult and costly access, only users with certain capital assets are able to visit this pasture. For this reason, and because of the large area, the average density of grazing animals and users on this pasture is low. The former *kolkhoz* herders have continued to practice various measures to protect the resource. The high diversity and density of the vegetation layer in most sites indicate a medium grazing impact, lower than that in the other two examined pastures. This is also indicated by the dominance of the *Aconogonon–Prangos* community, which generally characterizes less intensely grazed slopes (pasture user information; author's survey).

Despite the high vegetation density and species richness, several problems threaten the pasture. Informal purchasing of leases that evade the auction procedure (which was obligatory until 2009), exclusion of interested third parties during this process, pasture use without official documents, and toleration of goat grazing were enabled in most cases through informal agreements with underpaid staff members of the allocation and management institutions of the *leskhoz* and the *rayon*. These practices are manifestations of the insufficient management services provided by these authorities (pasture user information; author's survey).

Conclusion and recommendation: Strengthening local structures

The pastures examined in this study differ in social and ecological features. Such specific resource-related socioecological characteristics can only be explained adequately by taking into account social and ecological factors. Therefore, our research combined sociohistorical and ecological research. This hitherto rarely applied approach has considerable potential to produce new insights into pasture-related socioecological problems, such as access and utilization conflicts, and into the resilience of pastures to disturbances introduced by human activities.

Our findings suggest that lack of management is a particularly important factor in such problems. This issue was present in all three pastures under study and seems to be common across the country (Shamsiev et al 2007: xiv). In order to establish sustainable utilization regimes, pasture users should be encouraged to develop management systems suitable to the specific conditions of the particular pasture. The new pasture law focuses on this aim and assigns management responsibilities to the pasture users, who have to create so-called pasture committees.

However, given their lack of knowledge and financial assets, pasture users are often asked to do too much. Hence, the formal delegation of responsibilities to these new institutions should be accompanied by capacity building, particularly educational programs on pasture ecology and resource management. Material support is also necessary for committees with little financial capital. Although forest enterprises are relatively strong economically and officially responsible for forest fund pastures, they often manage them carelessly, as at Otuz Art. The approach pursued by the new pasture law should be extended to pastures located on forest fund lands.

ACKNOWLEDGMENTS

We thank B. Tagaev, N. Kadyrov, G. Lazkov, T. Asykulov, N. Schwab, and A. Weichert for their support in fieldwork and data preparation. We are grateful for the financial support provided by the interdisciplinary joint project "The Impact of the Transformation Process on Human–Environmental Interactions in Southern Kyrgyzstan," funded by the Volkswagen Foundation. This project was carried out by Kyrgyz and German scientists and research groups at the universities of Osh, Bishkek, Bonn, Berlin, and Hamburg. For comments on earlier drafts, we would like to thank M.B. Wilson and J. Ponsens.

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Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
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Grazing Practices and Pasture Tenure in the Eastern Pamirs

The Nexus of Pasture Use, Pasture Potential, and Property Rights

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This paper deals with the relations between grazing practices, pasture potential, and property rights in the Eastern Pamirs of Tajikistan 10 years after the privatization of 1999. It provides an overview of the spatiotemporal variability of current pasture use and livestock numbers. Assumptions about pasture potential are reconsidered in relation to animals' forage needs in order to draw field-based conclusions regarding over- or underuse in particular areas. Data are derived from interdisciplinary research on post-Soviet pastoralism and associated human–environment interactions. We show that pastoralists in the Eastern Pamirs face several problems: As the land cover resources are meager and variable and hay meadows for winter fodder are rare, herd mobility or external forage inputs are necessary to compensate for weather-related shortages. The current multiseasonal pasture use—a change from the mono-seasonal use of Soviet state farms—discourages plant regeneration. Competition between pastoralist groups is exacerbated by unresolved questions about formal user rights. Conflicts seem inevitable, limiting the sustainable use of natural resources. Based on 2 telling examples, we show that pastures close to villages are used year round, particularly in winter, and are heavily overgrazed. There is less grazing pressure on summer pastures, but some distant and hardly accessible summer pastures show high livestock numbers in summer, contradicting former opinions about their underuse.

Keywords: *Pasture use; pasture potential; pasture tenure; carrying capacity; grazing pressure; transformation processes; Pamirs; Tajikistan.*

Peer-reviewed: *May 2012* ***Accepted:*** *June 2012*

Introduction

The dissolution of the Soviet Union and the independence of Tajikistan in 1991 resulted in significant political and socioeconomic changes. The people of the Eastern Pamirs, a peripheral mountain region with a harsh climate that was highly subsidized in the Soviet era, have been particularly affected by change (Breu and Hurni 2003).

For many centuries, pastoralism with extensive livestock herding has been a prime land use strategy in the region. Therefore, the Soviet administration set the production of meat as the region's main economic task and installed collective farms (*kolkhozy*) and state farms (*sovkhozy*). There, a well-balanced and sustainable utilization of all pastures of the Pamirs was fostered by substantial imports of transport and forage resources (Breu et al 2005).

The allocation of pastureland was subject to a management plan, usually with seasonal pasture camps—winter (*kishto*), spring (*barlo*), summer (*dzhailo*), and autumn (*kuzdoo*)—in order to use the entire area of the farm. In the subdistrict of Kuna Kurgan, highlighted in this work, most summer pastures were more than 100 km from the permanent settlement (Domeisen 2002). Since privatization in 1999, new collective structures called associations of *dekhan* farms (ADFs; literally, a *dekhan* farm is a "peasant farm," indicating private and heritable land; see Robinson et al 2010: 7) have inherited the *kolkhozys'* land titles and are responsible for distributing pasture use rights in order to ensure more sustainable pasturing, which they are often not able to do (Kraudzun 2012).

Today, without the external inputs from the Soviet economy, traveling long distances between seasonal pastures is a major problem for most smallholders (Hangartner 2002; Ludi 2003), as can be observed in other Central Asian countries as well (Maselli and Arynova 2010; Wolfgramm et al 2010). As a result of this change, some authors have observed an overexploitation of easy-to-reach pastures near permanent settlements, while vast but remote areas lie fallow (Domeisen 2002; Breu and Hurni 2003; Robinson et al 2010). However, according to Breu (2006), even if all pastures are included in the calculation,

FIGURE 1 A typical *pamer* (plain and wide valley) in the Eastern Pamirs. (Photo by Tobias Kraudzun)

the potential carrying capacity of the Eastern Pamirs' pastures is limited and would supply the subsistence needs of only 3000–5000 people living exclusively on livestock breeding. This would be far below the current population of about 14,000.

The aim of this paper is to provide an overview of the spatiotemporal variability of current pasture use and associated livestock numbers, as well as to reconsider and substantiate common assumptions about pasture potential in relation to animals' forage needs (cf. Breu 2006; Sedik 2009). It is based on interdisciplinary data collected over 3 years of extensive intermittent fieldwork, which yielded evidence on grazing pressure in specific locations and allowed us to model possible over- or underuse in particular areas.

This study addresses a need recently expressed in a review paper on research on Central Asian mountain pastoralism, which noted that "authors are often repeating each other's assumptions and preconceptions" about pasture mismanagement and degradation and "there is a clear need to do more in-depth field work" (Kerven et al 2011: 38–39). It also offers a prime example of the governance problems of common-pool resources (Ostrom et al 1999) in regions undergoing economic transformation from state control to individual initiative (Bichsel et al 2010).

The following hypotheses constituted the point of departure for this paper:

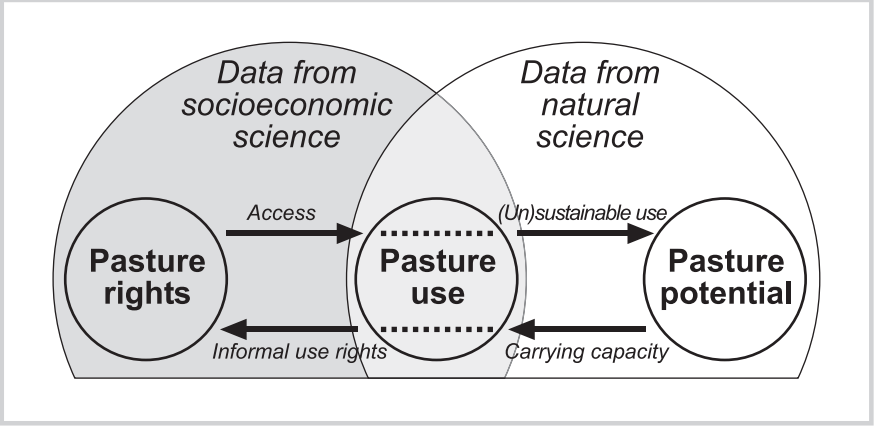
1. Multiseasonal use is the main threat to sustainable pasture use and the preservation of pasture productivity.
2. The intensity of pasture use decreases with distance from permanent settlements; however, distant pastures are still heavily used.
3. Economic conditions and lack of administration of pasture rights cause inflexible grazing schemes and stocking rates that are inappropriate to ecological conditions.

Study area

The Eastern Pamirs are a mountain area with high plateaus in Central Asia, predominantly located in Tajikistan. A *pamer* is a plain or wide valley covered with productive meadows (Figure 1) and separated by ranges (Kreutzmann 1996). The valuable pastures of these high plateaus are about 3500 to 4600 masl. The high altitude causes low temperatures throughout the year, with an annual average of only -1° C in the valleys (Miehe et al 2001). The region is also arid, with precipitation in some areas below 100 mm per year, because the high mountain ranges shield it from the westerlies and the Indian summer monsoon. The Eastern Pamirs can be described as a cold high-mountain desert with scattered, slow-growing vegetation (Agakhanjanz 1979; Walter and Breckle 1991; Breu and Hurni 2003; Abdullaev and Akbarzadeh 2010).

Given these conditions, extensive and mobile herding of yaks, sheep, and goats seems to be the only agricultural option. The population density is low, with an area of 37,900 km^2 but only 14,000 inhabitants, of 77% Kirghiz

FIGURE 2 Conceptual and methodological framework of the study. (Figure by Kim Vanselow)



and 23% Tajik origin. Half of the population lives in the district capital and economic center, Murghab, the other half in far-flung villages and hamlets (Statkom GBAO 2002; Statotdel Murgab 2008).

Methodology

To appraise the grazing impact of herds on pastures, it is essential to quantify the pasture potential and the patterns of current livestock densities in space and time. An interdisciplinary approach is required that combines data and methods from the socioeconomic and natural sciences (Figure 2). These were elaborated during extensive fieldwork between 2007 and 2010, for a total of 14 months in the communities of Alichur and Kuna Kurgan in Murghab district.

Pasture access and use and livestock numbers

In a first step, the access to pastureland for mobile husbandry was assessed. Starting from the results of the baseline studies of the Pamir Strategy Project (Breu and Hurni 2003; Breu et al 2005), pasture utilization was surveyed and its spatiotemporal variations were mapped. The pasture camps were repeatedly visited and the pastoral practices of 280 pasture users were recorded over 3 years, using a standardized, pretested questionnaire. Information was gathered on previous and present use rights, pastoral practices, and provision of winter fodder, as well as composition, size, and ownership of the herds. Livestock numbers were summarized as small livestock units (SLU). This measure consists of the small livestock (SL; sheep and goats) headcount plus the number of big livestock (BL; yaks and occasionally cows) multiplied by 3, which best reflects the animals' grazing impact (Dong et al 2006; Committee on Nutrient Requirements of Small Ruminants 2007). Information about conflicts over pasture access was sought in problem-centered interviews.

Pasture potential

Data on land cover, species composition, phytomass, and forage quality were collected to estimate the pasture potential. These data were then compared to the seasonal numbers of livestock in the pastures, allowing an appraisal of the grazing impact and thus an evaluation of possible overuse (Samimi and Kraus 2004). All calculations that involved pasture potential and herd size were based on growing animals of average weight and standard range of pasture that a herder and herd would cover in a day, as described in Vanselow (2011).

The method of assessing pasture potential is as follows: initially, two hundred sixty-two 60 × 60-m plots were set up in selected valleys, distributed over the entire study area, with at least 1 plot on the valley bottom and 1 on each of the 2 slopes wherever possible. The size of the plots was determined in relation to the remotely sensed data used in this study. Then, the cover of each plant species was estimated during the growing season according to an adjusted Braun–Blanquet scale on 4 randomly selected 4 × 4-m plant survey plots within each large plot. The data from the 4 plots were aggregated and their median considered as representative for the related larger 60 × 60-m plot.

After this, the species data were classified by hierarchical cluster analysis (isopam; Schmidtlein and Collison 2010). Subsequently, 11 variables were extracted for each plot from different sources of remotely sensed raster data and used to model the land cover as defined by the classification (Table 1). Topographic variables were extracted from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Map. Spectral and texture variables were computed from images of the satellite RapidEye (RapidEye AG 2010). The model used in this work is a random forest (Breiman 2001). To distinguish between all types of dwarf shrub vegetation, a second, focused model was created and merged with the initial one. Finally, the model accuracy was evaluated by out-of-bag validation.

TABLE 1 Explanatory variables used in the land cover model.[a)]

Explanatory variables	Description
Topography	Derived from 30-m ASTER Global Digital Elevation Map
1	Elevation (masl)
2	Slope (°)
3	Elevation (m) above isobath
Spectral characteristics	Derived from RapidEye images
4	Mean of Band 5 (near infrared, 760–880 nm)
5	Modified NDVI based on the ratio between band 5 (near infrared, 760–880 nm) and band 4 (red-edge, 690–730 nm)
6	Soil-adjusted vegetation index (according to Huete 1988)
Texture	Derived from RapidEye images by a range filter of 3 × 3 pixels; the resulting standard deviation is used as texture value
7	Texture value of filtered band 1 (blue, 440–510 nm)
8	Texture value of a modified NDVI based on the ratio between band 4 (red-edge, 690–730 nm) and band 3 (red, 630–690 nm)
9	Texture value of the filtered soil-adjusted vegetation index
Location	Derived from the UTM grid (zone 43N)
10	UTM easting
11	UTM northing

[a)]NDVI, normalized difference vegetation index; UTM, universal transverse mercator.

Phytomass availability was estimated on one hundred nine 1-m^2 plant survey plots within the large plots, using a point-intercept method (Mueller-Dombois and Ellenberg 1974; Samimi and Kraus 2004). During the growing season (mid-June to mid-August 2007 and 2008), 72 plots were recorded, and 37 were examined at the end of the cold season (March and April 2009). Woody plant parts and hard cushions were excluded from the estimation as they are only rarely consumed. To assess knowledge about the animals' diet, we observed livestock and interviewed 30 herders about favorite forage species. Then, samples of the identified fodder plants were collected and analyzed for their nutritive value by the Weender–van-Soest method in order to draw conclusions about forage quality. The results of the analysis were used to calculate the total digestible nutrients, which were converted to metabolizable energy (van Soest 1994). Taking into account that fodder values are season dependent, samples were taken whenever possible both during the growing season and during dormancy. The estimated phytomass values and the average nutritive values of the dominant pasture plants were combined to calculate the availability of metabolizable energy (MJ/ha) in each vegetation unit, which determines the pasture potential; this was compared to the temporal and spatial patterns of livestock numbers.

Historical and current conditions

Data on current pasture use, pastoral production, and economic conditions were supplemented by information about the Soviet era and the subsequent transition period, collected in topic-specific interviews with 30 key informants. Regional archives also provided historical information, which shed additional light on the current situation. The conditions of the pastoral economy were identified by analyzing legal and administrative documents and statistical data.

Results and discussion

As the study area is too large to visualize and discuss in detail, we focus here on 2 representative examples. Example A is in the northeast part of the study area, covers 1790 km^2, and contains the district center (Murghab) and the nearby settlement of Kuna Kurgan (the administrative center of the subdistrict), as well as the surrounding pasture areas, primarily in the Pshart and Kara-Suu valleys. Example B is in the southern part of the study area and encompasses the distant pasture areas of Jang-Davan, Shakarak, and Chesh-Debe, with an area of 1702 km^2. A comparison of the 2 areas is presented in Table 2.

TABLE 2 Comparison between Examples A and B.

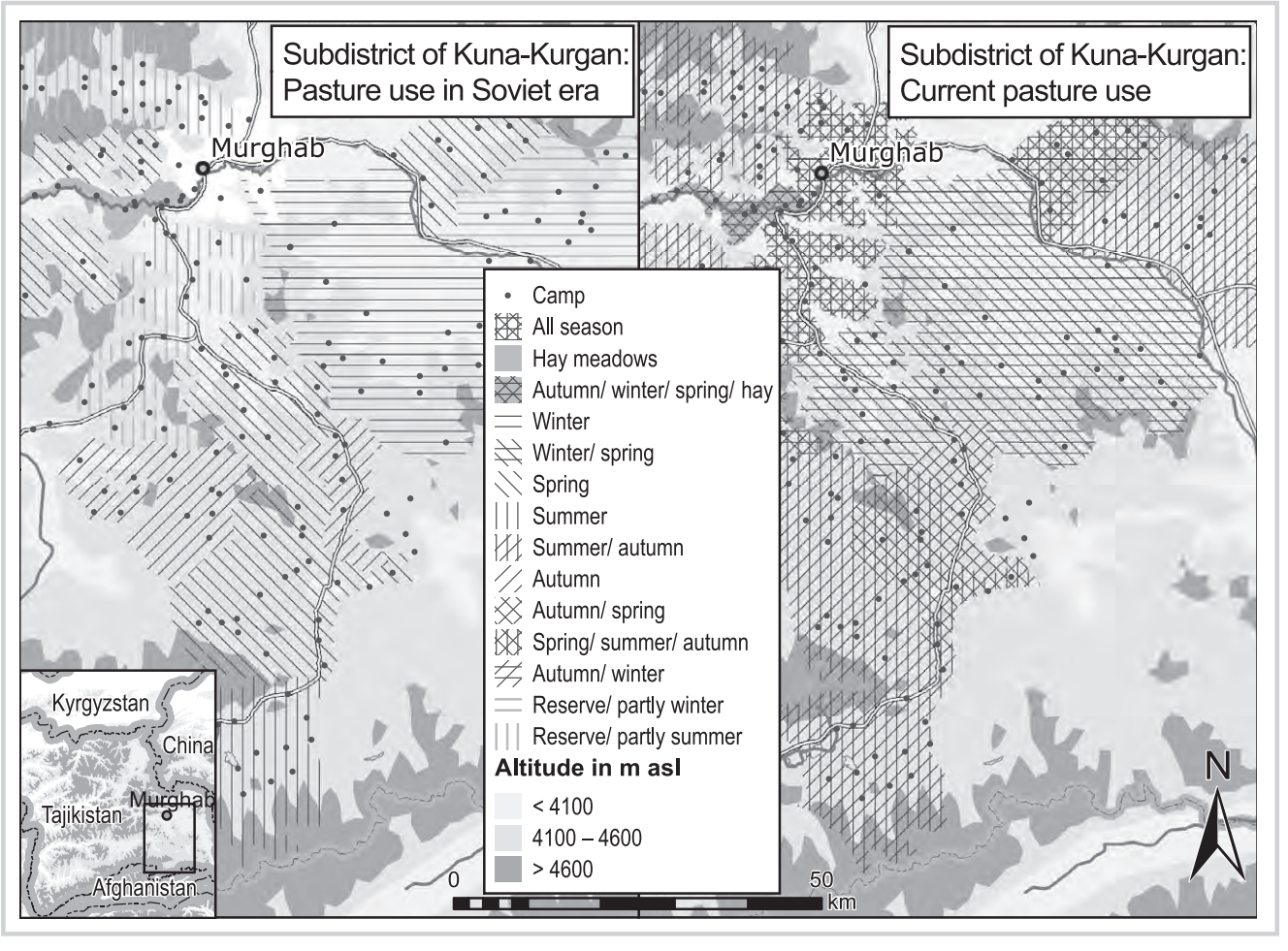
Subject matter	Example A (Figure 4)	Example B (Figure 6)
Location	Northeast of the study area (Murghab town, Kuna Kurgan village, Pshart and Kara-Suu valleys)	South of the study area (pasture areas of Jang-Davan, Shakarak, and Chesh-Debe)
Distance to settlement	Predominantly close to settlements	Predominantly remote
Use patterns		
Use during the Soviet era	• Hay meadows • Reserve pastures (predominantly for the winter season)	• Pastures for 1 season (spring, summer, or autumn)
Current use	• No spared areas • Hay meadows also used as pastures in winter and spring • Used in at least 2 seasons; partly used year-round • Maximum use in winter	• Predominantly used only in 1 season (sometimes 2 seasons) • No year-round use • Maximum use in summer
Users	Predominantly smallholders	Predominantly affluent livestock owners with large herds
Area (km^2)	1790	1702
Land cover classes (%)		
Degraded deserts	16	<1
Dwarf shrub deserts	30	9
***Teresken* steppes**	30	57
Meadows	4	4
Rocks and scree	14	9
Snow and ice	1	1
Water	1	<1
Cloud cover (%)	4	19
Livestock numbers (SLU)		
Spring	16,334	3889
Summer	11,380	9325
Autumn	11,300	3459
Winter	18,193	1118
Conclusion	Heavy overgrazing on pastures in the vicinity of settlements and on winter pastures	Sufficient forage for current livestock numbers; no extensive overgrazing

During the Soviet era, the farms used pastures only for 1 season and shifted all herds 4 times a year (Figure 3). In contrast, today most pasture users do not relocate their livestock. In the Kuna Kurgan subdistrict, from 2007 to 2009, 55% to 64% of the interviewed herders shifted their livestock to a separate autumn pasture, whereas only 26% to 38% followed a similar pattern for separate spring pastures. Thus, animals use pastures longer and the recovery period for the vegetation is limited.

Use and potential of pastures close to settlements

The pattern described above is particularly true for the pastures in Example A (Figure 4), located close to a settlement. In the Soviet period, pastures near Murghab town were spared from use; now they are grazed in all seasons. Based on the land cover classification, many of these pastures are degraded deserts, amounting to 16% of the area of Example A. In this class, forage productivity and quality are lowest (a median of 376 MJ/ha in summer

FIGURE 3 Comparison of Soviet and current pasture use schemes. (Map by Tobias Kraudzun)



and 381 MJ/ha in winter—see Figure 5 and *Supplemental data*, Table S1; http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00001.S1). Based on interviews with pasture users, this degradation appears to be caused by heavy gathering of firewood and overgrazing. The former is due to the enormous amounts of energy needed to heat poorly insulated buildings that were erected during the Soviet period, when energy efficiency was not a priority (cf. Wiedemann et al 2012, in this issue). The latter is obvious when comparing the pasture's restricted use in the Soviet period and its heavy use, by 2600 SLU daily in summer and up to 7000 in winter, around Murghab town and Kuna Kurgan village.

At higher elevations and in side valleys, the vegetation consists of dwarf shrub deserts (30%) and *teresken* steppes (30%) that are dominated by *Krascheninnikovia ceratoides*. Both classes show a comparable pasture potential, with medians of 1422 and 1404 MJ/ha in summer and 957 and 1258 MJ/ha in winter. In particular, the pastures in the Pshart Valley in the north, the Kara-Chabyr region of winter pastures in the southeast, and the pastures in the mountain ranges west of Murghab town show these vegetation types. Today, the pastures of the Pshart Valley and the side valleys of the Madian Valley, spared under Soviet management plans, are used in summer and autumn, and the former winter pastures in the southeast are grazed until the end of spring.

The highest amount of forage energy per hectare was detected for meadows, with a median of 7365 MJ/ha in summer and 4274 MJ/ha in winter. However, this is the most limited resource, covering only 4% of the example area, predominantly in the Madian Valley along the Murghab River. During the Soviet era, these pastures were used exclusively as hay meadows. Today the area is spared only during the summer months in order to harvest more hay at the end of the growing season. However, it is used as pasture in the remaining seasons, particularly in winter (3158 SLU) and spring. Finally, 14% of land cover in Example A consists of rocks and scree, 1% is snow and ice, and less than 1% is water. The remaining 4% could not be assessed because it was covered by clouds.

FIGURE 4 Land cover and livestock numbers in Example A (pastures close to settlements). (Map by Kim Vanselow and Tobias Kraudzun)

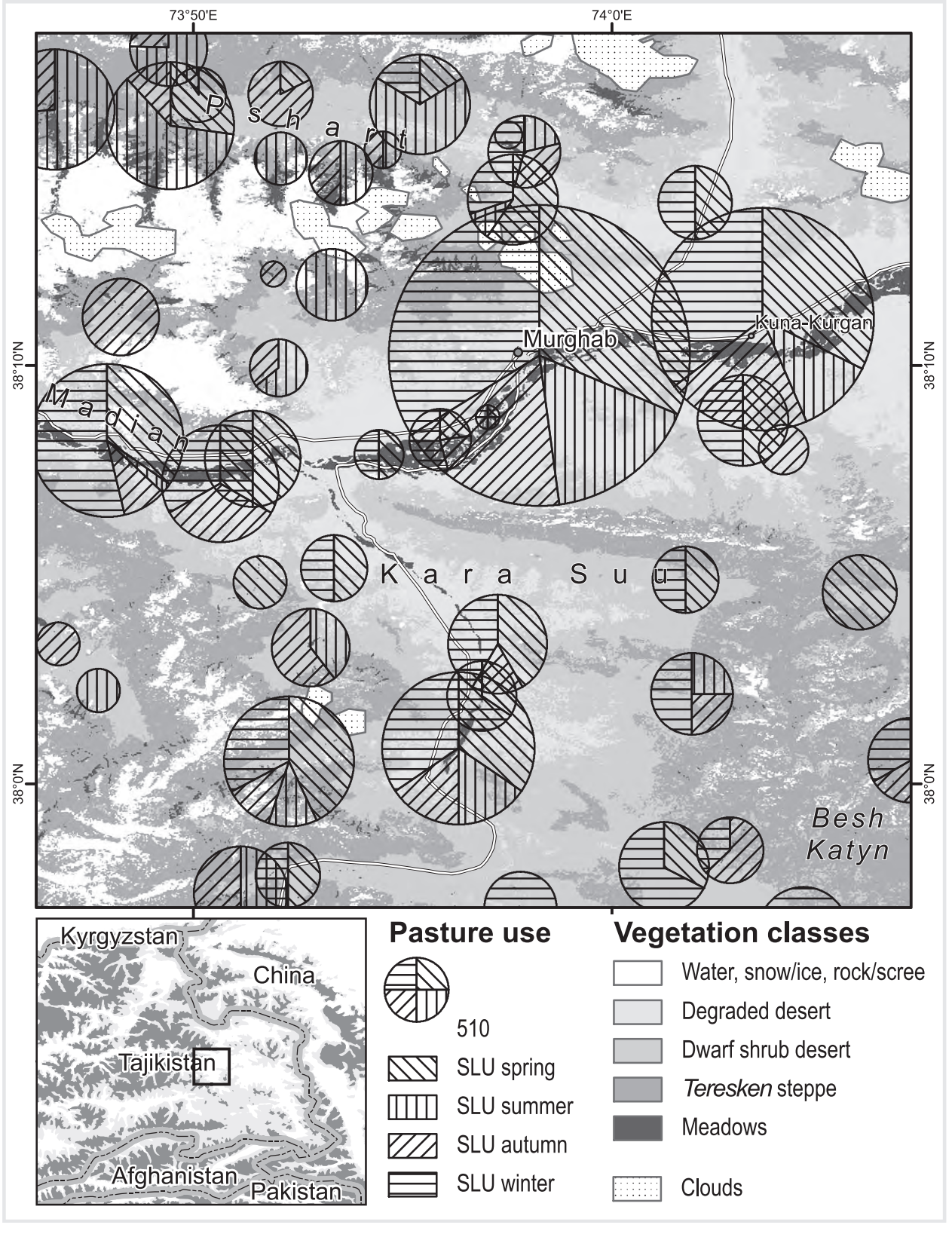


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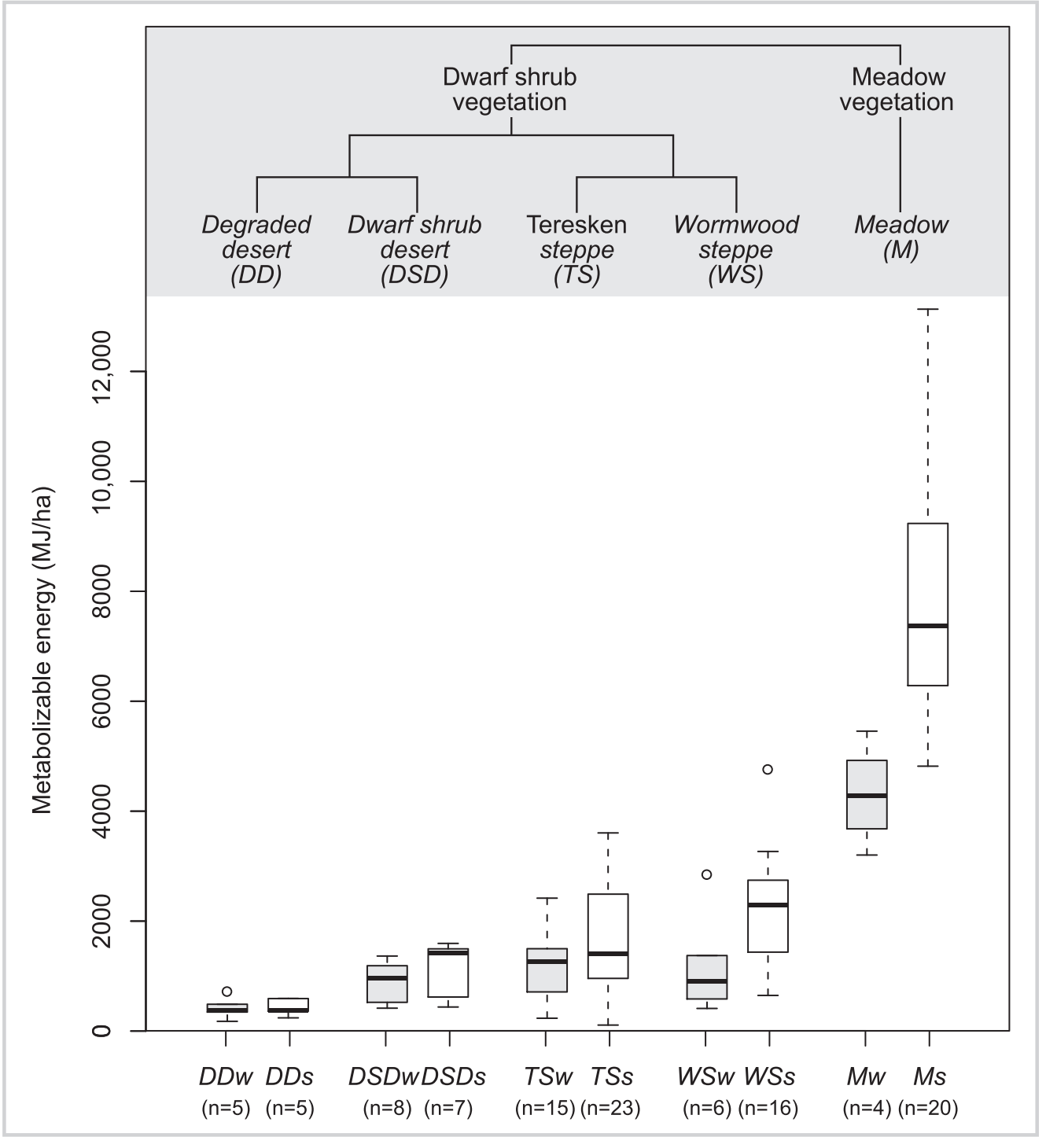
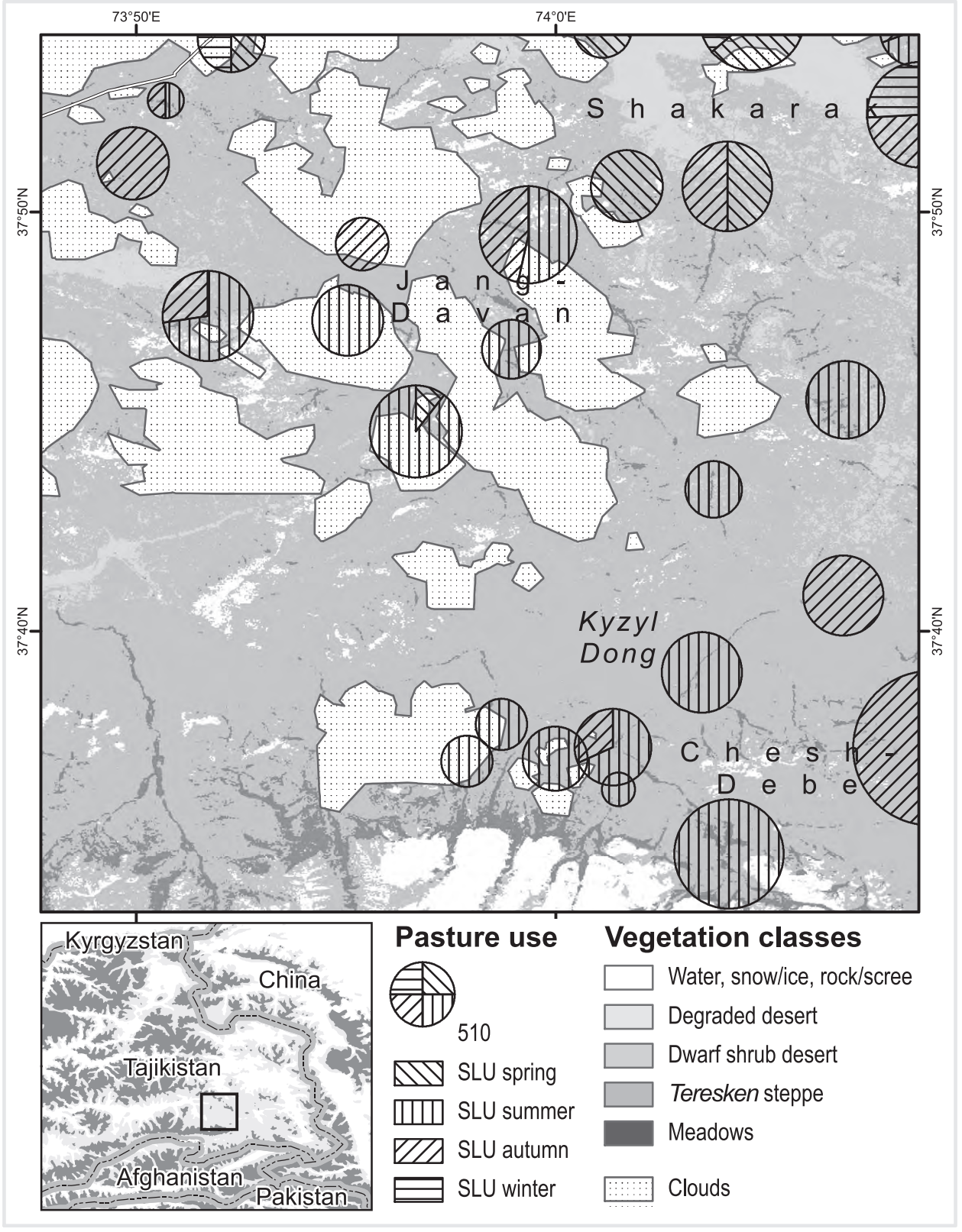
FIGURE 5 Classification and metabolizable energy of vegetation. (Figure by Kim Vanselow)



Use and potential of remote pastures

In Example B (Figure 6, distant pastures), pasture utilization is significantly lower, even though our survey shows that 9325 SLU are pastured in summer. In winter, the number decreases to 1118 SLU. Historical management plans show that this area was allocated as exclusively spring pasture (east) and autumn pasture (northwest) during the Soviet era. Only the outermost southern part of the example area was used as summer pasture.

FIGURE 6 Land cover and livestock numbers in Example B (distant pastures). (Map by Kim Vanselow and Tobias Kraudzun)



 http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00001.1

TABLE 3 Evaluation of the land cover and phytomass model (see also Table S1, *Supplemental data*; http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00001.S1).[a)]

Land cover	Class	OOB accuracy (%)
Model 1	Overall	87.4
	Degraded deserts	73.8
	Intact dwarf shrub vegetation	87.6
	Meadow	92.1
	Rocks and scree	83.3
	Snow and ice	100
	Wormwood steppes	100
Model 2	Overall	81.8
	Dwarf shrub deserts	79.4
	Teresken steppes	78.8
	Wormwood steppes	86.3
Phytomass model	**Forage type**	**R^2 ($P < 0.01$)**
	HGg	0.75
	HGw	0.7
	DSg	0.66
	DSw	0.48

[a)]OOB, out-of-bag validation; HGg, green herb and grass phytomass; HGw, withered herb and grass phytomass; DSg, green dwarf shrub phytomass; DSw, withered dwarf shrub phytomass.

The vegetation in this area is dominated by *teresken* steppes (57%). Compared to Example A, it is characterized by significantly smaller proportions of degraded desert (<1%) and dwarf shrub desert (9%). The shares of meadows (4%) and snow and ice (1%) are similar to those in Example A. In contrast, water (<1%) and rocks and scree (9%) make up a considerably smaller portion than in Example A. However, 19% of the area was covered by clouds and could therefore not be classified. (For more details, see *Supplemental data*, Table S1; http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00001.S1. The model accuracies are presented in Table 3.)

Regarding the current use of distant pastures, a closer look at the area adjacent to the southern part of Example B might be helpful. The territory of Chong Pamir belongs to Kuna Kurgan, but its pastures are at least 100 km away from this settlement. According to the ADF representative, in the first year after privatization in 1999, none of the herders were present here. In summer 2007, however, we counted herds totaling almost 3000 SL and 1400 BL on these pastures, and in summer 2008 the livestock numbers rose further, to more than 4000 SL and 1650 BL.

Winter pastures and winter forage: the scarcest resources

Winter pastures are a much scarcer resource than summer pastures, as the pasture utilization survey shows. The main reason is that in the Eastern Pamirs only a few valleys have pastures that remain snow free on a regular basis. These pastures are now in great demand. Hence, in Kuna Kurgan subdistrict, only 193,000 ha—one third of all accessible pastures—can be used without risk of weather-related problems in winter and spring, whereas 358,000 ha, double that area, are available as summer and autumn pastures.

During the Soviet era, the *sovchozy* accessed even more unreliable and far-flung areas, thus facing a higher risk of snowfall. They were able to do this as they could compensate for shortfalls by using stored dried forage and highly nutritious imported feed or by emergency removal of herds to reserved pastures. As a result, the seasonal pattern in the Soviet era was almost the opposite of the current one: 274,000 ha (61%) was used as winter and spring pastures and 175,000 ha (39%) as summer and autumn pastures (Figure 3).

In the Soviet era, according to key informants and historical management plans, the supply of winter forage was enlarged with forage crops from adapted grain seeds, augmenting the hay harvested on the natural meadows. Forage was also supplemented by imports from the Kyrgyz Soviet Socialist Republic. Valuable support originated from an exclave territory in the productive Alai Valley that was allocated to the Pamirian *kolkhozy* and *sovkhozy*: an additional 2000–5400 tons of winter fodder

was grown there yearly. Today, most herders have to rely solely on their own scarce forage reserves, if they can afford any at all, and these are used first to feed weak and pregnant sheep and goats. The few adapted winter pastures have to suffice until the summer pastures are snow free and green enough to feed the livestock. Given climate variability, such pressure can easily lead to severe degradation of winter pastures or loss of animals.

An example that highlights the current scarcity of and competition for viable winter pastures is Besh Katyn (Figure 4), southeast of Murghab town in the area of Example A. In 2007, 2 users with 590 SLU wintered here. The following year, a third herder also used this pasture because he wanted to escape the severe forage shortage elsewhere. This increased the livestock numbers to 794 SLU, far beyond the area's calculated carrying capacity of 323 SLU.

The nexus of pasture use and pasture rights

Overstocking is not restricted to winter pastures. Our study revealed that today, animal numbers are often inadequate with regard to the pasture potential. In particular, adjustments to yearly weather variations are hardly possible, as the herders have no flexibility in their range. One reason mentioned by herders and key informants is that small-scale farmers use pastures where they have succeeded in getting informal use rights, irrespective of the size of their herds. This practice is not challenged because the responsible ADF has not developed mechanisms for pasture administration and control. In contrast, during the Soviet era, the integrated management of all animals on a *sovkhozy* or *kolkhozy's* territory enabled the adjustment of herd sizes to varying forage conditions. Appropriate herd sizes for placement on seasonal pastures were assessed by a visual, on-the-spot inspection by farm specialists. Now, herd sizes are determined primarily by the wealth of the owner and are thus not adapted to ecological conditions.

Above all, present-day use patterns differ according to the socioeconomic status of the livestock owners, as shown in the initial survey. A first small group of successful breeders secured use rights for a well-defined set of large, productive pastures for each season. An illustrative example is the distant summer pasture of Kyzyl Dong, located in the area of Example B (Figure 6). In 2007, we counted 3 users on this pasture with 977 SLU. Underfed livestock led the principal user who claims this pasture to deny access to the third user, so that in 2008 only 2 breeders with 714 SLU were counted.

A second group of herders with medium-sized flocks reported that they have to agree among themselves and negotiate their stakes with the influential group of affluent owners; another option would be to switch to pastures that are less contested.

However, the major share of all users is constituted by the group of small owners. For them, practicing mobile pastoralism on an individual basis would have economically detrimental effects because of their limited livestock assets. They reported that most of them are now organized in herding groups and take turns grazing their animals throughout the year on pastures close to their settlements.

The nexus of pasture use and pasture potential

This pattern was confirmed by our observations of the pastures surrounding Murghab town. In winter 2007–2008, 3220 SLU were kept on these pastures. Their energy requirement for 1 season of 90 days amounts to $4 * 10^6$ MJ. However, as these pastures are used in all seasons, the forage demand is about 4 times higher, and could only be met by an unrealistic day range for pasturing of at least 14 km around Murghab. Therefore, it can be concluded that the vicinity of Murghab town is heavily overgrazed.

According to our survey, the livestock numbers grazed on the pastures in the area of Example A stay above 11,000 SLU in all seasons (Figure 4). The maximum is reached in winter with 18,193 SLU, consisting of 13,603 SL and 1530 BL. According to our calculations, in Example A livestock can access approximately 40,000 ha with a median available forage energy of $30 * 10^6$ MJ during the winter months. The present livestock would require $20 * 10^6$ MJ during 90 winter days. However, these pastures are used during at least 2 seasons, which clearly shows that the winter pastures in Example A are severely overgrazed. This result is consistent with the large extents of degraded vegetation shown in Figure 4.

In the area of Example B, livestock is present mainly during 1 season and only in some parts during 2 seasons (Figure 6). The numbers are much lower than in Example A, varying between 1118 SLU in winter (1013 SL, 35 BL) and 9325 SLU in summer (6493 SL, 944 BL). Our calculations show that the area accessible by livestock amounts to 40,000 ha as well, with a median available energy of $49 * 10^6$ MJ during the summer months. However, as 23% of the area assessed was covered by clouds, we corrected the values and concluded that the energy value should reach around $60 * 10^6$ MJ. The energy required for the livestock numbers in 2008 during 90 summer days totaled $10 * 10^6$ MJ. The numbers in the other seasons are far less than in summer; therefore, it can be concluded that the amount of forage in Example B is sufficient to feed the current livestock numbers. Consequently, as shown in Figure 6, only small areas were classified as degraded deserts.

Conclusions

The pastoralists of the Eastern Pamirs face several problems. Land cover resources are meager, and highly productive pastures are very limited. Furthermore, yearly variations in weather conditions control forage resources.

Therefore, adequate herd mobility and/or sufficient external forage inputs are necessary to compensate for weather-related shortages. Optimally, grazing in the Eastern Pamirs would be spread across 4 seasonal pastures. However, unlike in the Soviet era, pastures today are subject to multiseasonal use.

The number of livestock grazing on the pastures in the area of Example A, around Murghab and Kuna Kurgan, is far beyond an optimal stocking rate based on existing pasture potential, even assuming that animals are moved after 1 season. The share of the vegetation classed as degraded deserts in Example A around Murghab and Kuna Kurgan further supports the conclusion that multiseasonal use, which limits the time vegetation has to recover, has a severely damaging effect. A comparison of the extent of degraded vegetation in both example areas shows that multiseasonal pasture use is a significant threat to the preservation of the pasture productivity.

Our results generally confirmed the pattern of decreasing use intensity with increasing distance from settlements. However, the main causes for intensive pasture use include mesoclimatic conditions that control abundance of forage and water. This goes far beyond a simple center–periphery phenomenon based on the owner's economies of scale, which has been repeatedly argued by other scholars (Undeland 2005; Kerven et al 2006). Pastures close to villages are used year round, particularly in winter, and are therefore heavily overgrazed. In general, summer pastures are subject to much lower grazing pressure than winter pastures. However, distant summer pastures in particular are increasingly used, as the example of Chong Pamir illustrates. As for winter pastures, both near and distant, they are extremely overgrazed. In sum, the assumption that distant pastures are generally underused no longer holds true.

Since the privatization of the collective farms' assets in 1999, livestock numbers have increased considerably, which has boosted demand for pastures. As a consequence, competition between users has grown, as well as the pressure on fodder resources. Competition is exacerbated by unresolved questions about formal user rights. Land use regulations related to the privatization were not sufficiently enforced to settle disputes about pasture tenure. Four of the 5 collective farms were transformed into ADFs. They inherited the land titles for the pastures and are responsible for allocating pasture rights to their members according to the forage needs of their livestock; however, they often lack assertiveness because of the legal pluralism that has developed during the transformation process.

The delay in formally resolving land rights resulted in the establishment of customary law that fostered personalized use for almost a decade and led to the widespread assumption that the pastures are owned by specific users. This legacy complicates the process of reallocating pasture rights, which is overdue. The juxtaposition of 2 competing sets of rights—official land titles and informal user rights—has led to overgrazing and inappropriate claims. Pastures near settlements or without strong user claims are heavily used, whereas extensive areas are claimed by powerful livestock owners and are used less. Conflicts seem inevitable in such situations, making the sustainable use of natural resources more difficult. The prevailing informal structures and the lack of implementation of official pasture rights have resulted in inflexible grazing schemes and high stocking rates that are inappropriate to ecological conditions.

In sum, the various transformation processes following the breakdown of the Soviet Union prevented the establishment of viable institutions to implement effective pasture management. For sustainable pasture use given the still-growing livestock numbers, it is necessary to increase the flexibility of pasture use schemes. To prevent the fragile high-mountain desert ecosystem of the Eastern Pamirs from becoming completely degraded, an improved and assertive management of pastures as a common-pool resource is required. Livestock breeders will soon face the effects of what Hardin (1968) called "the tragedy of the commons"—a declining productivity of their herds—if this organizational change is not implemented.

ACKNOWLEDGMENTS

The authors are grateful to the Volkswagen Foundation, which made research in the Pamirs possible with a grant supporting the project Transformation Processes in the Eastern Pamirs of Tajikistan: Changing Land Use Practices, Possible Ecological Degradation and Sustainable Development (AZ I/81 976). The authors would also like to thank Dr. W. Bernhard Dickoré for the identification of plant species, and 2 anonymous reviewers who provided helpful remarks on an earlier draft of this article.

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Supplemental Data

TABLE S1 Phytomass, nutritive value, and energetic potential of the different vegetation classes.

Found at DOI: http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00001.S1 (45 KB PDF).

Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
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Rural Livelihood Trajectories Around a "Bull Market" in Kyrgyzstan

Studying Agropastoral Change at the Household Level Through Farming System Modeling

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Transhumant agropastoralism is a major concern in debates about economic development and food security in Kyrgyzstan. Using the concept of the "agropastoral system," this study emphasizes the diversity of existing family farming systems and agropastoral livelihoods at the regional level and their various economic perspectives in a constantly evolving environment. Qualitative and empirical research conducted in the eastern part of Chuy oblast *led to establishment of a typology of household farming systems, based on their resources and strategies, showing the agro-economic logic in the increasing socioeconomic inequalities in rural areas. Four farming systems were identified: deprived households involved in kitchen gardening and daily farm labor, risky small crop farming systems that increasingly rely on off-farm jobs to secure their livelihoods, sustainable dairy farming systems, and dynamic meat producers. In the context of increasing demand for animal products in urban areas, the position of each farming system in dairy and beef marketing reveals its ability to seize economic opportunities in the agricultural sector and in competition with off-farm activities.*

Keywords: *Agropastoralism; agriculture; livestock; farming systems; market economy; cattle; livelihoods; qualitative methods; Kyrgyzstan.*

Peer-reviewed: *May 2012* ***Accepted:*** *June 2012*

Introduction

Agriculture is a major sector in Kyrgyzstan's economy, representing 30% of the gross domestic product (GDP) and 20.4% of employment (FAOSTAT 2011a). Development of rural areas, where 64% of the population lives, is a major issue in the context of rural poverty and increasing migration toward urban areas, Kazakhstan, and Russia (Schmidt and Sagynbekova 2008).

With 94% of the territory lying above 1000 m, the country suffers from a lack of arable land. Nearly 87% of agricultural land is pastoral (Kerven et al 2011). Historically, the inhabitants developed an agropastoral organization based on a combination of intensive crop farming in the lowlands and extensive transhumant livestock farming in the highlands (Ives 2001). Anthropologists like Abramzon (1971), Japarov (2002), Jacquesson (2003, 2010a), and Farrington (2005) show how transhumance patterns have remained in the vast Tien Shan region, while agriculture progressively intensified in accordance with Soviet development plans (irrigation, mechanization, development of industrial and high-value crops).

After the collapse of the Soviet system, the economic transition crisis led to a great decrease in overall production, especially planned production such as wool sheep and industrial crops (sugar beet and hemp). Livestock numbers decreased by almost 60% between 1991 and 1996 (Musabekov 1999, quoted in Jacquesson 2010a; Farrington 2005; FAOSTAT 2011b; see also Ajibekov 2005). In the context of rising unemployment, rural households focused on private subsistence agriculture, especially after the fairly egalitarian land distribution in the mid-1990s (Giovarelli 1998). Ten years later, new market-oriented production systems have been developed for milk, meat, and vegetables. Livestock numbers have noticeably risen again (+37% since 2000, according to FAOSTAT 2011b). This case study of a small agropastoral area in North Kyrgyzstan seeks to demonstrate the concrete effects of these dynamics on rural livelihoods.

Approach

Many scholars have studied the evolution of the Kyrgyz agricultural sector using national and regional statistical data (Light 2007; World Bank Kyrgyzstan 2007; Favre et al 2010; USAID/UKaid 2011). Such studies often maintain a macroeconomic perspective and analyze the transformation of the agrarian structure following decollectivization and the general constraints on agricultural production. Sabates-Wheeler and Childress (2004) and Sabates-Wheeler (2007) criticize the idea that

privatization on an individual basis systematically leads to efficiency benefits for the agricultural sector. Formal and informal cooperation between families appears to be one of several strategies for dealing with an environment of great uncertainty (climatic events, market price fluctuations, and legal and institutional change—see Steimann 2011) and several market failures (involving access to financial capital, agricultural equipment, and land). In fact, 20 years after the breakdown of the Soviet Union, the trend is toward household-based family farms, because of conflicts within groups, growing social distrust, and reluctance to maintain Soviet-style collective forms of production. Today, 90% of agricultural production comes from small farmers (Favre et al 2010).

The individualization of production has not led to a fairer distribution of growth or to poverty reduction. There is a need for a more detailed analysis of the socioeconomic dynamics and living conditions in rural areas since the collapse of the Soviet economy. Since the late 1990s, an increasing volume of scientific literature has focused on the household level, that is, the "group of co-resident persons who share most aspects of consumption and draw upon a common pool of resources for their livelihood" (Kandiyoti 1999: 502; see also Howell 1996). Based on the concept of livelihood—"the capabilities, assets (stores, resources, claims and access) and activities required for a means of living" (Chambers and Conway 1991: 6)—research has highlighted the diversity of livelihood strategies (de Haan and Zoomers 2003; Sabates-Wheeler 2007). They often encompass both agricultural activities (Shigaeva et al 2007) and nonagricultural activities, such as small-scale retail (von der Dunk and Schmidt 2010) or labor migration (Schmidt and Sagynbekova 2008; Thieme 2008; Schoch et al 2010). The real diversity of strategies and responses described in these studies reveals the households' unequal capabilities (Sen 1989) to mobilize resources to manage externalities and maintain sustainable livelihoods.

Several factors underlie the increasing social stratification, creating serious poverty: unequal mobility and access to market or job opportunities, polarization of social networks, and progressive social exclusion of the poorest (Kuehnast and Dudwick 2004); irreversible deterioration of health, education, and social assistance services; and unequal access to common resources such as pastures, water, and forestry. On the other hand, there is a lack of analysis of the specific role of agropastoral production and revenues in the increase in inequalities in rural areas. Depending on households' resources and production choices, agropastoral outputs may have very different profitability in the market, but the interdependence of the different activities (cropping, husbandry, and off-farm work) requires suitable conceptual tools.

For that reason, I adopted a systemic approach based on the "agrarian system diagnosis" methodology (FAO 1999; Cochet 2011) developed in the 1960s by heterodox agro-economists (Colin and Crawford 2000). The concept of a farming or production system considers that each farm (here household-based) mobilizes various resources—such as land, labor, capital, equipment, and access to common resources (DFID 2001)—for different income-generating activities. They all form a coherent set with complex interrelations (self-supply of inputs, investment, but also tensions in resource allocations). Comprehension of both the internal functioning of each activity and its interrelations with the others helps to disentangle the farms' organization and logic of production. The overall outputs, consisting of self-consumed and marketed agricultural production and other revenues, underline the system's economic performance and risk exposure. This helps to characterize the households' potential livelihood trajectories (impoverishment, maintenance, or progress) in the medium term.

Study area

This research focuses on the eastern part of the Chuy *oblast* (province) in North Kyrgyzstan (Chuy and Issyk-Ata *raiony* [district], 180,000 inhabitants, 42.46°N, 75.14°E). The large and flat Chuy valley (elevation 700–1200 m) is suited to irrigated and mechanized crop farming. After the collapse of the Soviet economy, industrial crops gave way to subsistence crops (wheat). In the last few years, fodder and barley production has significantly increased due to livestock recovery (Favre et al 2010). In the villages, manual kitchen gardening (*ogorod*) is a major component of household consumption (potatoes, vegetables, fruits, and corn for animals). Herds are kept in the villages during the winter, grazing collective pastures and stubble fields as well as harvested fodder. Almost all the animals spend summer in the surrounding mountain pastures (*jailoo*) at an altitude of between 1800 and 3500 m. These are state properties and are managed by local pasture committees (Jacquesson 2010b; Steimann 2011).

Most of the *raiony* population is concentrated in the lowlands, around the multicultural towns of Tokmok and Kant. Outside urban areas, more than three quarters of the population are Kirghiz, the rest being mainly Russian and Dungan (Muslim people of Chinese origin), with some Dutch and some Meskhetian Turks. Proximity to dynamic locations such as Kazakhstan and Bishkek—the capital city is 1 to 1.5 hours away by public transportation—provides opportunities for farmers to sell high-value produce. Job opportunities also allow income diversification. Today, this area is one of the most dynamic in the country and attracts rural people from the center and the south.

The main questions pursued by the present study are: What kind of household farming systems can be observed in the area? What are the assets, incomes, risks, and economic perspectives associated with each system? What can be learned about the current socioeconomic dynamics in the Chuy *oblast*?

TABLE 1 Interviews conducted for this survey (March–July 2011).

Family farming system (FFS)	Number of interviews
FFS1: Home gardening and day labor	4
FFS2: Small crop farming	12
FFS3: Crop and dairy farming	7
FFS4: Herding	10
Total FFS1–FFS4	**33**
Other FFSs not discussed in this article (market gardening, nonfamilial farming systems)	11
Other actors from the agricultural sector	16
Total number of interviews	**60**

Methodology

The investigation was conducted from March to July 2011, following an empirical approach (*enquête informelle*, see Labé and Palm 1999). A preliminary survey of 14 open interviews was conducted with key informants such as village elders, in order to understand the past and current socioeconomic dynamics in this area and frame appropriate categories for data collection. Then, the main survey was carried out, consisting of 40 lengthy interviews with household members (Table 1). Considering the large number of households in the area and the limited surveying resources, a purposive sampling method was chosen, emphasizing, in each category, the diversity of the cases studied (apparent economic situation, assets, household size, age and gender of the householder, set of activities) to highlight common patterns. According to Flyvbjerg (2006: 229), such a strategic selection of cases can increase the generalizability of the case study: "It is often more important to clarify the deeper causes behind a given problem and its consequences than to describe the symptoms of the problem and how frequently they occur."

The semistructured questionnaire dealt with farm assets (labor force, land, livestock, equipment, and cash flow), the functioning of cropping and livestock systems (including kitchen gardening, fodder, dairy, and poultry), marketing, and other income sources and activities. Special attention was given to the combination of these activities in terms of work time and cash-flow management throughout the year, to highlight unsuspected constraints and logics.

Data analysis led to the construction of a typology of family farming systems (FFSs), each representing a specific combination of activities. Life stories were taken into particular consideration to understand socioeconomic trajectories since the Soviet era. Modeling of each "ideal-type" (Weber 2002) then made it possible to evaluate the average in-kind and cash incomes, savings and investment capacities, and risk management—in other words, to assess economic viability in the medium term. Surveys of market commodity chains (Challies 2008; de la Martinière 2012), based on observations in bazaars and during 16 open interviews with traders, meat processors, and retail salespeople, completed the data set.

This empirical, qualitative, and field-based methodology avoids the classic gaps found in statistical surveys about incomes or assets (Kandiyoti 1999) and allows for a more comprehensive and dynamic analysis, even if it is hard to assess the frequency of each FFS in the area. As a holistic approach, it requires the direct involvement of the researcher, with the assistance of a local research assistant (in this case, a Kyrgyz woman speaking Kyrgyz, Russian, and French).

Results

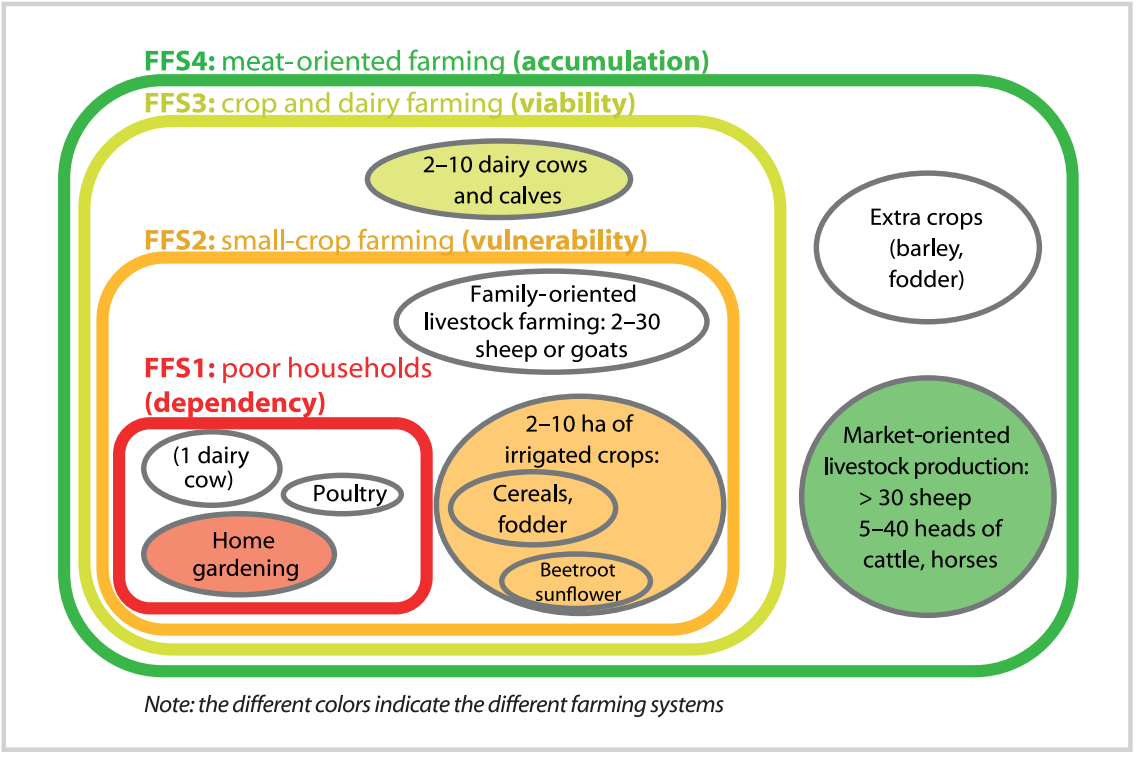
Typology of family farms

In the rural areas of Chuy and Issyk-Ata *raiony*, four main family farming systems were identified, mostly based on their marketing production (Figure 1). Other specific FFSs, such as Dungan family market gardening and different types of farming enterprises, were also identified but are not discussed in this article.

FFS1: poor households (home gardening and day labor): Most of the poorest households in the villages are headed by single parents or elderly people. Some are in charge of many children. They do not have enough assets (labor and cash) for land cultivation, so they have sold or rented the land they received during the agrarian reform. Most of them work on other farms as day laborers. The kitchen garden, poultry, and sometimes a cow ensure a home consumption-oriented production, and sometimes a surplus to be sold in nearby markets in Tokmok or Bishkek. They are economically dependent because they rely on irregular job opportunities and on social and familial assistance to buy the basic food they cannot produce themselves (flour, oil, sugar, and tea). They suffer from a clear dependence on the market for their basic needs. Despite existing social assistance (retirement pensions and family allowances), they often experience financial difficulties in late winter and early spring, because of food price increases. Food insecurity and malnutrition can thus be real problems, especially for those who cannot diversify their income through small jobs or market gardening.

Their gradual exclusion from traditional mutual help networks and their lack of connections that could help them get access to public services and jobs (Kuehnast and Dudwick 2004; Pétric 2011) accentuate their vulnerability and leave them trapped in poverty. According to Shigaeva et al (2007), who conducted a similar survey in the nearby valley of Sokuluk, these households represent around 20% of the local population.

FIGURE 1 Main farming systems in Chuy *oblast*: a complex combination of cropping and livestock systems with unequal economic outcomes.



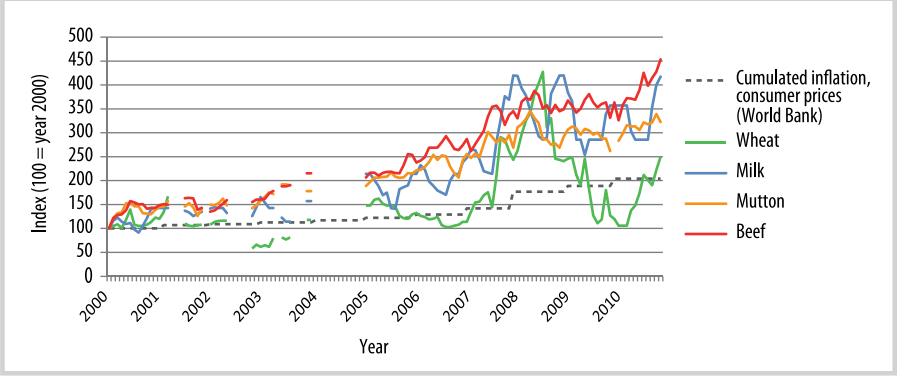
FFS2: risky small crop farming systems: This category consists of more traditional nuclear families involved in small irrigated crop farming on an average surface of 2–6 ha. Production is mechanized; people usually pay a tractor driver to plough, sow, and harvest. The main products are cereals and fodder, both home-consumed and sold on the market. This is the main agricultural cash income for these families. With a small family-oriented herd (2–30 sheep or goats), they have better living conditions than FFS1 families, and they can eat meat regularly.

However, this system has low value-added outputs (around US$ 300 per ha for wheat in a good year, which means US$ 75 per month for 3 ha) and is sensitive to agricultural and input price fluctuations: A drop in international cereal prices one year (see Figure 2) can cut a family's income in half and lead them to sell all their livestock to buy basic necessities. Moreover, much of their income accrues in autumn, and they often have trouble paying for sowing in springtime. Some increasingly turn to fodder cultivation (alfalfa and clover), because leguminous plants compensate for the lack of fertilizers and only need to be sown every 2–3 years, and hay bales are much easier to stock and sell throughout the year. Increasing livestock levels have created a viable regional fodder market, and the added value per hectare is higher (US$ 500 per ha or more). On the other hand, for technical reasons, it is hard to cultivate both fodder and crops, and a household that cultivates fodder often has to buy flour on the market at a high price.

In the medium term, this FFS is still very exposed to price variations and to climate-related risks, and it has low economic sustainability as long as not enough livestock are owned to serve as a form of self-insurance. For this reason, many members of these households consider taking another job in Bishkek (for example, as a taxi driver, security guard, or retail clerk) or migrating. Part-time or seasonal off-farm jobs are very common in this category and pay for daily expenses or seed purchases.

FFS3: viable crop and dairy farming systems: This category looks very similar to FFS2 at first sight. Households follow the same cropping system and have a small herd. However, FFS3 farms have accumulated a larger amount of capital and invested in dairy production. The money comes mainly from extra jobs and migration, and sometimes from microcredit loans. These households feed their livestock cereals and fodder and derive their incomes from marketing animal products, for which local prices have become high and stable since 2007 (Figure 2). So these farms are less vulnerable to international market variations than FFS2 farms. Milk sales provide regular cash income for 7–8 months a year, but this requires extra female labor (a woman milking up to 5 or 6 cows a day).

FIGURE 2 Index of food prices in Tokmok, Kyrgyzstan, 2000–2011. (Source: State Committee of the Kyrgyz Republic of Antimonopoly Policy 2011)



Calves born on the farm can also be reared and sold in the bazaar when money is needed. For these reasons, this FFS is economically viable in the medium term.

FFS4: dynamic meat-oriented farming systems: Livestock have multiple roles in rural livelihoods: They produce food needed for self-sufficiency (dairy and meat), constitute a readily available source of money, and have great social importance for feasts and life-cycle events (Schoch et al 2010). Households tend to keep their animals as long as possible and sell them only when they need money.

Only the wealthiest families can tie up enough cash to develop serious meat-oriented livestock farming (FFS4 is defined as having more than 30 sheep, 6 cattle, and a horse). Here, the crops are also used to feed livestock; farmers even have to cultivate extra fodder on rented irrigated or rain-fed land, or buy extra fodder, usually from FFS2 farms. Herders with the biggest herds usually have cowsheds in the mountains and use common pastures for free, which increases the profitability of their production system.

FFS4 farms, by marketing both dairy and livestock, generate high levels of income. Moreover, the livestock constitute an effective investment and self-insurance system. Whereas low- and middle-income households' strategies are focused on self-sufficiency and risk management, better-off households can take risks and adopt accumulation strategies. The proceeds from the sale of adult animals can be easily reinvested in young ones, especially in springtime, for fattening on summer pastures. These households are in a position to accumulate capital and to develop new activities such as a small retail business or agricultural equipment rentals (Shigaeva et al 2007).

Comparison between the types

This capacity-based typology shows that farmers face macroeconomic constraints in markedly different ways. The most vulnerable households are the ones that gradually sold the land they received during decollectivization in order to survive and have not been able to organize a lucrative farming system with intensive market gardening. Some households (FFS2) switch gradually to less risky types of jobs with regular, if not high, incomes. Others (FFS3–FFS4) have become viable to the point that they do not rely on off-farm activities to fulfill their basic needs. Those specializing in meat production (FFS4), especially beef, have grown rapidly.

The production choices depend not only on a household's assets, especially capital, but also on its decisions about allocation of resources between farm and off-farm activities. As Schoch et al (2010) have shown, there are a variety of diversification strategies, and not all improve livelihood sustainability in the long term: use of off-farm incomes only for current expenditures and lack of investment in agriculture generally lead to a high exposure to risk and inability to seize market opportunities.

Is beef a "bull market"?

The analysis shows the central place of husbandry in sustaining rural livelihoods. The local food price index (Figure 2) shows a constant increase in the price of animal products. While livestock have continually increased over the past 10 years, the price of beef has multiplied by 4.5 and that of mutton has multiplied by 3.3; in the same period, the overall price level in Kyrgyzstan has been multiplied only by 2 (World Bank 2011). This trend became even more pronounced in 2010–2011. The beef market has developed a lot over the last 10 years. Mutton and, to a lesser extent, goat are more likely to be consumed within the family, and the market for them is quite narrow. Beef is not consumed in rural areas because of difficulties in preservation; it is sold at retail markets in cities. Beef was 20% less expensive than mutton in 2000 because it has less fat and was considered less tasty (Schmidt 2001), but the two now sell for the same price, as urban eating habits trend toward less animal fat consumption, diversification of cooking habits, and increased popularity of globalized food types.

Today, beef production is almost entirely market oriented, and each farming system has a specific position

along this production chain: FFS2 sells inputs to herders; FFS3 sells young calves; FFS4 breeds and sells adult cattle. Other actors are also involved in fattening, such as professional shepherds and investors who carry out large-scale herding in the mountains using hired labor. Currently, few farms are involved in fattening and finishing, which requires large cowsheds, cash flow to buy cattle, and effective fodder management. In contrast, north of Bishkek (in Džangi-Džer, Dvadcat'-Khotor, and Manas), some large-scale farming enterprises do indoor fattening and finishing, with a stock of 100–400 cattle, selling directly to food industries and retailers. Kazakhstan represents 80% of the market. In the current context of rising prices, people representing FFS4, but also business people, have seized the opportunity to invest their money in a very profitable way. When they rely on hired labor, these farming systems can be considered really profit-oriented businesses maximizing their surplus. It is a very different logic than most of the FFSs, which have subsistence of the family as their priority (Chayanov 1966).

A study of cattle prices at the local market (Tokmok; see Figure 3) highlights the added value at each stage of beef production. The profitability of rearing a calf increases over time. Before weaning, a calf is cheap at the bazaar because its food (milk) has a significant opportunity cost. At the fattening stage, by comparison, the price of a bull, which depends only on the quantity of meat and fat, doubles in 6 months. The farming systems that invest in fattening benefit the most from the steady price increase, especially since they accumulate capital, which is re-invested in buying up even more calves produced in the area. This leads to a progressive concentration of beef production in the hands of a few fatteners–finishers. This "momentary bull market" (upward market trend associated with investor confidence of future price increases) for beef may show a tendency to speculation at some point, but it also seems to highlight a growing demand for this meat due to urbanization and improving living standards in urban areas, especially in nearby Kazakhstan.

The gradual concentration of beef production is also ensured by trade flows from all over the country (Issyk-Kul, Naryn, and Osh; Figure 4) to the main consumption areas (Bishkek, Almaty, and Russia). Bazaars such as the one in Tokmok, a few hundred meters from the Kazakh border, are major nodes in this network. Large and small traders play a major role gathering the fragmented production and managing transport and risks related to price variations. Some of them are part-time farmers making a small amount of money in the bazaar one day a week; some spend days in the villages to collect young bulls to be sold directly to the fattening farms; some are business people buying livestock in different *oblasty*. As the average margin is the same for all, around US$ 20 per sale, their income depends on their turnover. The most

FIGURE 3 Price for male cattle in Tokmok, Kyrgyzstan, April–May 2011. (Source: Personal field work)

powerful beef investors in Kyrgyzstan aim at controlling bazaars, showing their strategic position in the national economy (Spector 2006).

Discussion and conclusions

There is indeed a particular agro-economic logic in the increasing socioeconomic stratification in rural areas. Some farming systems (FFS1–FFS2) are not profitable enough to yield secure livelihoods, because of both insufficient resources and strategic choices of activities. On the other hand, agriculture based on high-value products (dairy and meat) can be very profitable, allowing development of a family farm, but also attracting investments from urban people in enterprise-like farming systems. Consequently, the dynamics of rural depopulation (through national or international migration) cannot be explained by the low profitability of the agricultural sector compared to trade and services, but by various individual strategies of income diversification in an environment of uncertainty.

The analysis also shows that every household is embedded in the market economy, even if some have a more favorable position than others. The academic literature is often not very clear about this and generally contrasts market-oriented and profitable farms with poor and subsistence-oriented ones (Sabates-Wheeler 2007). Of course, some FFSs make a profit, while others barely fulfill their needs. However, the market is also historically an opportunity for poor households to sell their high-value products and buy cheaper staples (Pianciola 2004).

Even if the informal cooperatives described by Sabates-Wheeler and Childress (2004) and Sabates-Wheeler (2007) are gradually collapsing, market failures are still visible when farming households consume their own products and supply their own inputs (fodder, manure, and seeds). These practices are common whatever the size of the farming system. The inability to find technical alternatives to tractors for cultivation also

FIGURE 4 Kyrgyz women selling calves in Karakol bazaar (May 2009, Karakol *oblast*, Kyrgyzstan). (Photo by the author)

prevents a greater variety of cropping systems that would probably be more profitable.

Nonetheless, the Chuy valley is in a much better situation than other parts of the country because it has good access to markets, however imperfect. In remote areas of Kyrgyzstan, such as Naryn *oblast*, there is no opportunity such as dairy farming for low- and middle-income families, and meat is the only valuable product that can be exported. Even if market access is unfair, these families need to be able to seize market opportunities and find the means to invest more in their farming activities in order to be able to make a living from the various resources of this mountainous area. Accordingly, development policies in the area should provide information and incentives that support such efforts.

ACKNOWLEDGMENTS

The author is grateful to the International Research Group "Nomadism, Societies and Environment in Central and Northern Asia," the University of Paris–Ouest Nanterre, France, and the French Institute for Central Asian Studies (IFEAC), Uzbekistan, which funded the field research in Kyrgyzstan, and to the University of Central Asia's Mountain Societies Research Centre for supporting publication of this article. Aida Usupova, translator and research assistant, is also thanked for her enthusiasm and friendly help.

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Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
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Village-level Behavior Under Conditions of Chronic Conflict

Evidence From Badakhshan in Northeastern Afghanistan, Drawing on a Livelihood Trajectory Analysis

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Drawing on a panel study of households established in 2002 and a revisit in 2008–2010 to a subsample, this paper explores the livelihood pathways of 24 households in 3 villages in Badakhshan in northeastern Afghanistan. It finds that most households were worse off than they were in 2001, although they experienced a brief period of relative prosperity based on the 1 market choice available, opium poppy. The paper draws attention to the corporate nature of villages and their variable capacity to support the provision of village-level public goods. This variability is influenced in part by the relative richness of the resource base of the village and the related degree of social differentiation. Where land inequalities are high and the elite are economically secure, they have few incentives to widen provision of public goods and can be immune from social sanctions. Where the elite are economically insecure, they are likely to have a shared interest in supporting village solidarity and a moral economy and may promote the provision of public goods. External interventions focusing on village governance need to pay much greater attention to village preconditions given the extent to which the effects of such interventions are often subject to the behavior of the elite and preexisting customary structures.

Keywords: *Livelihood trajectories; chronic conflict; elite behavior; informal institutions; Badakhshan; Afghanistan.*

Peer-reviewed: *May 2012* ***Accepted:*** *June 2012*

Introduction

This paper is an inquiry into household livelihood trajectories (Bagchi et al 1998; Murray 2002) under conditions of chronic conflict and the influence on these of village context and its social order (North et al 2007: 47). Although there have been a multitude of village-level studies in South Asia, including Afghanistan (Tapper 1991; Coburn 2011), few have established panel data sets and tracked households over time or situated trajectories within a wider institutional context (Da Corta 2010). Even fewer have compared villages, and little attention has been paid to intervillage variation (Wade 1988 is a notable exception). As Srinivasan (2004: 78) noted in his analysis of long-term change in villages in southern India, "higher-order statements about the developmental experience of villages is notable for its absence," although such differences are widely recognized.

A village is a place, but as with markets—which are places and also institutions with rules that govern behavior and the conditions and terms under which exchanges take place (Harriss-White 2003)—the village contains a multitude of institutions that govern the behavior of people inside it. Where the state is largely absent, as in Afghanistan, such institutions continue to play a key role.

Three customary structures are commonly found in most Afghan villages (Noelle-Karimi 2006; Brick 2008) that are central to village governance and the provision of basic public goods, including those of security and dispute resolution (Smith 2009). These are the village council or *shura*, the village leaders (*maliks* or *arbobs*), and the village clergy (*mullahs*). Each of these customary structures has distinct and nonoverlapping areas of authority (Brick 2008), gaining authority and legitimacy from different sources. In the case of the village council, its membership is based on reputation and performance earned through managing dispute resolution. The village headman is the key interlocutor between the village and district authorities, usually selected by the village. The clergy's authority is derived from religion and speaks on matters determined by Sharia law. As will be argued, the 3 study villages are distinctly different in the performance of their customary structures, with—it is suggested—long-term effects for the welfare of their households.

The paper first describes the methods and context of the study before exploring livelihood trajectories and village differences and their effects. The final section develops an explanation of what underlies variability in village behavior, drawing on the contrasts between them.

TABLE 1 Physical and resource attributes of the 3 study villages.

Village	Altitude (masl)	No. of HHs[a)]	Irrigated land (ha)	Rainfed land (ha)	Irrigated (as % of total)
Toghloq	1232	178	46.8	13.2	78
Shur Gul	1925	302	160	240	40
Khilar	1976	44	10	40	20

[a)]HHs, households.

Methods

In 2002 a panel set of 390 households in 21 villages was established in 7 contrasting provinces to build understanding of Afghan rural livelihoods post-2001 (Grace and Pain 2004). A subsample of these (64 households in 8 villages in 3 geographically contrasted provinces) was revisited in a second round restudy in 2008–2010 to explore household livelihood trajectories and welfare outcomes in the intervening period (Kantor and Pain 2011: 9–13). This paper reports on the livelihood trajectories of 24 of those restudy households living in 3 villages in Badakhshan, linking these with a detailed examination of the factors underlying village variability. The 3 study villages were originally selected in 2002 for their differences in resource endowments, but, as became clear in the study, they also had major differences in the ways in which customary institutions functioned.

The restudy focused on investigating patterns of similarity and difference in household trajectories and used a qualitative approach to collect in-depth information from a small number of carefully selected contrasting household case studies (Flyrbjerg 2006), based on a wealth group classification done in 2002. This provides a depth of understanding that statistically representative approaches cannot achieve (Hall 2003).

The field teams applied retrospective in-depth interview techniques to explore household lives and livelihoods from 2002 to 2009 to understand decision-making, resulting strategies, and their impacts in response to changes in circumstances. Interview teams were composed of 2 female and 2 male Afghan interviewers, allowing men and women of the respondent households to be interviewed separately. Two interviews were held with men and 2 with women, giving a total of 4 interviews per household. Further interviews were then held by the authors with key informants in the villages and districts to explore village social structures and differences between villages.

Badakhshan

Located in the northeast of Afghanistan, the mountainous province of Badakhshan is remote, economically marginal, and grain deficit, and there has been a history of seasonal and long-term migration. The provincial poverty rates (greater than 58%) remain among the highest in the country (MoE and WB 2010: 28).

There was an early investment in education from the 1950s so that education levels in the province in 1978 were notably higher than in other provinces (Guistozzi 2010), leading to the emergence of an educated elite. After 1978 there was considerable conflict between the leftist government and the mujahideen, and all the study villages experienced fighting during this period, although to different degrees. With the capture of Kabul by the mujahideen forces in 1992, Professor Burhanuddin Rabbani and Ahmad Shah Massoud—the 2 major northern political players—occupied key positions in the government. When the Taliban captured Kabul in 1996, Rabbani and Massoud established themselves in Badakhshan and the Pansher, a historical point of access to Badakhshan, as the center of opposition to the Taliban, holding out until the Taliban lost power.

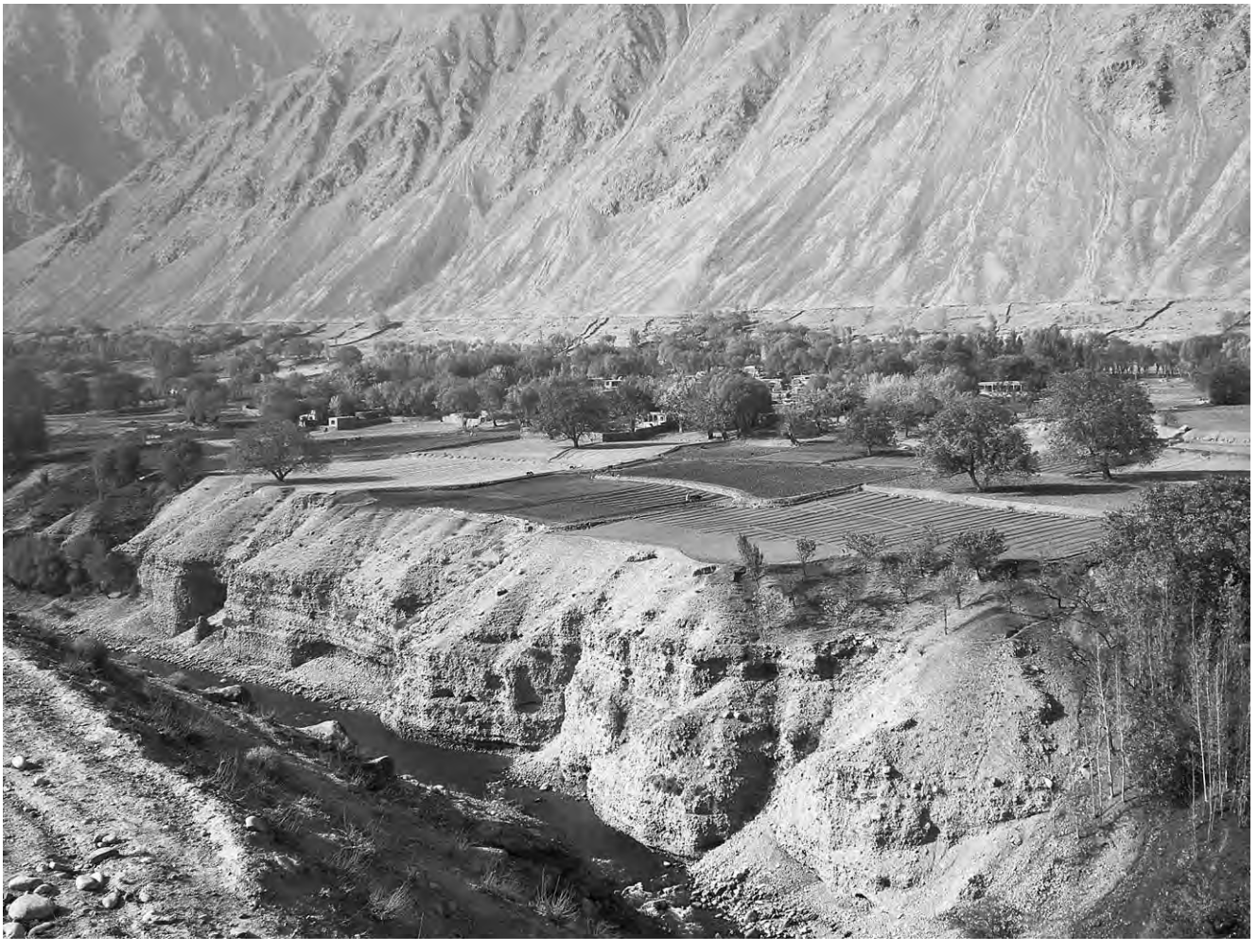
Up to 2005 Badakhshan experienced considerable anarchy (Guistozzi and Orsini 2009) under the weak patrimonial rule of Rabbani, with armed parties jostling for power and control of the rising opium economy (Goodhand 2000; Pain 2008). From 2005 President Karzai increasingly intervened in the province, seeking to "replace local systems of power and patronage…with an alternative one dependent on Kabul" (Guistozzi and Orsini 2009: 41). He supported a local politician, Zalmay Khan, who has had a long history of shifting political allegiances to build his political and economic power base, and the province has remained subject to political conflict, reinforcing insecurity.

Three villages: Toghloq, Shur Gul, and Khilar

The 3 study villages (Table 1) are located between 1200 and 2000 masl (Figure 1). Toghloq, the lowest-altitude and most accessible village, is 1 of 5 villages in a well-irrigated lateral valley that feeds the main Jurm valley. It has the highest proportion of irrigated land of the 3 villages and the greatest land ownership inequalities. Earlier, most households found employment as farm laborers, but there is now significant outmigration for employment, including joining the army or police.

Shur Gul is the largest and remotest of the 3 villages, being 3 hours' drive from Jurm in a narrow plain in the

FIGURE 1 The main valley in the study area, with villages characteristically located on the narrow river plain. (Photo by Adam Pain)



Kokcha valley. It has always been grain deficit, is unreliably irrigated, and has a long history of labor migration. In the past, the neighboring lapis lazuli mines provided employment for many households in the village, but this is now no longer the case. This village has had a long history of education.

Khilar, the smallest of the 3 villages, is located on a small plateau situated above a narrow valley. It is inhabited by a religious minority and with limited land resources; historically it has been economically and politically marginal. There has been a long history of male migration for work.

The household trajectories

The economic life of the study villages has been subject to considerable vicissitudes. War brought destruction and created refugees, although the extent of both was less in Badakhshan than elsewhere. Drought from the late 1990s affected the mainly rainfed economy of Badakhshan, bringing food insecurity and distress migration. An opium economy that gathered pace from 2001 onwards brought a level of prosperity to the province beyond its historical experience (Pain 2008), relieving debt and enhancing food security. The decline of this economy from 2006 onwards (although it has shown signs of a return; see Pain 2011; Figure 2), driven by falling prices and counternarcotic pressures, led to a sharp drop in the health of the rural economy compounded by recurrent droughts and volatile food prices.

All case households benefitted from the opium economy during the period of 2000–2006, but Toghloq benefitted most because of its resource richness. These were the years of relative prosperity, with high levels of food security for most. Since then there has been a decline in rural employment and wage rates, poor rainfall, and a significant rise in grain prices during 2008. Drawing on what households reported about their change in circumstances, they were classified as "prospering

FIGURE 2 Opium poppy growing and harvesting in Badakhshan in 2006. (Photos by Adam Pain)

economically," "coping," or "declining" (Pain 2010: 27). Out of the 24 households, 3 had prospered (Table 2) since 2002. Another 3 had managed to cope, broadly maintaining their economic position. The majority (18) had seen a decline in their economy, indicative of the precariousness of life in the province.

Of the 3 prospering extended households, 1 in Toghloq had done so through agriculture, but was originally landless. Rich in male labor devoted exclusively to sharecropping land, the opium economy allowed the household to sharecrop on additional land at the peak of opium's profitability and leverage that wealth into land purchase. The 2 households from Shur Gul have prospered primarily through salaried employment, 1 as a teacher and the other driving for a nongovernmental organization (NGO).

The 3 coping households—2 from Toghloq and 1 from Shur Gul—have either benefited from inherited resources (land) or through education secured some form of salaried employment. But large family sizes have raised consumption demand close to the capacity of these households to meet that demand.

For the declining households, variable but combined constraints of land, labor, household-specific health events (sickness and death), and aging contributed to their economic decline. In 1 of the Shur Gul wealth group II households, through a combination of bad luck and internal conflict that led to the son's setting up a separate household, there has been a severe economic decline (Pain 2010: 28). Khilar, which lost valuable pastureland to powerful commanders during the war, has suffered a major decline in its livestock population, and this has continued since the ending of the opium poppy cultivation. Many households have moved into food rationing as grain prices rose in 2008 and diversified into low-return and uncertain activities such as brushwood collection. Although some households have survived on informal credit, the level of poverty is such that in Khilar poorer men have been unable to marry. The sending of sons to join the army or police has its risks, and 1 household from Khilar had a son killed after he joined the national army.

The overall picture of economic life over the last decade for the study households is one of decline, thus limiting the contribution of individual action and markets to household welfare. Although there are resource differences between villages, more significant to the long-term prospects of households are the differences in village behavior and the extent to which collective action has provided public goods. Thus although the short-term prospects for the Shur Gul households are limited, in the longer term these households are better placed than the poor from the other 2 villages, given the investments the village has made in education and other public goods.

Village social orders

In the disputed Afghanistan presidential election in 2009, when President Karzai gained a second term, his

TABLE 2 Livelihood trajectories of case study households and key factors contributing to the directions of these trajectories.[a)]

Village/WG	Direction of trajectory	No. of HHs	Causal factors	Contributing/ mitigating factors
Toghloq				
WG I	Prospering	1	Labor rich, land purchase	Opium economy
	Coping	1	Household size	
WG II	Declining	2	Household size and composition, age, household division, lack of nonfarm income	
WG III	Coping	1	Household size	Salary
	Declining	3	Household size, health, household division	
Shur Gul				
WG I	Coping	1	Salary, sale of land	Son at college
WG II	Prospering	2	Salary, wage labor	Male labor
	Declining	1	War, household division	Age, son at college
WG III	Declining	4	Loss of wages, household division, age, death, sickness, household size	Illness, labor, children at school
Khilar				
WG I	Declining	2	Household size, decline in livestock, death	Debts
WG II	Declining	3	Debts, deaths	Increasing livestock, salary
WG III	Declining	3	Lack of labor, age, unmarried, sickness	Labor-rich, small household

[a)]WG, wealth group; HHs, households.

representatives and those of his chief opponent Abdullah Abdullah came to Badakhshan and visited each of the 3 villages. Toghloq largely ignored the election, had little to do with both campaign teams, and the campaign teams in turn did not pay much attention to the village. Shur Gul, by contrast, was visited by representatives of both campaigns, who each asked to set up an election office in the village. Both requests were considered by the village council, and both were rejected on the grounds that the presence of either party might contribute to conflict in the village during and after the election. In Khilar, President Karzai's representatives took the village leaders and local power holders to campaign on the president's behalf in the neighboring valleys.

The above account was given by 1 key informant and corroborated in the 3 villages. Drawing on evidence from field observations, key informants, and village-level discussions (Pain 2010: 16–24), it appears that the actions of the leadership of Shur Gul to manage the village's external relations in the interests of the village were consistent with other actions they had taken in the past. The ways in which the other 2 villages engaged in the elections were also in keeping with their past behavior. This observation on the contrasting "behavior" of 3 villages begs the questions of what is meant by village behavior, what underlies it, and what effects it has on the security and welfare of people who live in these villages.

Central to an understanding of the social order of the 3 study villages is the behavior of their elites. The villages differ significantly in this respect, with implications for household access to public goods. The first point of contrast is with respect to education (Table 3). In the case of Shur Gul, over 60 years ago the *arbob* (village leader) put the village on an educational track through the establishment of a school. A significant number of boys graduated and went to university in Kabul and elsewhere, building a wider network of social connections. After 1978 many returned to the village to maintain its educational investment and were paid for by the village. A girls' school was established in the mid-1990s and the first girls were graduating by 2009.

TABLE 3 Literacy rates and school attendance by age and sex for the respondent households.

	Toghloq	Shur Gul	Khilar
Literate male head	1	4	2
Literate female head	0	0	0
Males 18 and older: total number	24	19	25
Males 18 and older: % literate	17	47	24
Females 18 and older: total number	23	16	15
Females 18 and older: % literate	8.7	12.5	7.0
Males 5–17: total number	14	17	11
Males 5–17: % in school	71	94	100
Females 5–17: total number	11	13	9
Females 5–17: % in school	73	100	78

Toghloq also established a school, but there was less interest from the elite in education, and by 1978 only a few students graduated to university. After 1978, the village and the valley as a whole quickly joined the opposition. The school, as a symbol of government presence, was destroyed by the mujahideen, the teachers were killed, and all education was stopped until 2001. The school was restarted after 2001, but recruitment of both boys and girls has been gradual. Khilar has never had its own school, and boys went to school in the valley. A few managed to graduate before 1978, but access for girls to education did not start until after 2001, and the distance still restricts girls' access when they are older because of social norms about such girls being in public.

Table 3 compares—to the advantage of Shur Gul—the educational outcomes between 3 villages. In contrast to the other 2 villages, all the poor households in the Shur Gul sample were making every effort to keep all their children in school because of the long-term advantages they saw in education.

The differences in educational outcomes in the 3 villages are reflected in the levels of other public goods. The village leadership in Shur Gul has been effective in securing levels of health provision, safe drinking water, road access, and electricity that the other 2 villages have not reached (Pain 2010), in part because of its effectiveness in building connections to NGOs, as discussed below. Khilar, in contrast, only got road access in 2007.

The second point of comparison is with respect to security. Toghloq entered into armed opposition and the valley successfully defended itself against government forces after 1978. With the departure of the Soviets the valley came under control of a powerful regional commander, allowing various subcommanders within the valley to compete for position. Collective action had been effective in defending the village and valley from the outside world during conflict. Even in 2005, when an opium eradication team attempted to enforce the opium ban, it was met with armed resistance and the team's vehicles were seized and burnt, an action that would have been unlikely in the other 2 villages. But the power of commanders within the valley has been a source of insecurity, and 1 informant reported how his daughter was taken by force to marry a commander's son (Pain 2010: 43).

Khilar suffered predation and lost pastureland to powerful commanders in the valley during the war (Pain 2010: 21). Only when the village placed itself under the protection of a sympathetic commander in the valley did they gain protection. This valley commander still retains influence over the village, and his authority exceeds that of the village council (Pain 2010: 23).

In contrast, Shur Gul at the start of the conflict selected an educated and prominent figure to lead the village defense and managed to limit its engagement in the conflict. Although the village had divisions, its ability to maintain good external relations as a form of defense was central to its survival. Links with key provincial commanders established by the educated elite ensured both its physical and economic survival, particularly during the drought when they gained access to work in the lapis lazuli mines for a regular period each year. The ability of the village leadership to build external relations was critical to gaining the interest of NGOs after 2001 and the expansion of public good provision, with long-term welfare effects for its inhabitants in contrast to the other 2 villages.

Discussion

What underlies the contrasts in behavior of the leadership of these 3 villages as seen by their actions in the recent presidential election and their different interests in

supporting the public good in their villages? Brick (2008) argues that 3 features of village customary structures in addition to their distinct areas of authority can be supportive of village-level public good provision. The first is the capacity of these customary structures to independently raise revenue from within the village. The ability of the *shura* in Shur Gul to raise a levy for the school teachers during the war is consistent with this.

Second, there need to be checks and balances that can prevent abuse of authority by anyone of these customary structures. The reason for this relates to the third factor—the need for there to be sufficient actors who have the ability to stop potential abuses of power and act as veto players. Where land distribution is relatively equal between landowners, power is more likely to be dispersed. Where landownership is concentrated, so is power. Under such conditions there are few constraints on elite behavior and they are more likely to act in their own interests.

It is the relation between social solidarity and inequality that is the critical issue. Where land inequalities are higher and the elite are more economically secure, as in Toghloq, they have fewer incentives to widen provision of public goods and are largely immune from social sanctions; social relations can be hierarchical and exploitative. Where, however, the elite are economically insecure, as in Shur Gul, they are likely to have a shared interest in supporting social solidarity and a moral economy (Scott 1976) and promoting the provision of public goods. But Khilar, with its small size, limited resources, and social marginality, indicates the limits to village collective action.

Two conclusions may be drawn from this discussion. First, the evidence suggests that collective action is likely to be stronger under conditions of relative equality linked to poorer resource conditions. Second, village preconditions in Afghanistan are likely to matter to program design. Although programmatic practice has been attentive to the need for provision of public goods at the village level, it has specifically sought to displace existing village customary structures (Pain and Kantor 2010). There has been no interest in understanding and responding to the variability in village preconditions that might affect public good provision. There has also been no attention to the ways in which "modernizing" organizational practices have engaged with customary institutional behaviors. The consequence of this is that interventions have more often operated subject to existing practices rather than displacing them, a process of institutional "bricolage" (Jones 2009). Sometimes this has worked to the good, expanding public good provision, as in Shur Gul. In others it has not, reinforcing elite positions and leading to external resources being captured by the elite.

ACKNOWLEDGMENTS

Funding for this research was provided by the Economic and Social Research Council (ESRC), UK, grant number RES-167-25-0285.

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Improving Quality of Life in Remote Mountain Communities

Looking Beyond Market-led Approaches in Badakhshan Province, Afghanistan

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This article explores how physical remoteness influences the quality of life of people living in mountain communities in Afghanistan's Badakhshan Province. Basing its analysis on data obtained from a quality of life assessment carried out in Badakhshan, the article compares how quality of life indicators differed between villages that are more remote in terms of their access to markets, services, and transport, and those that are closer to small urban economic hubs. Indicators in a range of domains including the household economy, built environment, health, and education were poorer in remote villages. However, less tangible aspects of life such as trust between people, social cohesion, cultural life, and people's own perceptions of the quality of their lives were similar or better in these locations. Nevertheless, we argue that remoteness acts as an important barrier to improving many aspects of health and wellbeing in remote mountain villages. Market-led approaches by themselves are inadequate for helping to promote quality of life improvements in these communities. This research suggests that the holistic framework, mixed funding, and innovative approaches that the Aga Khan Development Network is pursuing as the main implementing partner of the National Solidarity Program in the province—including infrastructure development, strengthening local governance, and cross-border development programs with Tajikistan—stand a better chance of improving quality of life.

Keywords: *Market-led development; mountain societies; quality of life; remoteness; Badakhshan; Afghanistan.*

Peer-reviewed: *May 2012* ***Accepted:*** *June 2012*

Introduction

In 2007, the Aga Khan Development Network (AKDN) initiated a quality of life (QoL) assessment program in selected geographical regions to which it has made long-term commitments and where it uses the combined expertise of its social, cultural, and economic development agencies to promote broad-based area development. The concept of QoL draws on Amartya Sen's (1993, 1999) work on capabilities and on more recent work on wellbeing (Alkire 2002; Diener et al 2003; Gough and McGregor 2007; White 2008; Layard 2010). Sen has argued that rather than measure "utilities," as economists tend to do, we should measure people's "capabilities," that is, what they are able to do and achieve in their lives. Human wellbeing can be conceived of in terms of the interplay of 3 dimensions: the material, relational, and subjective (McGregor and Sumner 2010). The authors' working definition of a "good" QoL encompasses these dimensions: "A state of being in society where people's basic needs are met, they can act effectively and meaningfully in pursuit of their goals, and feel satisfied with their life." (McGregor et al 2007: 3).

Development policy has long tended to emphasize the material dimension and has underplayed the importance of relationships and people's own perceptions. This leads to a view of development that is not rounded nor aligned with people's own lived experience. The Sarkozy Commission on Measuring Societal Progress, set up in 2008, concluded that it was necessary to shift emphasis from measuring economic production to measuring people's wellbeing (Stiglitz et al 2009). Adopting the concept of QoL allows AKDN to think about and do development differently. AKDN's programs are more wide ranging, including areas such as culture and music, which communities regard as important in promoting their wellbeing.

Badakhshan (population 1 million), located in northeast Afghanistan between 36 and 38°N and 70 and 74°E, and with a surface area of 44,059 km^2, is mountainous, sparsely populated (23 people per km^2), and relatively isolated. Villages in Badakhshan reflect the attributes common to mountain societies, including a

BOX 1: Migration in the context of increasing local opportunities

Although in previous decades many men from Osast and Deh Ghulaman left for both Pakistan and Iran because of fear of the draft, war, debts, poverty, or lack of food, at present very few migrants leave Afghanistan. In Osast cross-border migration "has lost its appeal" because of the presence of more jobs in the region (eg with NGOs) and the nation (eg the Afghan National Army and the police), along with more educational opportunities. In Deh Ghulaman both men and women similarly note that work and school opportunities have increased in recent years, and "the people's lives have been improving." Rather than go to Pakistan, some men from the village now migrate north into the Little Pamir region of the Wakhan, where they work as shepherds or construction workers for rich Kyrgyz (another ethnic group) during the summer months.

Source: interviews conducted during the survey

general reliance on livelihoods based on agriculture and livestock, experiences of migration and remittances, rudimentary education and health infrastructures, and limited access to markets and services (see Box 1). The region is ethnically, linguistically, and religiously diverse. However, the cultural separateness of Tajik-majority Badakhshan from Afghanistan's Pashtun-majority heartland has led to a certain degree of political isolation from central government structures in Kabul. Badakhshan is comparatively secure in relation to other parts of Afghanistan, though the situation is by no means stable. Many lower-altitude parts of Badakhshan were sites for extensive opium cultivation, especially in the early to mid-2000s, although production declined greatly in the latter part of the decade because of factors such as a drop in the price of opium, eradication activities, and support for alternative livelihoods. Since 2010, however, there are indications that cultivation has increased slightly (Pain 2011).

Sixteen districts in the province (of a total of 28), most of which are located in the Hindu Kush and Pamir Mountains, are a focus for AKDN's programs; in this area, AKDN is the main implementing partner of the government's National Solidarity Program (NSP), the national framework for development. It is Badakhshan′s isolation, particularly away from its economic hubs, which is the province's most striking characteristic. The implications of physical remoteness on economic and social wellbeing have been documented in both mountain (Jodha 2000; Kreutzmann 2001; Bird et al 2002; Ives 2004) and nonmountain areas (Ravallion and Wodon 1999; IFAD 2001; Stifel et al 2003; Kanbur and Venables 2005; Bird et al 2010). This literature tends to focus on economic growth and livelihoods, and has not sought to empirically demonstrate the influence of remoteness on wide-ranging aspects of people's lives, including relational and subjective elements. This article seeks to fill this gap by using disaggregated data relating to QoL, to show how key indicators differed between non-remote and remote villages in Badakhshan.

Methodology

The principal aim of the QoL assessments is to understand changes in QoL in an area over time, and to inform programming within AKDN and its partners. The domains examined in the QoL assessments are derived from asset-based frameworks and empirical exploratory studies in Syria, Tajikistan, and Mozambique. Using interviews and group discussions, the aim of the exploratory studies was to understand people's own socially and culturally embedded perceptions of what is a good and poor QoL, and the domains and resources that they consider important. We also experimented with the Person-Generated Index of QoL (based on Ruta et al 2004), which asks individuals to choose 5 important areas of their lives and spend a maximum of 10 points on the various areas. The studies confirmed the importance of the following domains: livelihoods and the household economy, the natural and built environment, health and education, and social and cultural life, as well as voice and representation (Kanji 2007). Consultations with sector experts helped select a few key indicators in each domain that would best reflect progress or a worsening in that domain. These exploratory studies also highlighted the need for mixed methods, reinforcing the maxim that "not everything that counts can be counted."

Assessments consist of a survey with a representative sample of households and qualitative research undertaken in 5 or 6 selected sites. Household heads and their spouses are interviewed to enable disaggregation by gender of relevant survey data. The qualitative research sites capture diversity in characteristics that influence QoL, and key informant interviews, focus groups, and individual interviews differentiated by gender and age are used to obtain in-depth and more sensitive information that is difficult to capture through a questionnaire. The mixed methods are also used to triangulate findings. Assessments are repeated every 3 to 5 years to assess changes in QoL in a specific context. Results are analyzed with local and national actors, including communities where possible. AKDN's interventions are adjusted in light of the findings and feedback.

The QoL assessments highlight in which domains indicators are poor and where they are improving over time. The studies also reveal how people themselves think about their QoL and their priorities and aspirations to inform AKDN programs. Attributing particular results to AKDN's work is difficult because there are many other influences on QoL, such as the work of other

FIGURE 1 Badakhshan Province, Afghanistan, with non-remote and remote areas. (Map by Anand Nandipati)

FIGURE 2 (A) Sooch: a non-remote village in Badakhshan; (B) Nushi: a remote village in Badakhshan. (Photos by Romin Fararoon)

TABLE 1 Differences in household income between non-remote and remote villages.

	Non-remote	Remote
Cash income	*N* = 490	*N* = 614
Median annual cash income (US$)	1287	870
Range of cash incomes (1st quintile) (US$)	30–580	17–394
Range of cash incomes (5th quintile) (US$)	3109–26,950	1783–16,148
In-kind income	***N* = 550**	***N* = 650**
% of households receiving in-kind income	94	99

organizations in the same area and factors outside its control, such as global recession or climate change.

In 2010, AKDN carried out its first QoL assessment in Afghan Badakhshan. This consisted of a survey of 1200 rural households in 12 districts as well as a qualitative study of 5 villages. The villages were chosen, using local knowledge, to capture diversity in QoL related to remoteness from urban centers, ethnicity and religion, and agroecology, as well as livelihoods and access to services. The instruments used for the assessments were adapted and contextualized through discussions with local key informants and extensive piloting in communities. Insecurity and/or inaccessibility forced the survey to exclude 4 districts that were part of AKDN's programming focus.

This article's analysis of remoteness was motivated by the QoL qualitative study, which found important differences between villages depending on their access to basic services, markets, and transport. To see how representative these differences were, the QoL survey data set was disaggregated into 2 categories: "non-remote" and "remote" villages. Based on local knowledge, a classification of remoteness was developed. Any village located 4 or more hours on foot from 4 hubs of economic activity—Baharak, Jurm, Ishkashim, or Faizabad—was defined as remote. This criterion was used because entire districts were considered remote, and the above classification captured this view (Figure 1). Distance-based criteria for categorizing remoteness have been used elsewhere (McCabe 1977; Minten and Kyle 1999; Jacoby 2000; Stifel et al 2003), though these classifications mainly used kilometer distances or travel time by car to economic centers. Using travel time by foot was seen to reflect the limited options for road transport in Badakhshan and may be relevant for other similarly isolated mountain areas. It is important to recognize that physical distance often brings with it noneconomic forms of isolation, such as a "lack of political capital" (Bird et al 2010) and difficulties in effectively voicing needs to far-off decision-makers.

A total of 26 sampled villages were classified as remote, and 22 villages were classified as non-remote (Figure 2).

TABLE 2 Household income sources and median annual cash incomes derived from these sources.[a)]

	Non-remote		Remote	
Income source	**% (*N* = 490)**	**Median annual cash income (US$)**	**% (*N* = 614)**	**Median annual cash income (US$)**
Sale of livestock/poultry	30	352	56	224
Agricultural wage income	36	440	37	220
Nonagricultural wage income	25	264	32	220
Sale of agricultural products	32	330	23	220
Salary	23	1319	28	1266
Self-employment in nonfarm enterprises	36	1099	16	330
Remittances from migrants	14	1099	17	571
Aid/charities/relatives	2	176	5	110
Other sources	2	495	1	659

[a)]Percentages exceed 100%, as households may have received income from more than 1 source.

TABLE 3 Differences in household ownership of durable goods between non-remote and remote villages.

Durable good type	Non-remote % *N* = 550	Remote % *N* = 650
Full floor-covering carpet (*mukhet*)	84	82
Carpet (machine made)	76	72
Sewing machine[a)]	68	41
Radio[a)]	56	39
Tape recorder[a)]	46	35
Mobile phone[a)]	62	16
Television	39	30
Carpet (handmade)	27	20
Satellite dish	28	18
DVD/VCD/CD player	16	11
Generator	12	4
Microhydel power generator, motorcycle, car, bicycle, electric fan, computer	<10	<10

[a)]Denotes a statistically significant difference in ownership.

The data set upon which this analysis is based comprised 650 households in remote and 550 households in non-remote villages. All indicators were calculated separately for remote and non-remote areas. Univariate differences in proportions between non-remote and remote villages were tested using a modified chi-square test. Statistical significance was set at the 5% level, hereafter referred to as "significant." The paper draws on this quantitative analysis as well as the qualitative research to present the main findings.

Insights into QoL in non-remote and remote villages

Households in remote villages were worse off in terms of income and asset ownership

The characteristics of the households in non-remote and remote villages were similar in terms of household size (median of 8 persons), age of household head (average of 45 years), and percentage of households with migrants (around 22%). Dependence on livestock husbandry and agriculture was greater in remote villages, with about one half of men reporting it as their primary occupation compared with one third in non-remote villages. Higher percentages of women in remote villages reported housework as a primary occupation (86% versus 77%) but raising livestock and processing milk into butter, yogurt, and cheese in household compounds were also viewed as part of domestic work. The occupations data also showed that there were fewer opportunities for men in casual work and for non- and off-farm employment in remote villages.

Income: Income data are often inaccurate and do not alone represent a household's wealth, but it is nevertheless worth noting that median cash income was significantly lower in remote villages, the income range was narrower, and the dependence on in-kind income in goods was almost universal (Table 1). Respondents were given the option of not disclosing their income, which is why the number of households responding to the cash income question is lower than the sample.

For remote households, 35% earned income from 3 or more sources, as compared to 26% of non-remote households. Greater income diversification is a necessary strategy for survival, especially as land gets subdivided

TABLE 4 Access to basic services for households in non-remote and remote villages.[a)]

Indicator	Non-remote (*N* = 550)	Remote (*N* = 650)
% of households with access to an improved water source[b)]	75	32
% of households with access to an improved water source within 30 min (cold/warm season)	65/66	25/26
% of households that have electricity	73	56
% of households above with access to electricity "all the time" (cold/warm season)	19/26	8/30
% of households with access to telephone communications	74	35
% of households with access to latrines (excluding shared facilities)	20	13
% of households without access to any toilet facility	31	65

[a)]All differences are significant except for household access to electricity "all the time" in the warm season.

[b)]Improved water sources include piped water, public tap, borehole or pump, protected well, protected spring, rainwater.

TABLE 5 Household shortages of main food groups in non-remote and remote villages.[a)]

Food group	Non-remote		Remote	
	% of HHs with food shortages ($N = 550$)	Median no. of months of food shortage	% of HHs with food shortages ($N = 650$)	Median no. of months of food shortage
Staple food (wheat, barley, rice)	18	3	13	3
Vegetables/fruit	75	6	93	6
Beans, pulses/lentils	74	7	91	7
Animal protein (dairy products, eggs, or meat)	51	4	70	5

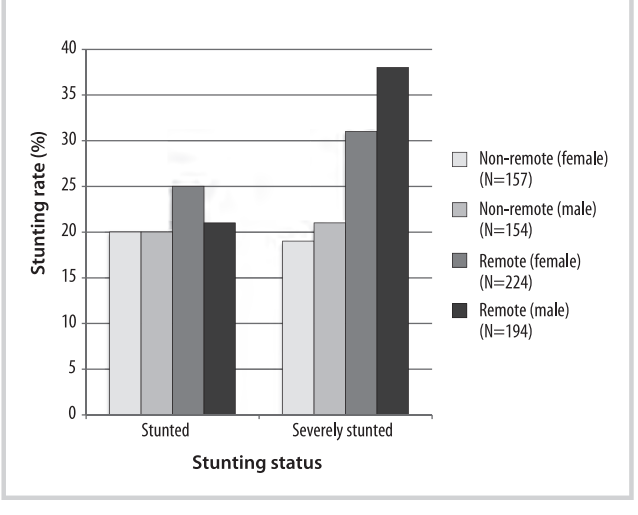
[a)]HHs, households.

over time. Nevertheless, the median income from self-employment in nonfarm enterprises was 3 times less in remote villages, and there were also significant differences in agricultural wage income and in remittances from migrants (Table 2). Migrants in non-remote villages were more likely to migrate to Iran and Pakistan, which was more financially beneficial but often involved difficult and dangerous journeys as well as harsh treatment for migrants at their destinations. Migrants from remote villages were more likely to migrate within Badakhshan or to other locations in Afghanistan, including Kabul. Income from salaries was similar and such secure employment is coveted everywhere.

Assets: Almost all households in both non-remote (93%) and remote villages (95%) owned their own homes. However, levels of ownership of other assets differed. A significant difference was found in the percentages of non-remote and remote households owning second homes (14% versus 8%) and agricultural land (73% versus 91%). However, remote households owned smaller plots—an average of 2 *jeribs* (one fifth of a hectare) of irrigated and 3 *jeribs* of rainfed land, versus 3 *jeribs* of irrigated and 4 *jeribs* of rainfed land for non-remote households. Across the board, there was a significant positive association between cash income and the amount of land owned. Higher percentages of remote households owned sheep, oxen, and goats—in higher median numbers, confirming a greater dependence on livestock than agriculture in remote villages. Ownership of trees was low in both village types, though non-remote households owned greater varieties of trees. Agricultural equipment was owned by more non-remote than remote households (36% versus 29%).

Significantly lower percentages of households in remote villages owned a range of durable goods (Table 3). Although 62% of households in non-remote villages owned 5 or more of the durable goods listed in the table, only 37% of remote village households did.

FIGURE 3 Child stunting rates in non-remote and remote villages.



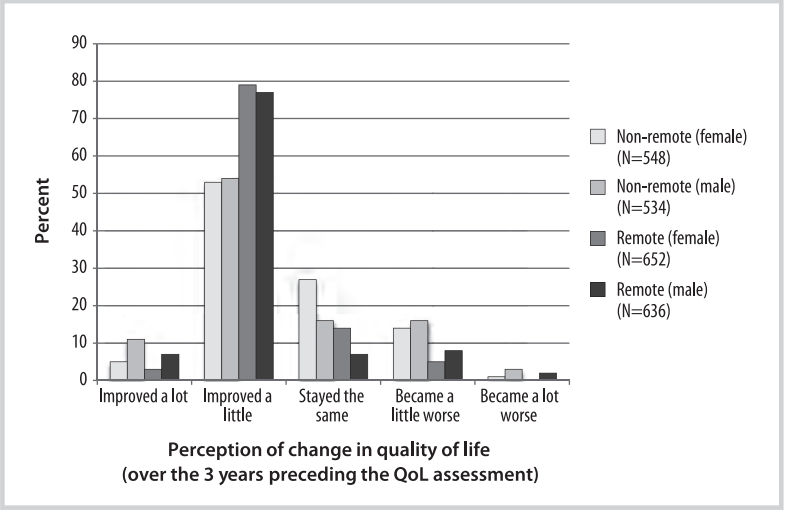
Households in remote villages had poorer access to basic services

Households in remote villages were more likely to lack access to water, electricity, telephones, and sanitation than were households in non-remote villages (Table 4). An exception was access to electricity "all the time" in the warm season. Here, it is possible that households in both village types made efficient use of microhydels powered by peak river flows and/or solar panels to obtain more reliable electricity supplies in the spring/summer.

Food shortages and selected health indicators were worse in remote villages

Major crops grown in Badakhshan include wheat, barley, fodder, and root vegetables such as potato. There was a minor difference in the percentage of households that experienced shortages of staple foods, but significant differences were found when it came to shortages of the other 3 food groups (Table 5). Diets were generally restricted, but households in remote villages fared worse, with serious implications for household nutrition. Remote households were less able to cope with food price inflation, were unable to access markets for agricultural

FIGURE 4 Perceptions of change in QoL in non-remote and remote villages.



foodstuffs, and were more vulnerable to seasonal fluctuations in food availability.

Women's and children's health were adversely affected by remoteness. Over half of women in non-remote villages received antenatal care (from a community health worker, nurse, or midwife) during pregnancy, whereas just below one third of women in remote villages did so. Only 3% of babies were delivered by a skilled birth attendant (nurse or midwife) in remote villages compared to a still low 13% in non-remote villages.

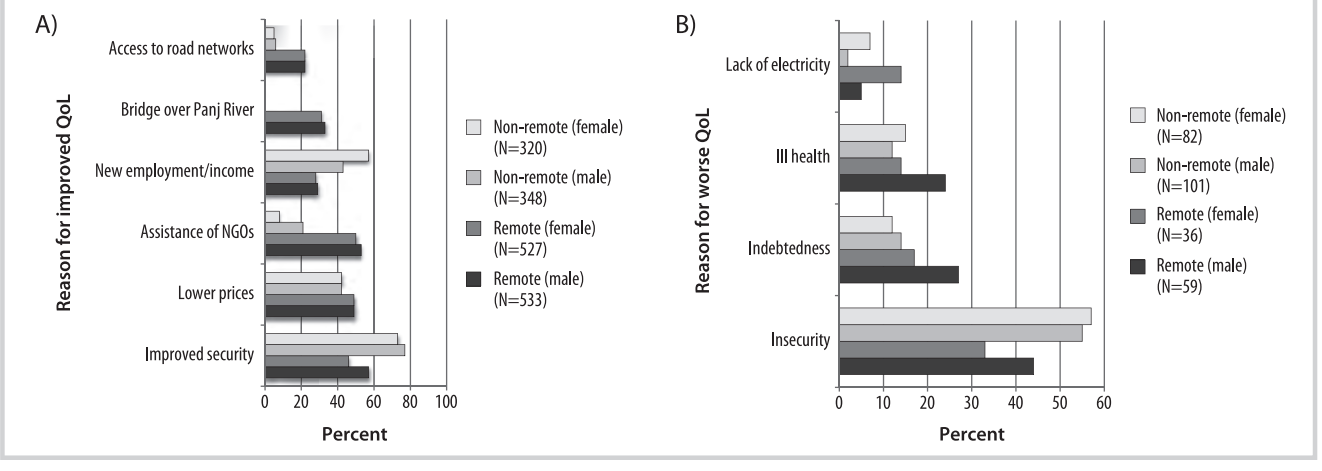
As a result of poor nutrition and health, about 50% of children under the age of 5 suffered from chronic malnutrition (stunting), but significantly more children in remote villages were "severely stunted" (Figure 3).

Perceptions of health status differed between non-remote and remote villages, with those in non-remote villages being significantly more likely to report that their health had been "good" or "very good." Regardless of village type, however, significantly more women than men reported being ill in the 2 weeks preceding the QoL assessment. Of those who were ill and said that they did not visit a health center, men and women in non-remote villages were more likely to report the poor quality of care as a deterrent, whereas distance to health centers and lack of time were more common reasons given in remote villages.

Education outcomes were slightly better in non-remote villages

Education indicators were poor across Badakhshan, regardless of village remoteness. Illiteracy was significantly higher in remote villages at 63% compared to 56% in non-remote villages. However, parents across sites in the qualitative study expressed pride in their

FIGURE 5 (A) Main reasons for perceived improvements in QoL in non-remote and remote villages; (B) main reasons for perceived worsening in QoL in non-remote and remote villages.



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children's recent achievements and valued having someone literate in their household. Levels of education were similar for males (around 45% had primary and just below 20% had secondary schooling), but females in remote villages were less likely to have primary schooling (27% versus 37%) and secondary schooling (5% versus 9%). Disruptions in schooling caused by prolonged conflict and inadequate and/or inaccessible schooling facilities contribute to these poor outcomes. On the positive side, a higher percentage of younger groups (15 to 24 years) had completed primary education: 60% of males and 51% of females. However, the qualitative study did document views that questioned the need for further education, even for males, given high levels of unemployment.

Social cohesion, trust, and QoL

Although this study shows that material wellbeing, health, and education outcomes were better for people living in areas with greater access to markets and services, there are some aspects of life that were reported to be similar or better in remote villages. Reciprocal community work known as *hashar* was found to be common across villages, and social cohesion was reported to be high across the board. The qualitative study revealed well-functioning village support systems where the poor were taken care of in times of need. This included the ritual distribution of food to the poor from the community mosque or *jamat khana* (Ismaili mosque). The practice of *ushor* or *dah-yak*, in which 10% of one's harvest is distributed to the poor, was also common. Levels of trust within villages were high regardless of remoteness, but interestingly, 90% of men and 75% of women in remote villages said that they trusted most people in neighboring villages, as compared to 76% of men and 61% of women in non-remote villages.

When asked about perceptions of their current QoL on a 5-point scale, over 60% of men and women in both village types reported that it was "good/very good." Men and women in remote villages were more inclined to say that their QoL was "neither good nor bad" and less inclined to report that their QoL was "poor/very poor." More interesting, perceptions of changes in QoL over the 3 years preceding the QoL assessment showed that men and women in remote villages were significantly more likely to report positive changes, even if it was to say that life had improved a little rather than a lot. Those in non-remote villages more often said that their QoL had either "stayed the same" or "became a little worse" (Figure 4).

These findings are surprising for remote households, given such poor material indicators, but they likely reflect some recent improvements and the importance of subjective and relational aspects of QoL, which in turn depends on expectations and comparisons with others.

What influences changes in people's QoL?

Changes in the security situation played a critical role in shaping QoL perceptions irrespective of remoteness (Figure 5A, B). More striking, however, is that the assistance provided by nongovernmental organizations (NGOs) and AKDN/NSP efforts to improve infrastructure (eg bridges and roads) were very important in shaping positive QoL perceptions for those in remote villages. However, fewer individuals in remote villages claimed that their QoL had improved because of accessing new employment or income-generating opportunities, and people in these villages were more likely to report that lack of access to basic services, debt, and, in the case of men, ill health, were negatively impacting their QoL. This reflects the real challenges of access to markets and services faced by remote communities.

The statistical relationships between a perceived good QoL and other variables in the household survey were investigated separately. A good QoL was associated with material, social, and health factors. For both men and women, it was associated with an annual household income of over 75,000 *Afghanis* (US$ 1650), ownership of 5 or more durable goods (from the specified list of 17), and reported good health in the previous year. For men, a good QoL was also associated with owning a higher number of trees and for women owning a higher number of animals, reflecting their role in livestock husbandry. Associational life was found to be important to people. For men, a good QoL was associated with participating in *hashar*, and for women, membership in a community group. The richness of community life emerged clearly in the qualitative study, with people enjoying a range of religious and cultural events where special food is prepared and there is sport, music, dancing, and poetry. Where issues of voice and representation were raised in the qualitative study, perspectives were mainly informed by the perceived quality and effectiveness of village leadership. Remoteness affects these factors by shaping opportunities for leaders to establish political connections with more powerful patrons capable of garnering resources.

When community members were asked about their aspirations in individual interviews, nobody expressed the wish to migrate, but rather their hopes were for peace and the opportunities to improve life in their villages. This attachment to place is illustrated by people's preference to pursue local opportunities and improve their lives at home wherever possible (Box 1).

Strategies for improving QoL in Badakhshan

This research provides empirical evidence to show that people in Badakhshan's remote mountain villages face greater barriers in improving their health and wellbeing. Despite this, development aid (in Afghanistan and elsewhere) tends to be directed towards less remote rural

locations, with a belief that serving these more accessible areas will produce multiplier effects that will "trickle down" to all. In reality, remote locations lack comparative advantages and will almost always continue to lag behind (Bird et al 2010). As global integration has increased and market-led development has gained ground internationally, the need to recognize diversity in rural areas has become more important. Wiggins and Proctor (2001) sought to capture this diversity by dividing rural regions into distinct categories based on their access to urban markets: peri-urban, the middle countryside, and remote rural areas. In the latter locations, they argue, physical constraints to development are severe and subsidies are likely to be necessary to foster development.

Major development agencies such as the World Bank have recently come to recognize the need to address market failures by investing in core public goods such as physical infrastructure, education, and health, as well as the use of public policy to provide safety nets such as cheap access to credit, cash transfers, food aid, or secure land tenure, rather than emphasizing the immediate need for competitive markets built through private sector growth and operating on the basis of profits (Kanbur and Venables 2005; World Bank 2008). In many mountain locations, distance (physical or psychological) from the centers of political power within countries may hinder the allocation of these investments (Bird et al 2010). This may be particularly true in Badakhshan, where there are ethnic cleavages and a lack of political connectedness to political elites in Kabul. Nevertheless, there is evidence that road building, microcredit, and/or local skills development programs successfully reduce levels of outward migration and produce higher levels of local economic growth in remote areas even in the absence of well-developed markets (Jodha 2000; Bryceson et al 2008).

Given the low levels of infrastructure in Badakhshan, due to historical factors, the foundations of an enabling environment for markets to flourish are still being built. Yet the political leverage held by certain donors committed to market-led processes has led to initiatives like the Accelerating Sustainable Agriculture Program, where "pro-poor" investments in capacity building or the provision of key services such as credit to poor households has been neglected in favor of policies aimed exclusively at market efficiency and "trickle-down" growth (Pain and Shah 2009; Pain and Kantor 2011). These efforts run the risk of allocating resources to what Bird et al (2010) call "higher-potential" areas where opportunities for market growth already exist but do little for the "lower-potential" areas where material poverty is most prevalent and entrenched.

AKDN has worked in Badakhshan since 2002 and has employed a number of approaches that go beyond a market-driven strategy to promote wellbeing. Interventions have taken the form of public–private partnerships for investments in infrastructure and services as well as grant-funded programs. Infrastructure development has included road building, energy provision, and development of mobile telecommunications through shareholder support of Roshan, the country's leading telecommunications provider and largest private sector employer. However, there is no doubt that providing infrastructure and services for remote areas is challenging. Distance and difficult terrain increase technical complexity, and low population densities can create diseconomies of scale that will fail to attract private investors. Even in middle- and high-income countries, governments struggle with providing services and infrastructure for remote areas, and the political economy of justifying public investment in such areas can also be challenging.

Cost recovery from the provision of infrastructure and essential services in remote mountainous areas is low and accrues only over prolonged periods of time. An AKDN-supported health program in Pakistan's mountainous Northern Areas, for example, recovered only 50% of its implementation costs over its first 20 years of operation (Walraven et al 2009). Given that the provision of infrastructure and services has been found to have broad positive effects on income and health, however, there are strong social justifications for bodies like AKDN to step in to provide these public goods in partnership with the government and the private sector. The same cannot be said for market actors seeking high and reasonably quick returns on their investments.

In common with many other NGOs, AKDN adopts a community-based approach to build technical capacity and improve local governance. Agricultural extension services, microfinance services to low-income households, supporting provincial and district education departments, and offering community health nursing and midwifery education are all part of the program. Perhaps the most important components, however, relate to building community-level institutions such as community development councils (CDCs) and community-based savings groups. The positive case studies of CDC work in Badakhshan, supported by AKDN, led to the approach being adopted at a national level in the third phase of the NSP. These groups, which strengthen associational life, can and do support governance processes that are more likely to promote development that meets people's own aspirations.

AKDN's cross-border program with Tajikistan's Gorno-Badakhshan Autonomous Oblast (GBAO) addresses social and cultural as well as economic issues. This program takes advantage of historical legacies in Tajikistan of better developed infrastructure, health, and education, and aims to reconnect communities that were separated by an arbitrary border imposed by Britain and Russia in the 19th century. In this program, new roads and bridges have been built, cross-border markets have been developed, and energy has been supplied to Afghan

villages by Pamir Energy, a utility provider in Tajikistan, to improve services to Afghan villages that are closer to urban hubs on the Tajik side of the border. Cross-border health programs have also been introduced to improve health care in the areas close to GBAO (Walraven et al 2009). The Aga Khan Music Initiative supports talented musicians and music educators across Central Asia to preserve, transmit, and further develop their musical heritage. An annual celebration of dance and music—the Roof of the World festival—brings together musicians from 4 countries and promotes tourism.

The findings of the QoL assessment were used internally to review AKDN strategy with local field staff as well as staff at the national level. As a result, the constituent agencies of AKDN have developed a joint food security strategy, and child health and nutrition have been made a greater programming priority. The distinctive characteristics of a mountain economy have been further discussed and recognized, as well as the need to consider further strategies to target remote villages. The wide range of data collected through the QoL assessment has been useful in promoting policy coherence by bringing together AKDN staff and partners working in different sectors to look at how their interventions are connected and how they can best complement each other. It has also encouraged staff to understand and analyze their interventions in light of the concerns and aspirations of program participants.

After improved security, the next most common reason given for improvements in QoL in remote villages is intervention by NGOs. This suggests that AKDN and others are reaching remote villages. For example, recently built bridges and roads have contributed to revenue from import-oriented trade with Tajikistan and have facilitated greater contact between communities. However, the gap in the indicators presented in this paper between remote and non-remote villages shows that the challenges are great and progress is slow. A long-term perspective is needed in this and other similar mountain societies, as is an in-depth knowledge of the local and regional context to identify development strategies that go beyond the short-term thinking and project time frames that are still too often adopted by international aid agencies. The disaggregation by remoteness highlights both the nonmaterial dimensions of life that are important to people and the limitations of depending on market-led approaches to improve QoL in Badakhshan Province.

ACKNOWLEDGMENTS

The authors would like to thank the communities involved in the QoL assessment, on which this article is based, for being so generous with their time and experience. Thanks are due to the field research teams that worked with real dedication under difficult conditions. We are very grateful for the full support of the Aga Khan Foundation in Afghanistan, in particular the monitoring and evaluation unit. Thanks also to all the AKDN agencies in Afghanistan for interesting discussions on the results and implications of this study. We acknowledge the help of Zainul Nurani in data disaggregation and analysis. Finally, thanks to Gijs Walraven, Azim Lakhani, Keith Child, and Pam Hunte for their very useful comments on earlier drafts of this article. The authors acknowledge support from the University of Central Asia's Mountain Societies Research Centre for the publication of this article. The views expressed in this article are solely those of the authors and do not reflect the views of the Aga Khan Development Network.

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The University of Central Asia's Mountain Societies Research Centre (MSRC)

UNIVERSITY OF CENTRAL ASIA
MOUNTAIN SOCIETIES RESEARCH CENTRE

The University of Central Asia (UCA) is committed to addressing sustainable mountain development through the design and implementation of its academic programs and in its operations. In June 2011, UCA launched its first university-wide, interdisciplinary research center—the Mountain Societies Research Centre (MSRC).

University of Central Asia: a mountain development university

The University of Central Asia (UCA) seeks to promote the social and economic development of Central Asia, particularly of its mountain societies, while at the same time helping the different peoples of the region to preserve and draw upon their rich cultural traditions and heritages as assets for the future. UCA is an institution born of a forward-thinking treaty among the governments of Kazakhstan, Tajikistan, and the Kyrgyz Republic, and His Highness the Aga Khan, for the benefit of a region that has often been denied opportunity because of its mountain geography and history. UCA's commitment to mountain development is reflected in the decision, arrived jointly with the three host governments, to locate its campuses in economically depressed mountain communities in the three countries.

UCA began operations in 2006 with its School of Professional and Continuing Education. More than 40,000 individuals have subsequently earned internationally benchmarked certificates aimed at improving skills and employability. In 2008, UCA began its Central Asian Faculty Development Program and has since supported more than 40 individuals to pursue PhD degrees at partner universities around the world. Faculty development fellows will return to Central Asia to serve as UCA's founding faculty at the commencement of UCA's degree programs. UCA's core undergraduate and graduate degree programs, targeted to begin in 2016, will include interdisciplinary, place-based programs focusing on core competencies and application to local, regional, and global challenges (Figure 1).

Research is also central to UCA. In 2011, UCA launched 2 research units: the Institute for Public Policy and Administration and the Mountain Societies Research Centre (MSRC). This article introduces the Mountain Societies Research Centre and summarizes the centre's initial outputs.

Research for the development of mountain societies

The MSRC is a university-wide, interdisciplinary research center dedicated to supporting and enhancing the resilience and quality of life of mountain societies through sound research on the sustainable development and management of their physical, social, economic, and cultural assets. The centre has five objectives:

1. Generate and disseminate relevant knowledge though sound research.
2. Build Central Asian capacity to conduct research relevant to mountain societies.
3. Inform the policy and practice of sustainable mountain development through evidence-based research.
4. Serve as a knowledge hub in Central Asia for scholars, development practitioners, and policy-makers.
5. Support the development of relevant UCA academic programs.

Developing a contextualized and application-focused research agenda

Through consultations with regional and international sustainable mountain development experts, 6 broad thematic areas were identified as initial areas of focus for MSRC's research agenda:

1. *Mountain economies,* including high-elevation agriculture and pastoralism, mountain market chains, labor migration, small and medium-sized enterprises and microfinance, and nature and culture-based tourism.
2. *Environmental change and natural resource governance,* including sustainable land management, climate change and adaptation and mitigation practices, and biodiversity conservation and the equitable sharing of its benefits.
3. *Natural hazards and disaster risk management,* including risk and vulnerability assessment, mitigation, and preparedness.
4. *Health status and services,* including food security, nutrition, health care access and provision in remote and severe environments, and ailments prevalent in or unique to mountain societies.
5. *Energy in mountain areas,* including alternative and renewable sources of energy, energy-related economic opportunities, and social and environmental assessment of energy production.
6. *Cultural heritage,* including documenting, preserving, and advancing the study of mountain society heritages and examining the relevance of cultural heritage to mountain societies today.

Using these broad and interconnected themes as a guide,

 http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00061.1

FIGURE 1 Kyrgyz government and civil society members participate in a Rapid Rural Appraisal training organized by UCA's MSRC and Mountain Partnership. (Photo © University of Central Asia/Mikhail Romanyuk)

MSRC is developing a series of background papers that aim to (1) identify the particular challenges and opportunities of Central Asian mountain societies, (2) assess the state of knowledge on identified challenges and opportunities, and (3) assess the lessons learned from previous attempts to apply scientific knowledge to action in these areas. The final outcome of the background papers is a contextualized research agenda based on critical gaps and clear links to policy or implementation practice. A synthesis of MSRC's first background paper, on Central Asian mountain pastoralism, is featured in the MountainNotes section of this issue of MRD (Kerven et al 2012). The full version can be accessed in English and Russian at http://msrc.ucentralasia.org/events.asp.

Working with national and international partners

In its inaugural year, MSRC successfully laid the foundation for its role as a regional facilitator of research, information exchange, and action by scholars, practitioners, and policy-makers on critical issues faced by mountain societies in Central Asia. MSRC was designed as a collaborative effort, and the centre is working closely with universities, other institutions, and individual researchers to create important networks and partnerships to further its mission.

MSRC serves as a regional focal point for key international networks and agencies, including the Mountain Partnership and the Swiss National Centre of Competence in Research (NCCR) North-South, and has been a key player in international advocacy efforts to ensure that issues of concern to Central Asian mountain societies are well represented at international forums such as the United Nations Framework Convention on Climate Change (COP17) and the United Nations Conference on Sustainable Development (Rio+20 Summit).

Closer to home, MSRC has engaged in joint research efforts and has produced resources and guidelines to support efforts by Central Asian mountain communities as they harness their unique natural and cultural resources to address emerging issues (Figure 2). Following are a few examples of MSRC's first outputs. Additional information on these and other outputs can be found on the MSRC website.

FIGURE 2 A UCA Central Asian Faculty Development fellow conducts field research. (Photo © Zheenbek Kulenbekov)

Symposium on mountain pastoralism: MSRC's inaugural event, cohosted by the NCCR North-South, was an international symposium on pastoralism in Central Asian mountain areas attended by 140 researchers, practitioners, and policy-makers from more than 20 countries. The event included scientific and implementation-focused presentations, policy roundtables, and a 3-day field visit based from UCA's facilities in Naryn, Kyrgyzstan. Participants also provided structured feedback on a draft version of MSRC's first background paper on mountain pastoralism.

Herders' manuals: Also in collaboration with the NCCR North-South, MSRC produced herders' manuals for Kyrgyzstan and the Western Pamir region of Tajikistan. Drawing on local expertise of Central Asian herders, the manuals provide a combination of traditional knowledge about key pasture plants and current scientific knowledge about sustainable pasture management, livestock production, and health management. The manuals are designed for on-the-job training of livestock herders, village pasture committees, and other village-level pasture management and monitoring organizations. They are available in the English, Russian, Kyrgyz, and Tajik languages at http://msrc.ucentralasia.org/Herders-Manual.

Preparatory meeting for government climate change negotiators: Jointly organized by MSRC and the Mountain Partnership in collaboration with the government of Tajikistan and with support from the World Bank, MSRC hosted a regional technical meeting on Climate Change Impacts, Adaptation, and Development in Mountain Regions. Thirty-five experts from Tajikistan, Kyrgyz Republic, Azerbaijan, Iran, Nepal, and Mongolia came together to strengthen regional inputs for climate-change negotiations and to integrate concerns over potential impacts of climate change and adaptation options in mountain ecosystems into international processes, including COP17 and the Rio+20 Summit.

Progress report on sustainable mountain development since 1992: MSRC also served as the focal point for a Central Asian regional assessment of progress related to the 1992 Earth Summit goals specific to the sustainable development of mountain areas (Chapter 13 of Agenda 21). With support from the Swiss Agency for Development and Corporation, the MSRC, Mountain Partnership Central Asia Hub, and

Zoi Network facilitated a process to identify and consolidate trends, developments, lessons, and opportunities for action in Central Asia. Fifteen case studies were compiled on activities by stakeholders including nongovernmental organizations, government agencies, and Mountain Partnership member organizations in Kazakhstan, the Kyrgyz Republic, and Tajikistan. The regional assessment—which was presented at the Lucerne World Mountain Conference—contributed to a global synthesis report used by delegates during the Rio+20 Summit and relevant regional events.

Special issue of MRD: Finally, this special issue is another important outcome of MSRC. The publication of this theme issue supports MSRC's objective to raise the standard and visibility of Central Asian mountain societies research and researchers.

Looking ahead

With a rapidly expanding staff of researchers and solidification of local and international partners, MSRC is enhancing its capacity to advance sound research for sustainable mountain development in Central Asia. Through its series of background papers, a clear research agenda is being developed to practically address issues facing mountain societies in Central Asia, and as UCA's academic programs progress toward full operation, MSRC will also work to ensure that these academic offerings are grounded in recent and relevant research. MSRC is well positioned within UCA and the region to make a significant contribution as an intellectual hub to improve the quality of life and resilience of Central Asian mountain societies through action-oriented research that will enhance relevant policies and practice.

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Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
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Researching the Future of Pastoralism in Central Asia's Mountains: Examining Development Orthodoxies

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This paper synthesizes research findings on contemporary mountain pastoralism in Kyrgyzstan and Tajikistan, based on a longer review characterizing mountain agropastoralism in Central Asia. We focus here on the principal issues that have been emphasized over the past two decades in policy, programs, and projects regarding pastoralism in Central Asia's mountains. We conclude that this emphasis has largely been driven by two unproven orthodoxies about

- *The extent and causes of pasture degradation; and*
- *The need for decentralization and pasture land privatization.*

The paper proposes that new research should critically assess these orthodoxies through more empirical and long-term field research. This will yield practical applications to improve conditions for Central Asian mountain pastoralists and their environment. Pursuing measures for addressing pasture degradation will require determinations of whether, where, how, and why degradation and desertification are occurring. Detailed field research is also called for on the processes and effects of decentralizing the power to allocate and manage pasture resources from national and regional state authorities to local communities, as well as on the long-term effects of privatizing pasture land.

Keywords: *Research agenda; pastoralism; former Soviet Union; Central Asia; Kyrgyzstan; Tajikistan.*

Reviewed by the editors: *May 2012*

Accepted: *June 2012*

Introduction

Societies living in mountainous areas of Central Asia face particular adversities as a result of the geopolitical and economic conditions of post-Soviet states. Current adaptations by mountain societies were reviewed in an extensive report on pastoralism and farming in Central Asian mountains (Kerven et al 2011). The present paper is a shortened and partial synthesis of that review, aimed at two notable themes that emerged from our overview of research on Central Asian mountain agropastoralism over the past 20 years. These themes are (1) pasture degradation and (2) promoting participatory approaches to communal pasture management.

This paper considers only mountain pastoralism in Kyrgyzstan and Tajikistan, where we found that the bulk of relevant studies have been conducted. We have not sought to cover all variables that affect the lives of mountain pastoralists in Central Asia (eg the role of religion and ancient cultural beliefs). We propose an agenda for biophysical and socioeconomic research on mountain pastoralism in Central Asia.

Old and new research directions

The emphasis of research has radically changed since the end of the Soviet period in 1991. Contemporary studies of pastoralists and the context of pastoralism in Central Asia have moved far from the practical concerns of Soviet social and biological scientists. Scientists in the USSR were looking long and hard at the ground, the plants, and the animals. Directed by state planning committees, their obligation was to increase and stabilize production output within a strict ideological parameter of development.

In contrast, much post-Soviet research on agricultural production systems in Central Asia is rooted in Western development models, activated through international (mostly Western) funding channels that support short-term research and development programs, and variously aimed at bolstering civil society, biodiversity conservation, sustainable land management, and market value chains. The post-Soviet swing in emphasis has meant less basic biological research and few rigorous investigations regarding the present-day status of Central Asian mountain pastoralism. At the same time, the quality and funding of national research institutions has eroded throughout the transition period since 1991 (Kerven et al 1996).

There is, however, a considerable body of documentation—in development project reports and in Russian-language scholarly works—on ethnohistory, livestock breeding, pasture vegetation and soils, and other specialized fields relevant to understanding Central Asian mountain pastoralism. We do not summarize Soviet-era research on this topic, though this is recommended for a more complete

TABLE 1 Mountain pasture area in 1975 and percentage in 2009.

Countries	Total permanent meadows and pastures in 2009* (km^2)	Percent pastures of total agricultural land	Natural mountain pastures in 1975** (km^2)	Percent mountain pastures of total pastureland in 2009*
Kyrgyzstan	92,663	87%	88,168	94%
Tajikistan	38,750	82%	33,479	86%

Sources: *FAO 2011; **Mamytov 1987.

understanding of the basic issues (Kerven et al 1996).

Characterizing mountain pastoralism and transhumance in Central Asia

Most of Central Asia has a semiarid or arid climate. Thus, the mountains are attractive to pastoralists because they usually receive more precipitation than the plains and valleys (Mamytov 1987; Russian Nature 2011). The natural mountain vegetation offers alternative nutritional qualities for livestock (Kerven 2003). Slopes can be used to build gravity-fed irrigation channels to water food and fodder crops. Springs and streams provide water to people and livestock. The cooler mountain climate in summer means a more pleasant environment for people and their livestock.

But there are also severe drawbacks to making a living on mountain land in Central Asia. Higher levels of precipitation result in deep snowfalls in winter, which can cut off villages for long periods. Some livestock breeds cannot forage under deep snow and are not physiologically equipped to cope with intense cold periods. At higher altitudes, the short frost-free period results in a limited growing season for food and fodder crops, as well as natural pasture (Khukmatullo et al 2005). Transport is impeded by steep and dangerous terrain, and routes may be blocked by avalanches and rock falls. Remoteness and inaccessibility can lead to social isolation, as well as political and economic marginalization, as discussed later in this paper.

Given the attractions and disadvantages of mountains for making a living, from prehistoric times in Central Asia, people adopted the practice of transhumance: They spend part of each year with livestock in the mountains, when environmental conditions are optimal, and the rest of each year somewhere else—in adjacent lower valleys, distant plains, or even cities (van Leeuwen et al 1994).

Natural pastures—that is, unimproved by planted species or techniques—constitute the principal land area in the two countries, where mountain pastures are by far the greatest source of livestock forage (Table 1). Mountain pastoralism is a significant contributor to the gross domestic product in Kyrgyzstan and Tajikistan (Peyrouse 2009: 5).

Most pastures are located at altitudes between 1000 and 3500 masl, in intermontane valleys and mountain slopes, while one quarter are found at elevations greater than 3500 masl. Climatic conditions therefore differ according to slopes with different aspects, enclosed basins, and exposed plateaus (Russian Nature 2011; Sedik 2009). Annual precipitation varies from more than 1500 mm in the Gissar Range of Tajikistan to less than 100 mm in the Eastern Pamir (Khukmatullo et al 2005; Conservation International 2012). Much precipitation falls as snow in autumn, winter, and spring. Snowmelt in summer provides drinking water for humans and livestock, and for crop irrigation, in environments that are otherwise often very dry.

The mountains of Central Asia are a biodiversity hotspot, containing two major mountain ranges, the Pamir and the Tien Shan, characterized by exceptional levels of plant endemism and, it is claimed, by serious habitat loss (Conservation International 2012). There are many unresolved conflicts of interest among mountain villagers, foreign and national wildlife hunters, national wildlife conservation policies, and international conservationists in the region (Lüthi 2003; Undeland 2005; Haslinger et al 2007). The mountains also contain indigenous domesticated livestock breeds, eg cashmere goats, that are a valuable and endangered genetic resource (Kerven et al 2009).

Pasture degradation

Degradation of land has been the predominant issue for many researchers and development agencies concerned with mountain regions of these two countries. This is evidenced by the proportion of reports and projects on the subject, noted in our review (Kerven et al 2011). Pasture degradation—its definition, causes, effects, extent, and amelioration—was also the most debated topic at the Bishkek Symposium titled "Pastoralism in Central Asia: Status, Challenges, and Opportunities in Mountain Areas" in June 2011.

The concept of degradation and its particular applicability to Central Asian mountain pastures is not simple. There are multiple and nonstandard criteria of degradation regarding pastures (Briske et al 2005). The initial problem is to decide what

is to be measured (Behnke and Scoones 1993). A few examples are loss of plant and wild animal diversity from some previous measured state, retreat from botanical climax, rise in toxic and unpalatable plants to livestock, loss of topsoil and humus, increasing bare ground with no vegetation cover, and permanent loss of an economic good, in this case an irreversible decline in livestock production. Botanists, range ecologists, socioeconomists, pasture agronomists, livestock production specialists, and agricultural policymakers are unlikely to all agree on the critical indices of degradation.

In the last decades of Soviet planning for agriculture, Central Asian pasture scientists steadily and insistently challenged the orthodoxy that humans could always conquer nature by intensifying production and relentlessly increasing livestock output on the pastures (Kerven et al 1996; Alimaev and Behnke 2008). They pointed out the ecological ceilings that, if surpassed, resulted in critical environmental damage and loss of economic productivity and warned against greater development of irrigated fodder and food crops on steep mountain slopes (Mamytov 1987; Zotov and Adenov 1992). Since the 1990s, this early warning has expanded into a crescendo of concern by international donors and nongovernmental organizations (NGOs).

But in less than 1 decade after 1991, the entire Soviet mode of production in Central Asian pastoral regions was destroyed, and livestock numbers plummeted (Kerven 2003; Pomfret 2006), leaving the locus, causes, and degree of pasture degradation all radically altered (Coughenour et al 2008). Meanwhile, the ability of most private pastoralists to invest in alternative pasture management methods has been severely limited.

To date, studies in the region have indicated determinants of pasture degradation that are fundamentally different from the damage to land caused by the high input and overstocked Soviet pasture management systems. The multiple and interacting drivers of pasture degradation in the mountains of Kyrgyzstan and Tajikistan are now said to be

- Reduction of livestock mobility in terms of distances moved and the number of times per year that animals are taken to pastures in different locations;
- Reduction in affordable and good-quality supplementary winter feed (cultivated or natural hay);
- Poverty of many livestock owners, preventing their investment in improved livestock feeding technology and the hiring of shepherds;
- Changes in livestock species kept, which have different forage requirements and thus different impacts on the pastures;
- Rural labor outmigration to cities, reducing available rural labor for herding livestock on distant pastures and increasing the workload on women in managing livestock;
- Changes in pasture tenure regulations and de facto use, resulting in poorer people's livestock having limited access to better-quality pastures surrounding key resources, as well as allowing richer people to claim better pastures; and
- Global climate changes, leading to warming tendencies and changes in precipitation amount and timing in the region's mountains.

The following sections summarize the literature on these drivers.

Reduction of livestock seasonal mobility

Seasonal transhumance among plains, mountain valleys, and distant upper meadows has been greatly reduced in the post-Soviet period (Rahim and Maselli 2008; Robinson and Whitton 2010). Following dissolution of the state livestock farms ending state-controlled pasture use, pastures farther from mountain settlements have become underutilized, while the more accessible pasture areas are overutilized. This is reported for Kyrgyzstan by Schillhorn van Veen (1995), Ludi (2004), Farrington (2005), and Undeland (2005). In Tajikistan, studies show uneven seasonal grazing utilization over space (Domeisen 2002; Hangartner 2002; Haslinger et al 2007; Sedik 2009; Wirz 2009; Vanselow 2011). Grazing pressure is particularly severe during winter, and poorer households are obliged to graze their livestock continuously around villages and to destock. Efficient seasonal utilization of remote pastures requires expensive transport by vehicle and additional labor (either family or hired; Figure 1); moving livestock to remote pastures has therefore become an option mainly for richer households (Hangartner 2002; Farrington 2005).

Livestock feed shortages

By the later Soviet period of planned livestock production, state investments in irrigation, mechanized transport, and other infrastructure permitted heavier livestock pressure on pastures, making livestock reliant on plentiful and highly nutritious winter feed (Schillhorn van Veen 1995; Fitzherbert 2000; Ludi 2004).

In the early 1990s, fodder yields collapsed in both countries due to the privatization of arable land and the lack of cash investment, fertilizers, and working machinery. In the mountain areas, arable land is usually scarce and nowadays not irrigated; in the Soviet era, it was used for fodder cultivation or as hay land. Most rural households now, however, use irrigated mountain land to cultivate potatoes and vegetables for their subsistence needs (Eriksson 2006; Ronsijn 2006; Akramov and Omuraliev 2009). Furthermore, labor migration has led to abandonment of some arable land (Wolfgramm et al 2010), with consequent decline in availability of fodder crops, residues, and hay stored for winter. Cessation of concentrate imports from other former Soviet republics further

 http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00035.1

FIGURE 1 Hired shepherds in summer pastures, Surkhob valley, Tajikistan. (Photo by Carol Kerven)

worsened this winter feed scarcity (Fitzherbert 2000). The inefficient processing and storage of hay also aggravates the winter feed scarcity (Figure 2), with estimates that this leads to a loss of energy and nutrients of up to 40% (World Bank 2007).

Poverty of privatized livestock owners

Grazing and feeding livestock requires inputs of cash and labor, in addition to suitable land. When these are in short supply due to poverty, livestock owners must still try to keep their few livestock alive and reproducing. They do this by feeding them whatever is available, wherever they find it, and at the lowest cost. This has been one of the principal reasons more accessible pastures were overgrazed in the post-Soviet period (Kerven et al 2006, 2008).

The consequences for livestock of poor nutrition over winter are higher adult mortality, lower fertility and birth rates, and increased risk of disease. For mountain households that cannot afford to obtain sufficient quality and quantity of winter feed, this leads to a cycle of poverty, because their flocks and herds cannot grow due to low reproductive rates and more animals must be sold to support the remaining few (AKF 2004, 2005, 2006).

Many mountain households fail to enter rural commodity markets and to move beyond subsistence production. Emergence of secure and profitable value chains for livestock products is hampered due to remoteness, poor raw material quality, absence of disease controls, and insufficient price information (Ajibekov 2005; Näscher 2009; Steimann 2011). In Kyrgyzstan, a large share of rural households depends on small amounts of state welfare eg child allowances and old-age pensions. There is also increasing loss of mutual trust and aid among rural households, a further cause of impoverishment (Kuehnast and Dudwick 2004; Farrington 2005; Sabates-Wheeler 2007; Steimann 2011).

Changes in livestock species kept

Each species of livestock has specific impacts on pastureland through their foraging habits and preferences for different palatable vegetation species. The species composition of livestock has changed considerably in the past 20 years (Table 2). In 1991, Kyrgyzstan's mountains contained 2.5 to 3 times the number of sheep that are now kept. However, the number of goats in private flocks has more than doubled (FAO 2011, 2012). In Tajikistan, there has likewise been a great increase in the recorded number of goats, but unlike Kyrgyzstan, the numbers of sheep have risen slightly, again after a steep decline in the 1990s (FAO 2011, 2012). The rise in goat numbers relative to the other livestock species is related to the impoverishment of mountain villagers. Goats compared to sheep are more prolific, cost less to buy, and are easier to herd in these hilly environments (Kerven et al 2009). All these factors have made goats more attractive for poorer households. Local government authorities in these countries comment that they are worried that the increase in goats may be causing pasture degradation

FIGURE 2 Hay harvesting, Naryn, Kyrgyzstan. (Photo by Bernd Steimann)

through overgrazing. However, no field research has been conducted in this region to test the impacts on pastureland of the rising goat numbers versus sheep and cattle.

Rural outmigration and lack of herding labor

The lack of economic opportunity in these mountain areas has led to massive, mostly male, outmigration to national urban centers and to international destinations, mainly southern Kazakhstan and Russia (Olimova and Bosc 2003; Macours and Swinnen 2005; Jones et al 2007; Schmidt and Sagynbekova 2008; Schoch 2008; Schoch et al 2010). Remittances sent back by migrants are often used to build up flocks, to compensate the loss of domestic workforce by hiring local labor, or both. Outmigration is increasing the burden of women to manage livestock and pasture-related economic practices, with their greater domestic workload when their husbands and sons migrate to work elsewhere (Kanji 2002; Thieme 2008; Figure 3). The shortage of adult men has increased the cost for shepherding livestock farther from settlements. There is also a constant increase of livestock numbers partially financed through remittances (Eggenberger 2011). These changes may be aggravating the pressure on pastures around settlements that is already occurring due to other factors discussed here.

Changes in pasture tenure regulations

There has been a fundamental shift in the legal forms by which pastures are held. The application of new pasture tenure laws has had considerable effects on how pastures are used and thus the potential for overuse. In Kyrgyzstan, legal changes instituted in 2002 based pasture use on territorial leases, to be obtained by individuals or groups from local administrations (Undeland 2005; Liechti 2008). The pasture lease system was complicated and had the unintended effect of creating generalized open access of pastures. This led to overuse of more accessible pastures, as less wealthy villagers were effectively excluded from more desirable but more remote pastures (Jones 2003; Lerman and Sedik 2009; Steimann 2011).

In 2009, a new law in Kyrgyzstan abandoned the lease system and instead transferred all administrative authority over pastures to so-called grazing committees at the local

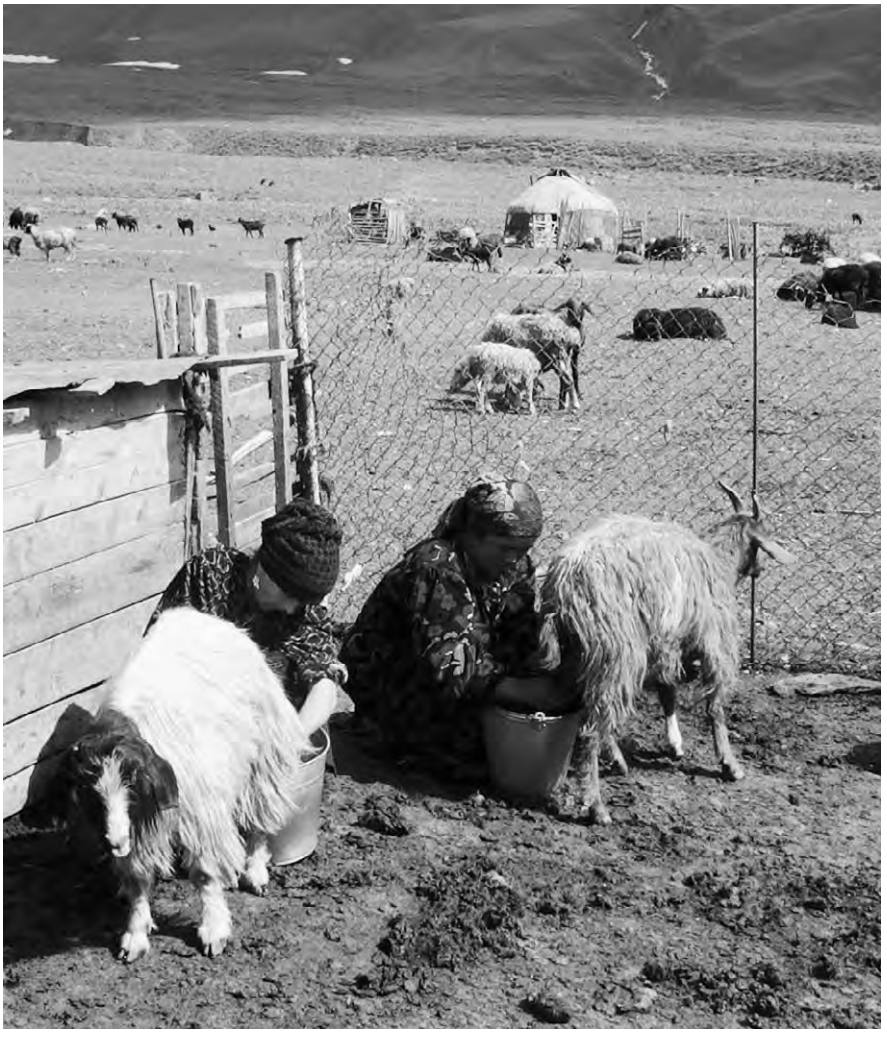
TABLE 2 Changes in livestock populations in Kyrgyzstan and Tajikistan, 1992–2009.

	Kyrgyzstan heads × 1000			Tajikistan heads × 1000		
Livestock type	1992	2009	% change	1992	2009	% change
Cattle	1190	1224	+13%	1390	1800	+13%
Sheep	9225	3606	−256%	2484	2578	+30%
Goats	300	897	+290%	870	1568	+180%

Source: FAO 2011.

 http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00035.1

FIGURE 3 Pastoral women milking goats, Surkhob Valley, Tajikistan. (Photo by Carol Kerven)



community level. However, comparatively wealthy and well-connected households can often afford to secure de facto exclusive access to a large pasture area through the construction of a barn on the winter or spring–autumn pastures (Steimann 2011). Such informal—yet not illegal—exclusion from formerly common property grazing areas can lead to further grazing pressure on the residual grazing areas that remain open access and unclaimed.

Similarly, in Tajikistan individuals can obtain use rights to pastures through negotiation with the state administration at a district level (Peyrouse 2009; Sedik 2009; Rowe 2010). The current legislation is unclear about when and how pastures may be privatized or leased by individuals. Large herd owners increasingly tend to privatize remote seasonal pastures, while smaller owners lose access to these pastures and are eventually forced to overgraze other, more accessible areas (Ludi 2003; Robinson and Whitton 2010).

Climate change and pasture degradation

Climate change trends and projections in Central Asia could have important implications for future pasture degradation. Annual average temperatures are steadily rising in Kyrgyzstan and Tajikistan at a rate similar to or greater than average global temperature rise (Aizen et al 1997; Giese et al 2007; Savitskaya 2010). Projections for mountain areas are difficult because of the inherent climate variability of mountains. Climate model projections for Central Asia, however, include warming much greater than the global mean (3.7°C by 2100 compared to an 3°C globally), maximum warming in summer months, and a greater temperature increase in high-elevation areas (Christensen et al 2007).

Pasture productivity, hay fields, and fodder crops are strongly influenced by climate conditions. The 2007 International Panel on Climate Change report concludes with a high level of confidence that Central Asia is very vulnerable (highest rating) to land degradation from climate change impacts (Cruz et al 2007). Research from Kyrgyzstan and Tajikistan concludes that drying associated with higher air temperatures could cause a significant reduction in the productivity of certain pastures (GoTJ 2008; GoKR 2009). While warming temperatures will result in a longer growing season that may benefit certain pasture plants and fodder crops, increased drying and precipitation variability (including drought) are likely to negatively affect pastures in particular (Tebaldi et al 2006). Climate change projections for warmer and drier summers are significant for agriculture, yet extreme climate events are equally or more important factors (Lioubimtseva and Henebry 2009). Livestock production is particularly sensitive to drought, while aridity is already a limiting factor in much of this region (Lioubimtseva and Henebry 2009).

Conclusions and research priorities

The most prominent research and development topics on Central Asian

pastoral regions over the last two decades have been pasture management and mismanagement and, linked to this, land degradation (Kerven et al 2011). Much money has been spent by international donors, the United Nations, and international NGOs on short-term research and projects to improve pasture management. However, many of the reports we reviewed were superficial, derivative, and nonempirical. Nevertheless, they have been influential in attracting still more donor funds to combat "degradation." Our first conclusion is that further research is needed to confront and test these "environmental orthodoxies":

> *A great amount of "development policy" has often been driven by simplistic, and even scientifically unsupported, assumptions, [for example] the collection of environmental orthodoxies embedded in the "Theory of Himalayan Environmental Degradation." The sheer simplicity and intellectual attractiveness of this particular orthodoxy has ensured its survival despite its effective scholarly rejection. (Ives 2001: 132–144)*

The promulgation of environmental orthodoxies suggests there may be a political economy of "degradation discourse" arising from the intertwined interests of researchers, NGOs, donors, and governments. Such a discourse can create incentives for researchers and research organizations to disseminate scare stories about the disastrous conditions of the land (and now the climate) that provide governments with justification to press for certain changes and additional funding. One of the difficulties for researchers is to be objective and independent yet obtain funding.

Donor and national government-supported projects have attempted all kinds of pasture management schemes, convinced that they were needed to halt degradation and desertification and to improve pasture productivity. (For a few examples, see World Bank 2003, 2007; CARNET 2005; UNDP 2007; Ji 2008; UNDP and GEF 2008; ADB 2009; ADB 2010; UNEP 2011; UNU-EHS 2012.) Nevertheless, conclusions about whether, where, how, and why degradation and desertification are occurring, and what methods could be used to tackle these processes, have been based less on updated field-based evidence and more on untested orthodoxy. "Overgrazing" or "overstocking" is often cited in these reports as causing land degradation. But new field studies assessing the causes, effects, characteristics, and implications of grazing and pasture degradation in Central Asian mountains are applying careful measurements that raise questions about any simple correlation of overgrazing and land degradation (Bimüller et al 2010).

The first research priority is to inventory the impact of the many pasture development projects and new pasture tenure legislation in the mountains. What was the uptake of the various pasture improvement methods demonstrated and advocated? Did mountain villagers who depend on the pastures apply these methods, and did the villagers obtain project results that were useful to them? What were the results? Are the benefits replicable without external technical funds and assistance? Who benefitted? What were the costs? Who bore the costs?

A second research priority is to assess the scientific basis for the interventions proposed and promoted to the pasture users. One reliable assessment of the reported findings is whether they refer to research results published in scientific, peer-reviewed international sources. A check through the bibliographic search engine Web of Science reveals that since the late 1980s there have been no scientific articles published with new data on pasture degradation in Tajikistan and only one article on effects of deforestation on soils in Kyrgyzstan. The same pattern is found by searching Google Scholar.

The reports about pasture mismanagement, degradation, and the need for rehabilitation in Kyrgyzstan and Tajikistan often repeat previous assumptions and preconceptions, usually without offering fresh data. There is a clear need to do more in-depth field work, followed by modeling, on the multiple interacting causes and feedback effects of changes in the soil, vegetation, climate, and animal populations—both livestock and wildlife—to understand the biophysical impacts of the profound changes in land management over the past 20 years.

Only when we have new and reliable data will we be able to say whether any practical measures can be taken to improve pasture management and still benefit the land users. Without sound data that tests the current assumptions, there is a risk that land users—farmers and pastoralists—will continue to be blamed for despoiling the land through bad management. This can provide a rationale for governments and their donor supporters to redistribute land through privatization, as is occurring in Tajikistan with World Bank support, or to exclude pastoralists from their land on the justification that this helps conserve vegetation cover, soil, biodiversity, river headwaters, etc, as is being implemented by the Chinese government in the mountainous pastoral regions neighboring Central Asia (Harris 2010; Xinchun 2011).

Community participatory pasture management

Another set of research priorities stems from the current policy trend to decentralize pasture management from the national to the local level to make it more "participatory." In Kyrgyzstan, the World Bank's efforts to establish standardized communal pasture user committees seem to be influenced by rather simplistic ideas.

 http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00035.1

Jacquesson (2010) argues that this new Kyrgyz pasture law rests on the longstanding misconceptions of "clan," "custom," and "tradition" as social institutions that would allow for a level playing field, thus ignoring the often unequal relations among local herders. After 1991, romanticized notions invoking "nomadic traditions" have become increasingly popular, not least because they have been politically useful to the government of Kyrgyzstan. Empirical evidence shows, however, that nowadays the mountain pastoral communities are anything but homogenous and are instead characterized by striking disparities in terms of wealth and power. Consequently, we would welcome more mutual exchange among donor agencies, development practitioners, and researchers, requiring a critical dialogue about assumptions and priorities and long-term scientific monitoring of the implementation and effects of particular development interventions. Unfortunately, though, development projects often operate with a much shorter time horizon than field research projects.

The towering mountains of Central Asia hold a great appeal to certain people—among others, geologists, botanists, wildlife biologists, conservationists, anthropologists, hikers, bikers, ecotourists, development workers, glaciologists, geographers, climatologists, and livestock scientists. But after the researchers, development agents, and tourists have come and gone, the mountain dwellers remain. They deserve a long-term commitment to understanding their problems and assisting with their efforts to find solutions.

ACKNOWLEDGMENTS

The authors thank Emanuele Costa and Kishvar Pallaev at the University of Central Asia and Lailo Shogunbekova, Jyldyz Shigaeva, Maqsad Suriev, and Alim Saileybaev for their work on the references for this paper. Thanks also go to Roy Behnke, Cara Kerven, Daniel Maselli, Sarah Robinson, and Inam ur-Rahim for their contributions. The authors acknowledge support from the University of Central Asia's Mountain Societies Research Centre for the publication of this article. The authors alone are responsible for the content.

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Making a Living in Uncertainty: Agro-Pastoral Livelihoods and Institutional Transformations in Post-Socialist Rural Kyrgyzstan

By Bernd Steimann. Human Geography Series Vol. 26. Bishkek, Kyrgyzstan and Zurich, Switzerland: University of Zurich, 2011. xxi + 245 pp. Free download at http://www.zora.uzh.ch. Hardcopy: CHF 25.00. ISBN 3-906302-09-1.

Bernd Steimann's work is a timely contribution to the scholarship on postsocialist transformation and provides a much needed microlevel analysis of postindependence institutional changes and their implications for agropastoral livelihoods in Kyrgyzstan. Often the scholarship on Central Asian postsocialist development focuses on macroinstitutions, such as the economy, geopolitics, and national elite networks, and neglects local actors and processes at the microlevel. As a result, the postsocialist transformation is poorly understood, and the academic community lacks the conceptual tools to explain many developments in the region. Steimann uses an actor-centered approach to examine local processes of transformation in rural Kyrgyzstan. The study focused on agropastoral livelihoods and institutional and organizational context, which embeds these processes of production, to explore transformational processes at the household level.

The book consists of 3 key sections and 12 chapters. Section 1 evaluates key theoretical approaches on postsocialist development and offers its own conceptual framework, which draws upon new institutional economics, property rights theory, and legal pluralism. In being critical of the transition paradigm, Steimann also uses a set of sociological concepts, such as path dependency, hybridity, bricolage, and uncertainty, to interpret postsocialist developments in rural Kyrgyzstan. In addition, this section discusses the research methodology, which integrates qualitative and quantitative methods, to evaluate the socioeconomic status of households and their livelihood strategies. The empirical evidence is based on household surveys and semistructured interviews carried out in 2 villages in Naryn region between 2006 and 2009. The study compares how household livelihood strategies vary in the 2 villages, which have different levels of resources.

Section 2 presents the results of the household survey data of the 2 villages, which show significant socioeconomic disparities among the households. The study finds that the rich households constitute no more than 3% in both villages, and they own large tracts of land and livestock. Most households have little or no livestock, and are unable to generate cash income and are dependent upon state welfare. Steimann argues that the socialist legacy is partly responsible for the socioeconomic disparities, because the soviet kolkhoz introduced inequality in the agricultural economy. Although the path dependency can account for the first decade of social inequality into postindependence Kyrgyzstan, the introduction of ill-conceived neoliberal reforms in the agricultural sector in the 1990s exacerbated existing inequalities, because existing elites exploited the privatization process.

Section 3 illustrates how socioeconomic disparities have had a considerable impact on people's property rights and their use of property. Livestock breeding, land cultivation, and access to pastures are dependent upon household assets, including cultural and social capital (such as practical knowledge, negotiating skills, networks, and bargaining power). Affluent households often abuse local regulations on land and pasture use to accrue economic wealth, a process referred to as "forum shopping." Most households cannot undertake sustainable farming because of high cultivation costs and inadequate institutional support in the form of credit or machinery, and are forced to abandon cultivation. They lack the resources and capabilities to be efficient and sustainable. This section illustrates how the neoliberal agrarian reforms failed to transform most actors into market participants.

Steimann argues that there are 2 livelihood trajectories in the context of institutional hybridity and uncertainties of rural Kyrgyzstan. The majority of poor households are trapped in a negative livelihood trajectory, unable to secure their property rights, and dependent upon state welfare and affluent households for their survival. The minority of rich households operate on a positive livelihood trajectory, able to develop long-term coping strategies. This difference in the rural trajectories, Steimann argues, "provides a good example of the continuing impact of the neoliberal shock therapy of the 1990s on rural livelihoods and institutions up to the present day" (p. 227). Steimann suggests that poor households' negative livelihood trajectory can be changed either by reducing their uncertainties or by improving their negotiating power. But he seems to be unclear on how to achieve such empowerment or to reduce uncertainties. In the conclusion, he states that the introduction of new institutions, such as communal resource user associations, is unlikely to reduce institutional uncertainties and might even exacerbate existing social inequalities.

This book is essential reading for academics and practitioners who specialize in the region or postsocialist developments. Few studies examine the emergence of socioeconomic disparities and their implications on livelihood trajectories. This book is of particular benefit to international policy-makers and donors, who are engaged in democratization and

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development projects in the region. Often they lack sufficient understanding of the local context and are guilty of introducing development programs that disregard unequal power relations on the ground and of weakening local state institutions that protect citizens' rights.

Overall, this book provides both rich empirical evidence and theoretical discussion on postsocialist transformation. But it does suffer from some weaknesses. The study lacks a deeper analysis of the nature of social inequality in rural Kyrgyzstan. This is a survey of rural livelihoods rather than a comprehensive examination of the causes of socioeconomic inequalities and the forces that produce them. Steimann provides some insights for the emergence of socioeconomic disparities (such as path dependency and neoliberal reforms) but does not explain why they continue to persist. I would have liked to see more discussion on the role of state and international institutions in shaping rural livelihood trajectories and socioeconomic disparities.

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Mountain Research and Development (MRD)
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Herders' Manual

Edited by Inam-ur-Rahim and Daniel Maselli. Bishkek, Kyrgyzstan: University of Central Asia, 2011. 124 pp. Available in Kyrgyz, Russian, and English. Free download at http://msrc.ucentralasia.org/events.asp?Nid=248. ISBN 978-9967-448-36-0 (Kyrgyz); ISBN 978-9967-448-39-1 (Russian); ISBN 978-9967-26-502-8 (English).

The Herders' Manual is an effort to take on the important task of tackling a little documented subject area and to provide comprehensive, practical advice to herders in the Kyrgyz Republic on pastoral issues, which range from vegetation to pasture management to animal health issues. The manual is a joint project of the University of Central Asia's Mountain Societies Research Centre and the Swiss National Centre of Competence in Research North-South in the Kyrgyz Republic. A similar manual was created for the Western Pamir region of Tajikistan.

The importance of taking on these issues is evident. The Kyrgyz Republic is undergoing profound reforms in pasture management, with many decisions that involve a change of practices being taken by pasture users directly. There clearly is a need to reform practices installed in the Soviet era, but all stakeholders are still in the process of gradually understanding what mix of traditional knowledge and more modern approaches will be optimal in the country context. Changes in pasture management have been slow, with the State retaining ownership but lacking the means for, and often also interest in, effective management. Furthermore, 70 years of Soviet management has meant that herders lost their ancestral knowledge about how to manage livestock and pasture usage. At the same time, the role of herding in Kyrgyz economy, society, and culture has been enormous, with nearly half the country's area being used as rangeland and with a whole way of life of the traditionally nomadic and seminomadic Kyrgyz tribes based on migration in search of good pastures.

This manual marks a strong effort to take on topical issues. It covers much ground, and much of the information is useful and well presented. The manual sets out basic principles of appropriate grazing, explaining, in simple ways, the relations between grazing and plant regeneration. The information provided on pasture improvement is valuable, given that some Kyrgyz herders have never been exposed to the knowledge and practices included in the manual. Livestock management is another topic covered by the manual, which presents principal methods of animal care. In general, the manual touches on many if not all of the topics most important to Kyrgyz herders.

However, there are 3 important shortcomings that detract from the overall valuable information provided. First, the manual does not fully meet its goal of combining traditional approaches with scientific information. In fact, little reference is made to traditional methods, and the applicability of traditional practices in different areas is hardly discussed. This is particularly the case in the second section of the manual on pasture management. Second, it remains unclear to which audience the manual is addressed. Although ostensibly targeting herders and local pasture committee members, the text is overly scientific and pitched at a more academic level than what would be practically applied by individual herders. Third, in its attempt to cover all knowledge related to livestock farming, the manual seems to have lost some of its focus and in some parts does not provide needed details.

The manual is composed of 4 parts, with the last one including annex materials. Part A presents photos and concise information about the most important and desired pasture plants and least desirable but widely seen weeds or toxic plants. The information is rich in visual material that can help herders to identify the plants in the field. There is, however, little cross-referencing of this information to other parts of the manual.

The manual uses a classification of plants that was established jointly with herders. The plants were identified and assessed with respect to their desirability to different livestock, their habitat, and their tolerance to different climates as well as anthropogenic pressures. Yet, presumably, herders would have benefited from additional practical guidance on how to apply this information. For instance, does poor grazing tolerance mean that animals should not eat a plant? How can farmers use the information on weather tolerance? Furthermore, in identifying poisonous plants and weeds, it would have been beneficial to provide information about the consequences of their ingestion, including the symptoms that animals show when poisoned by the various plants.

Part B is about pasture management. This is where traditional knowledge is especially crucial to ensure preservation and regeneration of biodiversity and ecosystems in general. The manual offers sound theoretical information about an appropriate rotational grazing scheme. However, although guidance, such as "Do not allow animals to stay too long on autumn pastures," (p 71) is correct, it appears to be too general.

Part B contains accurate information about biomass calculation and the regulation of pasture usage, but this information is of limited applicability by herders. Pasture assessment is based exclusively on vegetation and biomass, and only fodder plants are used as indicators. There are, however, other indicators that are likely far more important for ecosystem monitoring, including those that assess soil compaction, litter, incidence of cattle tracks, wind

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erosion, and increased rates of water loss. These indicators are embedded in traditional knowledge and hence easier for herders to apply; yet, they are not referenced in the manual.

Part C concerns livestock management. This part provides accurate and useful information but, in some parts, would have benefitted from more detailed explanations. For instance, the manual states that "Proper stacking of hay also prevents spoilage and allows for a longer period of storage" (p 96); however, it does not explain what proper stacking means. The authors also suggest that farmers should rely solely on fodder. This disregards the fact that many experienced Kyrgyz livestock farmers graze their animals on natural high pastures all year round, as in the old times.

Part C ends with a table of the most widespread animal diseases in the region. This information is crucial for herders in the Kyrgyz Republic today, because there is a lack of professional veterinarians in remote areas, and new animal diseases appear every year. Guidance on treatment, however, is limited to use of antibiotics and other pharmaceutical drugs, whereas traditional treatment methods and preventive measures used by Kyrgyz livestock farmers, including use of minerals, herbs, plants, and other natural elements, are not included.

In summary, the manual represents a courageous and important first step to provide practical guidance to herders on livestock and pasture management issues. This is no easy topic, because these issues are integral to Kyrgyz life and yet subject to many changes. The manual's strength is in its provision of relevant technical and scientific knowledge in a concise manner (although it must be noted that clearer, more detailed, and more comprehensive referencing would have enhanced the book). Yet, although at times it succeeds in making this information fairly accessible, in other parts of the manual, the style seems overly technical and somewhat removed from how a Kyrgyz herder would apply the knowledge.

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Mountain Research and Development (MRD)
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Dagestan: Russian Hegemony and Islamic Resistance in the North Caucasus

By Robert Bruce Ware and Enver Kisriev. Armonk, NY, and London, United Kingdom: M.E. Sharpe, 2010. xv + 251 pp. US$ 35.95. ISBN 978-0-7656-2029-3.

In this book, 2 authors, an American philosopher who turned from political philosophy and international ethics to political analysis of ethnic and religious conflicts in the Caucasus, and a scientist working at the Daghestan Research Center at Makhatchkala, share their competence to provide a double view on one of the most conflict-filled regions on Earth, aiming to reveal the different positions and to add to mutual understanding. Common associations with Dagestan are terrorism, Islamism, ethnic fragmentation, territorial isolation in high mountain valleys, neighborhood to Chechnya, Imam Shamyl, and Caucasian war. All these associations are dealt with, but the main focus of the book is on the opposition of Russian conquest and Caucasian freedom, of sovietization and tradition, and of Russian hegemony and Islamic resistance.

The first 3 chapters go back to the history. The first chapter explains the mountain context as the spatial frame for the differentiation of economy and social structure, and reflects the situation between different empires and then going back to Russian imperialism and the spread of Islam. The second chapter deals with the confrontation between the tsarist conquest and the murids who tried to establish an Islamic state in the East Caucasus. The third chapter argues that Soviet rule in the North Caucasus betrayed Islam in Dagestan and replaced religious identification of the population by a dubious ethnic construction since the politics of *korenizatsiya* in the early 1920s.

The following 4 chapters, comprising two thirds of the text, deal in detail with the political and social development since the breakdown of the Soviet Union and the beginning of processes of democratization. The collapse of the central authorities transferred new responsibility to the peripheral territorial entities of Russia. In Dagestan, the multiethnic structure required a special solution for the problem of adequate representation of the main ethnic groups in the regional government. In this respect, Dagestan developed a sophisticated electoral system that worked well for approximately 15 years. However, an opposite position was established when representatives of Wahhabism came to Dagestan and tried to introduce Islamistic elements of governance. Further fragmentation of the society resulted from this development: some of the Islamic population remained on the way to democracy, others fell under the influence of the Wahhabits and even supported terrorist attacks. Today, Dagestan is frequently shaken by political murder and terrorism and, therefore, is one of the most destabilized regions of the North Caucasus.

The book is based on a profound knowledge of Dagestan's history and political development. The authors provide detailed information on the main actors and all relevant events. The analysis of the relevant scientific literature is complemented by consideration of the content of daily newspapers. The argumentation always tries to find a way that not only presents the "Western" (or Russian) view but also takes into account the regional necessities and understanding. This has resulted in a coherent work that should be read by all who want to get a deeper insight into the political and social development in Dagestan, even if sometimes the search for a simplifying overview must be postponed.

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Mountain Research and Development (MRD)
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Himalayan Biodiversity in the Changing World

Edited by Pavel Kindlmann. Berlin, Germany: Springer, 2012. x + 226 pp. € 139.95. ISBN 978-94-007-1801-2.

Conservation of global biological diversity is severely compromised by the so-called Wallacean shortfall. Named after Alfred Russel Wallace, one of 19th century's leading experts on the geographical distribution of species, this shortfall refers to a lack of complete understanding of the distribution of many taxa. The Wallacean shortfall poses a serious challenge for biodiversity conservation planning and management because, without the understanding of the distribution of a species, decisions about where to target efforts for its conservation are hard to make. A knowledge gap of this kind is particularly severe in remote mountainous regions of the Himalaya where high species richness is combined with intricate topography and inaccessibility, which means that species assemblages of some groups and from some regions still remain relatively unexplored.

Himalayan Biodiversity in the Changing World not only makes a contribution to filling this knowledge gap but also identifies challenges and attempts to chart the way forward for conservation of Himalayan biodiversity. The book focuses on Nepal, a country at the heart of the Himalayan mountain range, which occupies nearly a third of its west-to-east length. This is a significant contribution to understanding the Himalaya-wide distribution of many species, their threat status, and key issues in their conservation. The book is a compilation of chapters, many written collaboratively by Czech and Nepalese authors. All have substantial experience of working in Nepal and acute understanding of the issues and driving forces in this country, a country that is experiencing rapid change in land use and resource use, while facing severe effects of global climate change. The book is well illustrated with maps, color photographs of ecosystems and landscapes, fauna and flora, and the people in Himalaya, which makes it successful in communicating scientific information in ways that are easily accessible to the lay reader. A compilation of species indexes at the end of the book makes a useful addition for experts who are interested in specific taxa. Therefore, the book has elements that appeal to both a general audience and subject specialists.

The first chapter introduces the region and provides an overview of biodiversity in Nepal. The chapter also familiarizes the reader with the country's 6 biogeographic zones or ecoregions, each characterized by its own vegetation types, fauna, and flora. The second chapter identifies challenges for conservation of biodiversity in Nepal, with particular focus on threatened species. It describes the setting of the country's protected area network, which has been successful thus far in offsetting effects of land use change, as well as illegal logging and poaching; but challenges remain as the population on the periphery of protected areas continues to grow. The chapter identifies the tension between conservation and development as the main challenge for conservation of biodiversity in Nepal. Although this is a reasonable conclusion, tackling this challenge is likely to require concerted regional policies that address both biodiversity conservation and poverty alleviation.

The following chapters focus on specific taxa and attempt to compile information on their geographical distribution in various ecoregions of Nepal. The third chapter takes on orchids, a group of plants characterized by high species richness and endemism, alongside considerable knowledge gaps in the geographical distribution of many species. The chapter reports findings of an extensive survey of orchids in a district in the foothills of Himalaya and describes the orchid composition of each vegetation type, and is supplemented by a useful matrix of the presence or absence of each orchid species across vegetation types within this region. Subsequent chapters focus on a variety of other taxa, storks, wild ungulates, Himalayan tahr, snow leopard, and tiger, and explore ecologies of these taxa or their groups at habitat and landscape scales. These chapters also examine the interaction of these taxa with vegetation, other wild species and, often, the livestock or people with whom they cohabit the Himalayan landscape. However, the chapters do not stop just there; they identify challenges for conservation and make precise recommendations based on empirical evidence from the research. The challenges tackled by these chapters include widespread hunting in Nepal's national parks and the need for conservation beyond the protected areas, within the densely populated agricultural landscape mosaic.

Although *Himalayan Biodiversity in the Changing World* has an all-encompassing title, in reality the book focuses only on a selection of taxa in which the authors have expertise because the work presented has been conducted by a relatively small group of researchers, so the choice of taxa is somewhat eclectic. For example, although orchids, storks, wild ungulates, or large carnivores are well covered, some of the critical knowledge gaps, notably in lower plants or invertebrates, are not addressed. However, the data presented are based on fairly long-term studies carried out by graduate students under supervision of researchers dedicated to understanding the distribution of Himalayan biodiversity for more than a decade. This temporal perspective, therefore, makes these data very useful for those interested in understanding the effects of environmental or anthropogenic changes on the presence and distribution of species in the Himalaya.

 http://dx.doi.org/10.1659/mrd.mm108

The book is well referenced throughout and exposes the reader to literature beyond what is presented in the empirical case studies. The reference lists at the end of each chapter are useful, should the reader wish to undertake further reading. Also useful are numerous good-quality photographs and maps, which allow the reader to put the case studies into appropriate context. Another useful feature is commentary at the end of each chapter that identifies conservation issues and the way forward, by providing policy makers with useful summaries of the issues at stake. This book, therefore, appeals to multiple audiences, but, most importantly, it is a useful starter and a suitable text for undergraduate or postgraduate students. By appealing to this latter audience, who might well conduct further research on Himalayan biodiversity to fill the pressing knowledge gaps, this book will, it is hoped, make a lasting contribution to conservation of Himalayan biodiversity in the face of rapid change.

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Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
www.mrd-journal.org

Assessment of the Impacts of Climate Change on Mountain Hydrology: Development of a Methodology Through a Case Study in the Andes of Peru

By Walter Vergara, Alejandro Deeb, Irene Leino, Akio Kitoh, and Marisa Escobar. Washington, D.C.: World Bank, 2011. xix + 157 pp. US$ 25.00. ISBN 978-0-8213-8662-0.

Climate change is expected to have strong impacts on water resources worldwide. Mountain regions are especially vulnerable to such impacts because, compared with lowland regions, they tend to rely much less on groundwater for their water resources because of their complex geology and the limited availability of large groundwater aquifers. Instead, water is provided by fragile surface water sources, including wetlands, forests, lakes, and glaciers, all of which are easily perturbed by external stressors such as climate change. The steep topography also significantly increases the costs and technical difficulties of transporting water, which makes it difficult to replenish dwindling water supplies. From a socioeconomic viewpoint, mountain areas tend to host pockets of poverty and vulnerable populations.

All of these are good reasons to be concerned with the potential impacts of climate change in mountains and underline the importance of developing strategies to adapt to changing water supplies in mountain regions. The scientific literature presents a plethora of methods and tools for climate change impact assessments, including global climate models (GCMs), statistical and dynamical downscaling tools, a wide range of hydrological models, and global and local data sets. It, therefore, is very relevant to analyze whether these tools are effectively fit for that purpose in mountain areas. This is the purpose of this report.

In the first part, the authors look at different methods to project climatological change into the future. In the second part, they implement and test a hydrological model as a tool to convert climate projections into changes in monthly streamflow. They use 3 economically important river basins in Peru as case studies: the Santa River basin, which receives water from the largest glacier system in the tropics; the Rimac River, which provides water for the city of Lima; and the Mantaro River basin, which is the food basket for Lima.

Unfortunately, rather than providing a comprehensive overview and discussion of strategies to assess climate change impacts in mountain regions, the report is little more than a set of loosely connected case studies that provide only limited guidance on how to select and apply models and other tools. For example, the first chapters analyze climate projections for Peru as generated by an ensemble of global climate models, a very-high–resolution global climate model, a dynamical downscaling method, and a trend analysis of local stations. However, the results are presented mostly side-by-side rather than in a detailed comparison. For instance, the use of both the high-resolution global climate model (AGCM3.1) and the dynamic downscaling is motivated by the fact that these methods account better for the topography of the Andes. This is indeed a very pertinent issue. Even though the use of GCM ensembles is advocated as a way to get a "non discountable envelope of uncertainty" (Stainforth et al 2007), it is quite likely that, in the case of the Andes, all the models will have a bias in the same direction (insufficient atmospheric blocking by the mountain range). However, model comparison studies in the region show that high-resolution regional models do not necessarily provide better simulations than lower-resolution global models (Buytaert et al 2010). The lack of comparison between, and the evaluation of the results of, the different methods, therefore, seems a missed chance.

The hydrological section is based on the use of the Water Evaluation and Planning (WEAP) hydrological model, which is implemented and evaluated on a monthly time step. Although the study goes to great lengths to implement specific processes of glacier melt and páramo wetlands, the relevance of these efforts is not very clear. On a monthly time step, the catchment water balance will dominate simulation errors. It, therefore, is crucial to get incoming precipitation and outgoing evapotranspiration fluxes correct. The extreme gradients in precipitation result in very large errors in the estimation of the catchment average precipitation, which may well hide errors in the representation of specific processes, such as overland flow or even glacier melt. It is surprising that little attention is paid to the generation of catchment average precipitation inputs and to the parameterization of the evapotranspiration routine and its impact on estimating future evapotranspiration rates. This again is crucial, given the potentially strong impact of increasing temperatures on evapotranspiration processes.

To summarize, the report poses some important questions about the applicability of certain methods and models in mountain regions, and highlights the need for careful assessment of model performance and associated uncertainties. However, it also lacks a coherent discussion about the strengths and weaknesses of each approach and how to address them.

Finally, on a more fundamental level, there is a missed opportunity to discuss how useful model projections riddled with uncertainties are for decision-making. There is a growing consensus in the scientific community that uncertainties in climate projections and related impact assessment are unlikely to decrease in the near future. For every known

 http://dx.doi.org/10.1659/mrd.mm106

model deficiency that is addressed, several "unknown unknowns" are discovered that complicate matters further. Given the extreme uncertainties, especially in regions such as the Peruvian Andes, this triggers the question as to whether model projections can inform decision-making at all. Rather then relying upon highly uncertain projections, there is a tendency to move away from a "predict-and-control" paradigm toward a more adaptive approach, with continuous learning and flexibility as key aims. In this sense, infrastructure investments with high sunk costs, irreversible decisions, or fixed management strategies prevent continuous learning and adjustment. A more effective way of dealing with unpredictability perhaps is to create the capacity to respond effectively to changing and unknown conditions in the future rather than making irreversible decisions now. This can be done by developing strategies that are robust under the full range of possible future scenarios and can be flexibly applied when needed, and through diversifying the range of strategies (Brugnach et al 2008). Even though this may be outside the scope of the report, these issues are highly relevant to promote sustainable development.

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Mountain Research and Development

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The overall mission of *Mountain Research and Development* (MRD) is to foster sustainable development in mountains by supporting peer-reviewed interdisciplinary, disciplinary, and transdisciplinary research on mountains, developing scientific capacity, capitalizing on development experiences, promoting policy dialogue, and strengthening networks within the mountain community.

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Mountain Research and Development (MRD) is devoted to mountains and their surrounding lowlands—ecoregions of particular global importance, in which communities are often marginalized. MRD seeks to present the best in recent research on and development approaches in the world's mountain systems.

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Mountain Research and Development (MRD) is published by the International Mountain Society (IMS).

Core funding for MRD is provided by the following organizations:

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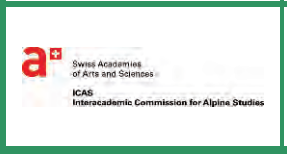

ISSN 0276-4741 (e-ISSN 1994-7151)