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Source: Mountain Research and Development, 33(3):294-304. 2013.

Published By: International Mountain Society

DOI: <http://dx.doi.org/10.1659/MRD-JOURNAL-D-12-00127.1>

URL: <http://www.bioone.org/doi/full/10.1659/MRD-JOURNAL-D-12-00127.1>

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The Role of Authority in the Collective Management of Hill Irrigation Systems in the Alai (Kyrgyzstan) and Pamir (Tajikistan)

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In the high mountain valleys of Kyrgyzstan and Tajikistan, gravity-flow irrigation systems support the production of grains, fodder, vegetables, herbs, and fruits as well as wood for fuel and construction purposes. In the Soviet and post-Soviet

periods, major changes in the organization of society and agriculture have occurred which, when combined with the effects of population growth and outmigration in recent decades, have fundamentally altered the normative and organizational arrangements that had sustained hill irrigation in the past. This article presents 2 case studies, one from the Alaikuu area of Tar Valley, Osh Province, Alai mountain range, southern Kyrgyzstan, and the other from the upper Shokhdara Valley in Gorno-Badakhshan, Pamir mountain range, eastern Tajikistan. A combination of rights and obligations form the foundation of self-managed offtake systems, the rules for which reflect existing social relationships. The importance of

authority to the effective management of these systems is highlighted. Multiple forms of authority coexist at the local level in the Alai and Pamir ranges because of the recent introduction of formal local government and water governance reforms in both countries and the persistence of informal local political institutions, such as the court of elders in Alaikuu and the village headman in Shokhdara. Population growth and diversified livelihood strategies, especially migration, have encouraged a degree of individualism—an attitude that undermines the recognition of authority required for the collective management of hill irrigation systems. An understanding of the heterogeneous role of authority in irrigation management that does not privilege externally created formal institutions is required for government and nongovernment agencies to support hill irrigation and mountain agriculture.

Keywords: Hill irrigation; collective management; authority; water rights; obligations; Gorno-Badakhshan; Osh; Tajikistan; Kyrgyzstan; post-Soviet.

Peer-reviewed: March 2013 **Accepted:** June 2013

Introduction

Irrigation is central to agricultural production in the high-elevation mountain valleys of the Alai in Kyrgyzstan and Pamir in Tajikistan because there is insufficient rainfall for rainfed cultivation. Irrigation water is supplied to farms and orchards by gravity-flow offtake systems, developed to utilize river flow (river valley offtake systems) or meltwater from glaciers or snow fields (slope offtake systems). Vincent (1995: 36) considers offtake systems the commonest form of hill irrigation in mountain areas; they are characterized by their ability to deliver regular irrigation across a cropping season. She defines an irrigation system as “the entire body of works involved in the practice of irrigation—the water extraction technology, conveyance canals, control structures and local distribution technology . . . and also the social infrastructure of rules and procedures that ensures the operation of technology and the delivery of water” (Vincent 1995: 34). Ease or difficulty of conveyance and adequacy or scarcity of water supply at key times in

the cropping season are useful factors for explaining the necessity of different water management activities, presence of particular functionaries, and use of certain technologies (Ambler 1989 cited in Vincent 1995: 36).

For community-managed hill irrigation systems to work, water users must take control of and carry out multiple tasks, including establishment and enforcement of regulations, distribution of water, operation of hydraulic works, maintenance of infrastructure, mobilization and administration of resources, and alliance building and networking (Beccar et al 2002: 14). The rules, a combination of individual and collective rights and obligations, are the normative foundation for the collective management of irrigation systems. Beccar et al (2002: 3) define water rights as “authorized demands to use (part of) a flow of water, including certain privileges, restrictions, obligations and sanctions accompanying this authorization.” Key to this definition is the term *authorization*, for rights and obligations can be developed and sustained only when water use and system management are sanctioned by an authority, be it

individual or collective, with legitimacy and power of enforcement, and recognized by users and nonusers alike (Beccar et al 2002).

Individual rights are derived from collective rights and duties; they are not uniform nationwide but vary from one irrigation system to another. They can depend not only on the fulfillment of obligations in the irrigation system but also on the performance of other collective tasks established by the community (Boelens 1998: 87). Rights and obligations developed during the construction, use, and maintenance of irrigation systems can be termed *hydraulic tenure* arrangements. Hydraulic tenure implies that the normative and organizational arrangements for irrigation reflect the underlying property grid formed during initial construction (cf. Coward 1986). Hydraulic tenure arrangements may not persist if major land reforms are enacted. *Conferred tenure* can exist where rights are granted to households or communities, and *claimed tenure* can exist where former workers of collective farms or estates claim water and land rights after agrarian reform (Vincent 1995: 95).

In Kyrgyzstan and Tajikistan, great changes have occurred in the organization of society and agriculture in recent decades because of the collapse of the Soviet Union, subsequent agrarian reforms, population pressure, and high levels of migratory nonfarm employment. Whereas in the Soviet period *sovkhoses* (state farms) and *kolkhozes* (collective farms) were formally responsible for water distribution and the maintenance of canals, in the post-Soviet era formal local governments have been introduced: the *jamoat* in Tajikistan and the *aiyl okmotu* in Kyrgyzstan. Both the *jamoat* and the *aiyl okmotu* are essentially federations of villages; they have limited competencies and budgets (Sehring 2009: 73). These local government structures function alongside informal political institutions dating back to pre-Soviet times, which were tolerated under the Soviet Union and gained a renewed importance in the post-Soviet period (Sehring 2009: 73), such as the *rais* (village headman) in Tajikistan and the *sud aksakalov* (court of elders) in Kyrgyzstan. The result is the coexistence of multiple forms of authority at the local level in both countries, representing different sociolegal frameworks. These forms of authority are not uniformly recognized by water users, however, because of changes in attitudes, partly attributable to migratory employment. Jodha et al (1992: 10) list individualism, factionalism, and commercialism as qualitative changes that have negative effects on traditional institutional mechanisms for collective management of resources in mountain areas. In the context of such changes, this article explores the role different forms of authority play in the collective management of irrigation systems.

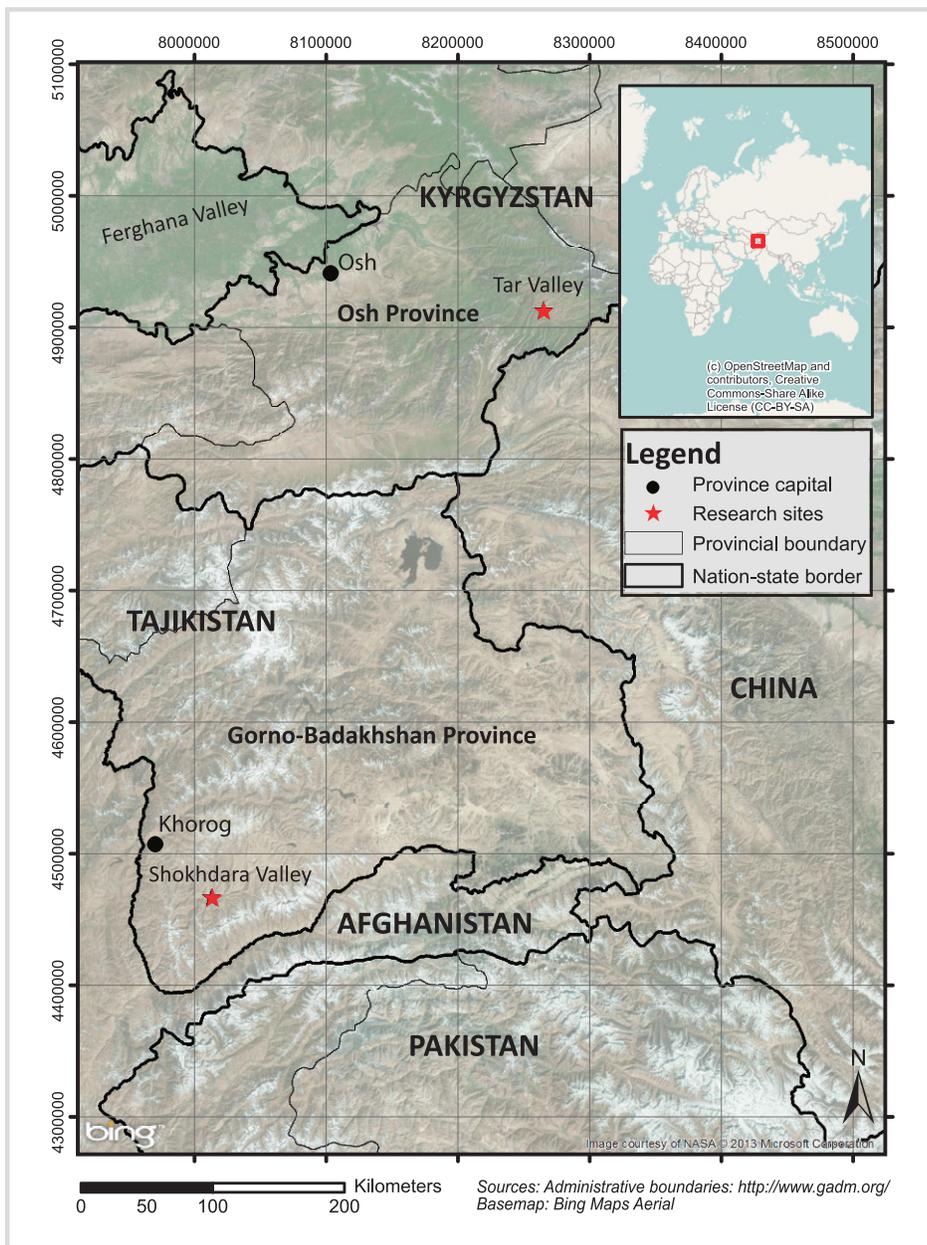
Data and methods

Qualitative field research was conducted in November 2011 and April–June 2012 in Kyrgyzstan's Osh Province

and Tajikistan's Gorno-Badakhshan Province for a total of 12 weeks. In each of the provinces, a graduate with a bachelor's degree was hired as assistant and translator. Fieldwork was undertaken in several *aiyl okmotu* and *jamoats*, although this article focuses on just one *aiyl okmotu* and one *jamoat*. In Osh, several field visits were made to the lower Tar Valley, facilitated by the Mountain Societies Development Support Program (MSDSP Kyrgyzstan). Two weeks were spent in the upper Tar Valley, an area known as Alaikuu (Figure 1). In Gorno-Badakhshan, several visits were made to Porshinev *jamoat*, and 2 weeks were spent in the Tusion and Barvoz *jamoats* in Shokhdara Valley (Figure 1). A case-study approach to irrigation systems was pursued that included observation, mapping of irrigation systems and farmland, and interviews (see also Hill 2012). Interviews were open ended or semistructured, conducted with male and female head-end, middle, and tail-end farmers (according to position of landholding in irrigation system), key irrigation system functionaries; village leaders; elders; and *jamoat* and *aiyl okmotu* officials. Limited data of relevance were collected from government and nongovernmental organization (NGO) offices in the provincial capitals and district headquarters.

This study did not seek to perform a comparative analysis, and therefore, the research sites were not selected with the intention that they should be directly comparable. The 2 research sites differ in physical characteristics, such as steepness of slopes, relative relief, aspect, dissectedness of landscape, elevation of farmland and irrigation headwork, water source for the irrigation system, and rate of precipitation (Table 1). The Kyrgyz of Alaikuu in the upper Tar Valley have a more pronounced system of vertical control—that is, coordinated livelihood strategies at different altitudinal zones—than the Tajik Pamiris of the upper Shokhdara Valley: indeed, the Kyrgyz are well known for the temporary relocation of most household members to the *jailoo* (summer pasture) for several months each year. Although both local jurisdictions visited for this study are quite remote, the upper Tar is relatively less inaccessible than the upper Shokhdara because of its proximity to the vibrant city of Osh, which is located on the fringe of the Ferghana Valley. Kyzyl Zhar *aiyl okmotu* is the second most remote of its district's 12 *aiyl okmotus*, located in a dead-end valley 80 km (4 hours) from the district headquarter Kara Kulja, and 180 km (6 hours) from the provincial capital Osh, Kyrgyzstan's second-largest city. In comparison, Barvoz *jamoat* is the second most remote of its district's 6 *jamoats*, located in a rarely traveled valley 65 km (3 hours) from the provincial capital Khorog, and a further 525 km (18 hours) from Dushanbe, Tajikistan's capital. The 2 sites share several livelihood characteristics: a single cropping season; a dominant cropping system of barley, fodder, and wheat; limited fruit production; significant animal husbandry; and high levels of outmigration.

FIGURE 1 Location of the 2 research sites. (Map by Antonio Rogmann and Joe Hill)



Agrarian and water governance reforms

Most irrigation systems in the Kyrgyz Alai and Tajik Pamir were constructed by the local population before or in the decades after czarist Russia's entrance into the region in the late 19th century. Ole Olufsen (1904: 110–115), head of 2 Danish expeditions to the Pamir Mountains in the late 1890s, documented the importance of irrigation in the pre-Soviet period. It is unlikely that the rulers of Tajikistan's Gorno-Badakhshan Province were able to

finance the construction of irrigation systems (Bliss 2006: 143); systems built in the late 19th and early 20th centuries were probably built by villagers with the help of outside experts (Mukhiddinov 1975: 19–20). Based on observations in the field and documentation of MSDSP's work in Gorno-Badakhshan (Bliss 2006), it is clear that new irrigation systems were developed during the Soviet period and later by MSDSP and international NGOs, all using local labor and outside financial and material resources. No documentation has been located for Soviet-era irrigation systems in Kyrgyzstan's Tar Valley.

TABLE 1 Basic characteristics of the research sites.^{a)}

Characteristics of study areas	Kyrgyzstan	Tajikistan
Province	Osh	Gorno-Badakhshan
District	Kara Kulja	Roshtqala
Local jurisdiction	Kyzyl Zhar <i>aiyl okmotu</i>	Barvoz <i>jamoat</i>
Research village(s)	Kuiotash, Terek	Shokhirizm
Valley	Tar	Shokhdara
Surrounding mountain ranges	Alaikuu, Ferghana	Shugnan, Shokhdara
Water source for irrigation system	Glacial stream-fed river	Glacial stream and snowmelt
Type of irrigation system	River-valley offtake	Slope offtake
Local name for irrigation channel	<i>aryk</i>	<i>wedh</i>
Length of channels	1–5 km	18 km
Irrigated farmland altitude	2200–2400 masl	2900–3000 masl
Channel headwork altitude	2250–2600 masl	3600–3800 masl
Estimated annual precipitation	570–900 mm	250–300 mm
Number of cropping seasons	One, starting in May	One, starting in May
Dominant crops	Barley, fodder, wheat	Barley, fodder, wheat
Ethnicity	Kyrgyz	Tajik Pamiri
Religion	Islam, Sunni	Islam, mainly Shia Imami Ismaili
Languages	Kyrgyz, Russian	Shugni, Tajik, Russian

^{a)}Data sources: altitudes estimated from Google Earth; annual precipitation (estimated) from Ashley and Ershova (2011: 14) and Bliss (2006: 27); other information obtained during field research.

The Soviet Union transformed agriculture by collectivizing landholdings and organizing workers into *kolkhozes* (collective farms) and *sovkhoses* (state farms). In Kyrgyzstan, the former principal veterinary surgeon for Alaikuu recalled that after the October Revolution in 1917 there were 13 *kolkhozes* in Alaikuu, which were combined to form 3 *kolkhozes* in 1950, before being further reorganized into one *sovkhos* in 1974. Later the units were divided again, to 2 *sovkhoses* in 1982–1983, 4 *kolkhozes* in 1990, and 8 cooperatives in 1991, followed by the establishment of land-reform committees in 1994; the 3 *aiyl okmotus* were created in 1994–1995 (interview data). Kyzyl Zhar *aiyl okmotu*, the focus of the Kyrgyzstan part of this study, contains the lion's share of Alaikuu's plowed land (irrigated and nonirrigated) and ranks third of Kara Kulja district's 12 *aiyl okmotus* with respect to both the total area privately owned and plowed and the irrigated portion of that land.

In Tajikistan, a similar reorganization of administrative boundaries occurred in Shokhdara valley during the Soviet period (see, for example, Herbers 2001). Carved out of a larger district in 1991, the Roshtqala district comprises 6 *jamoats*, including Barvoz (where our

Tajikistan research village, Shokhirizm, is located), with its headquarters in Vezdara. Barvoz is divided into 3 farm associations, which administer land transactions, collect land taxes, and provide seed to farmers. Shokhirizm's leaders say their village has more land than any other in Gorno-Badakhshan. Land distribution in the 1990s (after independence) took place on a village-by-village basis and allocated plots of land of different quality and in different locations to individuals, not households. This resulted in significant variations in household landholdings, within and across villages.

On their independence in 1991, both Tajikistan and Kyrgyzstan inherited a deteriorated water infrastructure, a shortage of financial means and professional capabilities, a hierarchal governance system inadequate to meet new challenges, and a need to develop their own water-governance policy strategy (Sehring 2009: 67). Both countries had to face external pressure based on the same norms of international development discourse, the result of which can be seen in policy decisions made in the 1990s and 2000s to introduce water codes and irrigation service fees and to transfer irrigation management to water user associations (WUAs) (Sehring 2009: 68). WUA reform has

been implemented almost exclusively by international NGOs and donors, for example, the World Bank and Asian Development Bank (Sehring 2009). Thus, the Aga Khan Foundation entered Gorno-Badakhshan Province during the Tajikistan civil war (1992–1997), supplying food aid beginning in 1993 and repairing *wedhs* (irrigation channels) beginning in 1995. Its program, renamed MSDSP (Mountain Societies Development Support Program) in 1997, was supported by international NGOs and donors.

WUA formation has hardly been implemented in the high-elevation regions of Tajikistan and Kyrgyzstan, which are seen to be less agriculturally productive than lowland regions, though MSDSP and the US Agency for International Development (USAID) have introduced the concept to at least 3 *jamoats* in Gorno-Badakhshan Province (Tajikistan). WUAs were formed in Porshinev in 2009 and Tusion in 2010, serving 1220 and 370 households, respectively. The jurisdiction of these WUAs matches that of the corresponding *jamoat*. In Osh Province (Kyrgyzstan), the World Bank supported WUA formation in 2004–2005, establishing 3 WUAs in lower Kara Kulja district; however, just one was functioning in late 2011. The jurisdiction of the WUA corresponds with that of the *aiyl okmotu*. Other similar characteristics are shared by the WUAs in both provinces: their functionaries work at an administrative and not a hydrological (irrigation system) level, and there is no government funding, so they rely on funding from international NGOs and donors.

Thus, over time and space, different formal sociolegal systems and forms of authority have coexisted at the local level in both countries. The next section presents case studies of several irrigation systems, and shows how these formal institutions interact with informal local norms and political institutions.

Community-managed hill irrigation systems in the Tar and Shokhdara valleys

River valley offtake systems in Alaikuu, upper Tar Valley, Kyrgyzstan

Kyzyl Zhar *aiyl okmotu* comprises 4 villages—including the 2 research villages Kuiotash and Terek—with a population of 6968 living in 1320 households, according to January 2012 census data compiled by the *aiyl okmotu* office. Each village has one or more river valley offtake systems, supplying water to private household plots, which remained in the possession of households throughout the Soviet period (see Lindberg 2007: 53). On household plots clover, sainfoin, and barley are grown to feed livestock through the winter months. Potato, onion, carrot, garlic, radish, cabbage, beetroot, and herbs such as fennel and dill are also typically grown. There are a few apricot and apple trees, though no orchards.

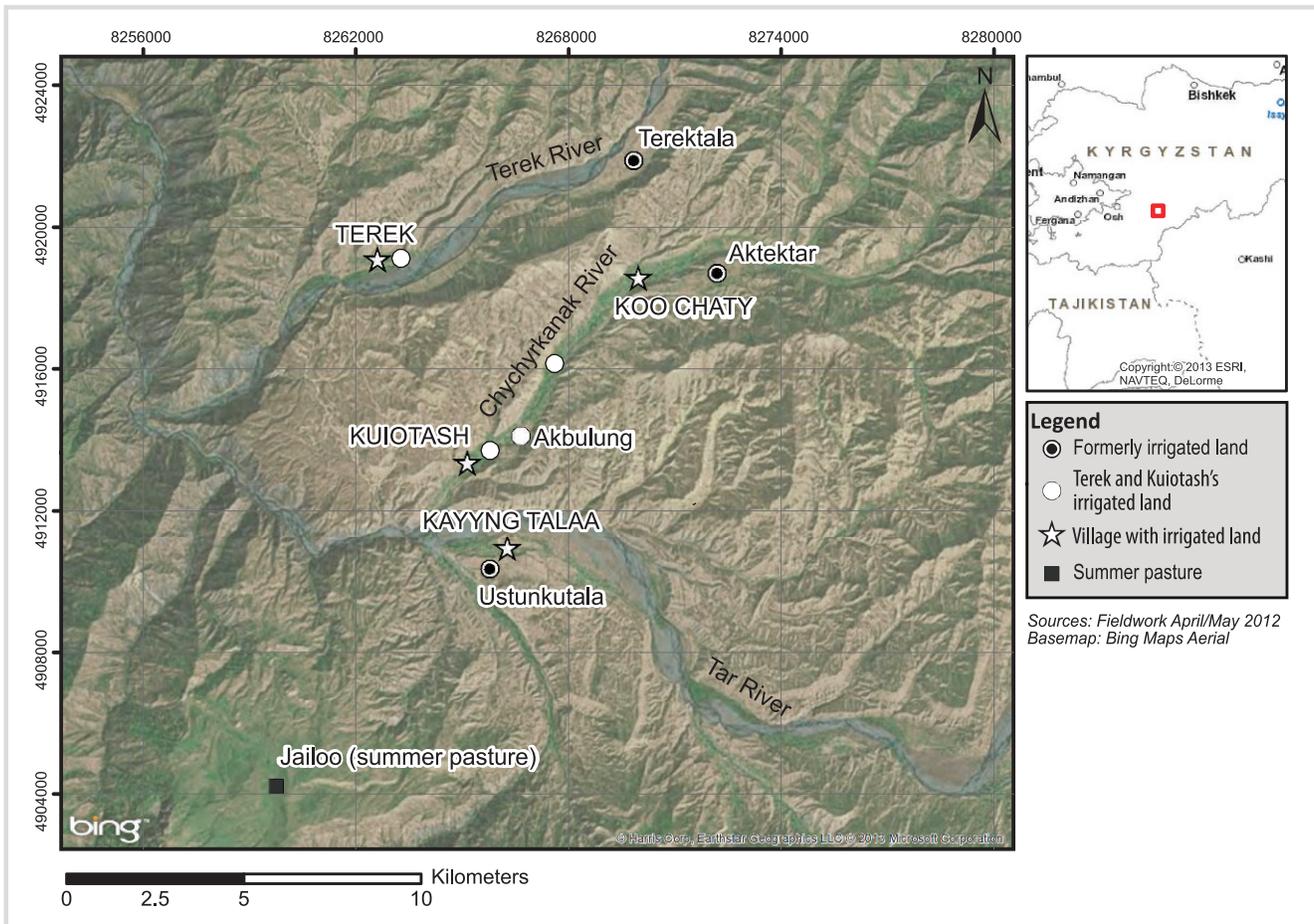
Other large areas of land, at varying distances from the villages, were irrigated in the past. During the Soviet period, Terektala (estimated to be 480 ha) and Ustunkutala (estimated at 20 ha) (see Figure 2) were irrigated by *aryks* (channels) supplied with water lifted from the Terek and Tar rivers using electric-powered pump stations. Aktektar (estimated at 220 ha) was irrigated by a slope offtake system that has since fallen into disrepair. On these lands, which were redistributed after independence, grass and fodder for livestock are now grown, though until recently wheat was grown. There are also the remains of *aryks* at the *jailoo* (summer pasture), where approximately 1000 ha of land was redistributed to the inhabitants of 3 villages, including Kuiotash. Natural grass is now harvested at the *jailoo*, whereas earlier barley was grown.

The *aryk* of Terek village's sole irrigation system was damaged by a rockfall in winter 2009–2010 (Figure 3A). The village's 241 households have since been unable to cultivate their household plots. Officials from the Ministry of Emergency Situations visited Terek in early May 2012, on the request of the *aiyl okmotu* head. On this day schoolchildren were mobilized to make gabions along the riverside of Terek's *aryk*. One teacher expressed his dismay at the villagers' focus on repairing the 5-km *aryk*, suggesting that they ought to construct a new channel with a headwork further up the Terek River. After Ministry of Emergency Situations officials visited the damaged *aryk*, and then discussed the problem with the *aiyl okmotu* head, the head of Terek village (Aiyl Bashy), and other *aiyl okmotu* officials, they concluded that they would not support the villagers. The Ministry of Emergency Situations had already provided an excavator, but the *aiyl okmotu* head was requesting more gabions and pipe material. One official stated, "there are other villages in Osh with problems like Terek's, but there the villagers solve their problems themselves."

Once the officials had departed, the *aiyl okmotu* head tried to placate Terek's villagers (Figure 3B) by reminding them of 3 projects he had undertaken on their behalf: repair of the bridge, provision of a mobile phone tower, and procurement of material for the repair of their *aryk*. One *aksakal* (elder) stood up and exclaimed, "If there will be water we will respect you." Another man shouted, "All meetings are like this." The *aiyl okmotu* head responded by saying he would go to Osh to request more gabion and pipe, but also instructed the villagers to remove the rock blocking their *aryk*.

Kuiotash's 273 households own private household plots irrigated by 8 *aryks* drawing water from the Chychyrganak River, as well as plots of land at Akbulung, on top of the low-lying grass-covered hills immediately adjacent to the village (Figure 3C) and at the *jailoo*. The villagers repaired Koo *aryk* in early May (Figure 3D). From its headwork, made of rocks to divert the river water, a 3.5-km-long channel supplies water to 43 households on both sides of Kuiotash's main road. Private household plots were found to vary from about 0.04 to 0.3 ha in size.

FIGURE 2 Kyzyl Zhar *aiyl okmotu*'s 4 villages (all irrigated) and the location of Akbulung and formerly irrigated lands. (Map by Jenny Kebschull and Joe Hill)



However, some households also farm an absentee brother's or neighbor's land. The *aiyl okmotu* keeps no data on each irrigation system's command area (area irrigated).

One tail-ender had gone door to door the night before the cleaning of Koo *aryk* to ask villagers to attend. Several respondents said that in the past *aksakals* monitored the *aryks* and checked households' water use and fulfillment of obligations; however, they no longer play this role. Twenty-five households turned out to clean the *aryk*. Six households had outmigrated, and their houses were boarded up. The rule is that the households that do not participate in the cleaning must repair the *aryk* later in the season if it gets damaged. Irrigation water is taken once a month, from May to August. Head-enders irrigate first and tail-enders last. No functionary exists to monitor water use, so tail-enders struggle to get enough water for their plots.

Akbulung, estimated to be 26 ha in size, is on the opposite side of the Chychyrkanak River from Kuiotash village. In the *sovkhos* period it was divided into 2 cooperative farms and sown with clover. When land was redistributed in the early 1990s, workers on the 2 farms received 0.01 ha and 0.05 ha, respectively, per household member. Landholdings in Akbulung presently vary from

0.07 to 0.2 ha per household. Potato, barley, and grass are cultivated.

Akbulung's *aryk* was cleaned in mid-May by the representatives of 25–30 households, a low turnout considering that nearly all of Kuiotash's 273 households own land there. A rule exists that those who participate in the annual maintenance irrigate first, for the first irrigation session only, after which others may irrigate. The low turnout was attributed to the villagers' laziness by a young man who until recently had lived in Bishkek. It also relates to a change in cropping pattern. In the past 4–5 years, fewer potatoes are grown on Akbulung, which farmers attribute to changing weather conditions. Spring is coming later, which sets back the date crops can be sown and the date livestock are taken to the *jailoo*. For all of Kuiotash's irrigation systems, each household is supposed to provide one member for maintenance duties irrespective of its command area landholding size.

Slope offtake systems in the upper Shokhdara Valley, Tajikistan

Barvoz *jamoat* has a population of 2647 living in 395 households. Shokhirizm, the research village, is the

FIGURE 3 (A) An official from the Ministry of Emergency Situations (on horseback) inspects damage to Terek's *aryk*; (B) the heads of Kyzyl Zhar *aiyl okmotu* and Terek village address Terek villagers, including *aksakals*; (C) Chychyrganak Valley, with Kuiuotash village in the forefront, viewed from the *jailoo*; and (D) villagers clean the *aryk*, with a research assistant on the left side. (Photos by Joe Hill)

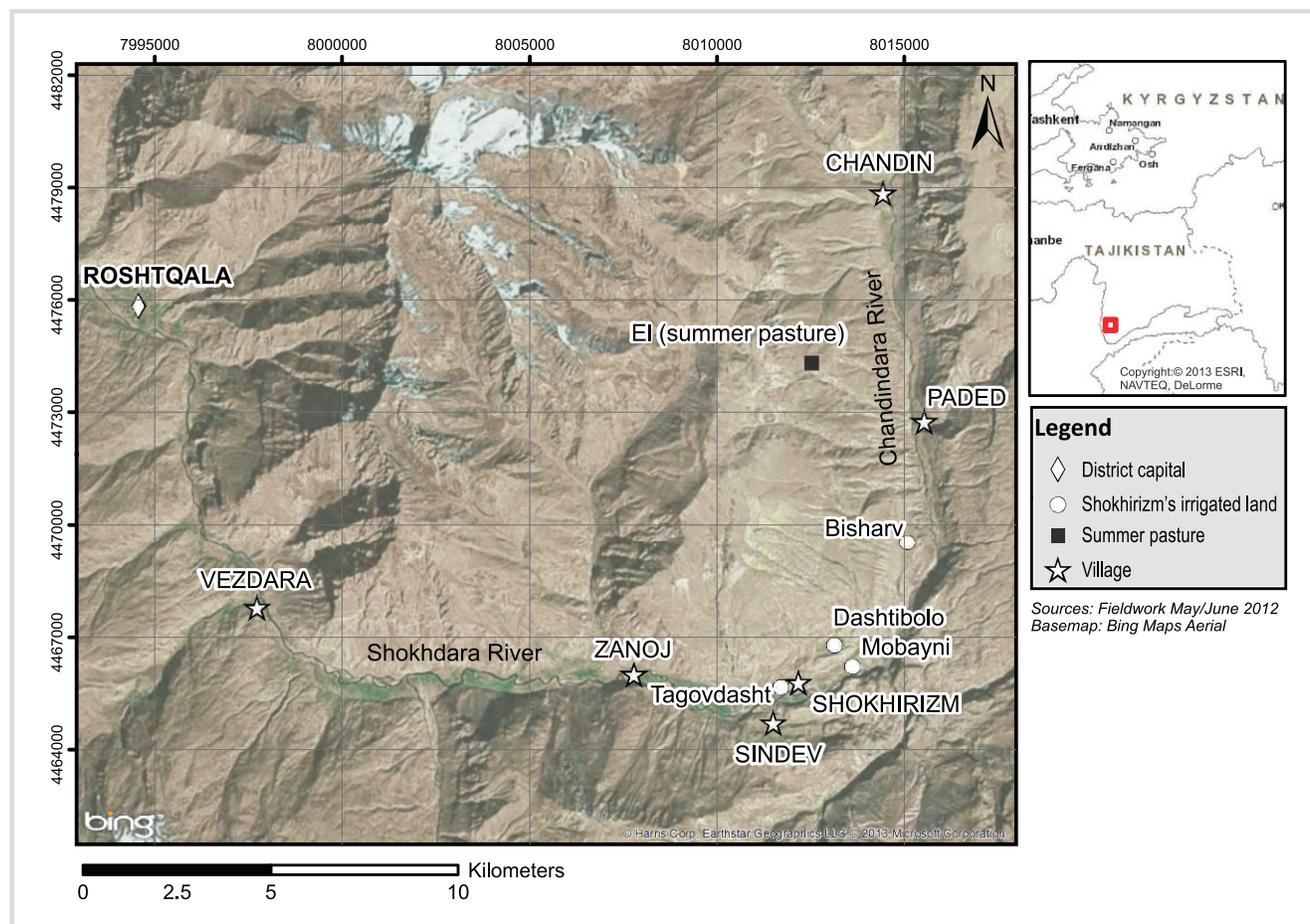


second-largest village in Barvoz, with 302 people in 45 households, according to data provided by MSDSP Khorog in 2012. Shokhirizm is divided into 3 inhabited and irrigated sections—Tagovdasht (at 2900 m altitude), Mobayni (at 2900 m), and Dashtibolo (at 3000 m)—and has a fourth irrigated but uninhabited section at 3200 m called Bisharv (Figure 4). While the latter is irrigated solely by Bisharv *wedh*, the former 3 sections are irrigated by Shokhirizm *wedh*. The first irrigation, from Shokhirizm *wedh*, rotates each year; for example, in 2012 Dashtibolo was irrigated first, then Mobayni, and last Tagovdasht. The 2 *wedhs* are of equal length, 18 km each, and run parallel at different heights, crossing each other at one point, across the steep slope above the Chandindara River. The water sources of both channels are located to the northwest of Chandin village. Shokhirizm *wedh* shares its headwork (at 3600 m) with a separate *wedh* that irrigates a part of Chandin village, whereas Bisharv *wedh* has its headwork at a higher altitude (3800 m). Shokhirizm's high altitude dictates that only wheat,

barley, and alfalfa can be grown, while its south-facing aspect allows only a limited potato crop. Shokhirizm's farmers sow less wheat these days, a trend also found in Alaikuu (Kyrgyzstan).

The coordinator of the management of Shokhirizm's 2 irrigation systems is the village headman (*rais*), great-grandson of the former ruler (*hakim*) of Shokhdara and neighboring valleys. The *hakim* Azizkhon established the village of Shokhirizm in the late 19th century, and the remains of his fort still stand in Sindev village. In 2011, Shokhirizm's *rais* of 20 years gave up his position as village headman and established and became *rais* of a WUA—in his words, to focus on bringing water to the village (Figure 5A). This WUA is unique in Gorno-Badakhshan Province in that its jurisdiction does not match that of the *jamoat* (the other villages in the *jamoat* do not have water problems). It was formed through the efforts of the *rais* and not by external intervention, though it was inspired by USAID. Before its formation, villagers had agreed on a set of financial rules: 0.06 Somoni (USD 0.01) per *hessa* (0.01 ha)

FIGURE 4 Shokhirizm village, location of irrigated lands, and neighboring villages. (Map by Jenny Kechsull and Joe Hill)



per irrigation session, and a monthly membership fee of 5 Somoni (USD 1.05). All households pay their fees.

Shokhirizm's offtake systems have one permanent *mirju* (water master), who takes care of both main *wedhs* (channels), and several *obshors* in charge of water distribution and secondary channel maintenance. The *mirju*, who resides on the mountainside from May to October, used to be paid in kind (wheat) for his services, but in recent years is mostly paid in cash. In early 2012, after 13 years of service, the *mirju* was forced to retire due to bad health. The WUA's *rais* and its manager were struggling to find a replacement. Three days after water began to flow the length of Shokhirizm *wedh*, on 2 June 2012, they resorted to sending 2 people up to the *wedh* daily, on a rotating basis. To merely walk its 18 km length, with an elevation gain of 600 m, takes 6 hours.

The command area of Shokhirizm *wedh* is divided into 3 irrigated sections, each 10 ha in size. Tagovdasht and Dashtibolo each have one *obshor*, while Mobayni has 2, both old men, one of whom has a younger helper. The *obshors* oversee the bringing of irrigation water to household plots, after which households irrigate their own crops. *Obshors* are paid in kind (alfalfa) for their

work; however, lack of storage facilities means they are forced to sell some portion of this in autumn, even though it would fetch double the price in spring. The 25-ha Bisharv (18.5 ha of which is irrigated, according to WUA records) does not have an *obshor*. A large proportion of Bisharv used to be sown with barley; alfalfa and grass are mainly sown now. Barley is known locally as "wheat number 3"; number 1 is wheat purchased from the market, and number 2 is locally grown wheat. Reasons for cultivating less barley at Bisharv (Figure 5B) include water-supply problems and lack of labor due to household members' preference for other types of work. Kreutzmann (1995: 109) cites the latter reason for a similar trend in the Hunza Valley, in the Karakorum, Pakistan: by the 1980s, a shortage of younger male shepherds led to a decline in the cultivation of grain crops in higher-altitude pastures.

Each year the 2 main *wedhs* require extensive repair, a situation the *mirju* says has not changed for 13 years. The villagers first repair Shokhirizm *wedh*, because its headwork is at a lower altitude, and it supplies a larger, lower-altitude command area. Twenty-two repair sites were observed along one *wedh* alone. For example, at one

FIGURE 5 (A) Head of the Water User Association and former village *rais* (on the right) and research assistant (left), beside Shokhirizm *wedh* as it enters Mobayni; (B) Bisharv in the foreground and the two parallel *wedhs* in the background; (C) Manager of the Water User Association (on the left) and research assistant (right) standing on geomembrane used to bridge a damaged part of the lower *wedh*; and (D) cement tunnel constructed by villagers without external assistance. (Photos by Joe Hill)



site the upper *wedh* had collapsed and the resulting rush of water had destroyed the lower *wedh*. Its repair has been aided by the provision of geomembrane by the NGO Global Partners (Figure 5C). At another site, a 10–15 m tunnel was constructed by villagers without assistance after a 2010 landslide (Figure 5D). The NGO Focus has supported the villagers at another site. In spring 2012, the repair work was particularly challenging because of a snowpack lying over the *wedh*'s headwork, which diverted the glacial stream's water away from the channel, as well as damage to 600 m of the main channel.

For repair work, the households are divided into 3 groups: Tagovdasht has 19 households, Mobayni 19, and Dashtibolo 18. Maintenance obligations can be divided into 3 types. First, for each of the 2 *wedhs*, each household has its own section to maintain annually (for example, the WUA manager has 0.5 ha of land irrigated by Shokhirizm *wedh*, which translates to 550 m of channel). Second, whenever major damage occurs to a channel, each of the 3 groups is assigned a third of the damaged section to

repair. Third, each household must clean and maintain the secondary channels close to its land. In 2012, the repair of Shokhirizm channel took 1.5 months, with each group working 15 days, supported at times by men from the neighboring villages Chandin and Paded (Figure 4), called for *hashar* (voluntary work).

The WUA's record lists 56 households, with 52 having irrigated land in the village and 51 having paid contributions. During the land-reform process (see Bossenbroek 2011), the *rais* stated that 38 ha of land was allocated to 49 households. According to the *rais*, at this time refugees who had settled in Shokhirizm (about 20 households) received small household plots, which went to their neighbors 3 years later on their departure. Other households have migrated, and their land is now farmed by family members. By 2012, the WUA records showed 48.6 ha of irrigated land controlled by 52 households. For example, the *obshor*'s wife said her household received 0.4 ha of land, 0.08 ha per person: 0.23 ha at Tagovdasht and 0.17 ha at Bisharv. The now retired *mirju* received

0.25 ha at Tagovdasht and Dashtibolo and 0.22 ha at Bisharv. With 0.49 ha, the *mirju's* household has the fifth-smallest landholding in the village. Irrigated landholdings average 0.95 ha per household and range from 0.36 ha to 2.27 ha per household. As stated previously, when major damage occurs to one of the main channels, maintenance obligations are assigned equally to every household. The implication is that a greater burden (relative to benefit obtained) falls on those households with lesser landholdings.

Discussion

The distinction between hydraulic, conferred, and claimed tenure arrangements in irrigation does not hold well for the offtake systems of the upper Tar and Shokhdara valleys. Where irrigation systems serve private household plots that have remained with families through the Soviet period to the present day, normative and organizational arrangements to some extent adhere to the idea of hydraulic tenure. However, water rights and the attached obligations have altered significantly over time because of the colonization of new land, the increase in number of households, and changing attitudes and livelihood options, particularly outmigration, since the collapse of the Soviet Union.

In offtake systems such as Akbulung, outside Kuiotash village (Kyrgyzstan), land and water rights have been both conferred by the state and claimed by former workers; no acts of favoritism in the redistribution of land were reported in Kuiotash. In the offtake systems of Shokhirizm (Tajikistan), a mixture of all 3 tenure arrangements influences the normative and organizational arrangements for irrigation management. Rights were conferred by the state, but in the process, certain rights were likely claimed by particular households with reference to earlier (hydraulic) tenure arrangements and in accordance with local notions of equity. Such a complex reshuffling of rights to land and water cannot be easily captured in a simple conceptual model.

Rights (the particulars of which include privileges, restrictions, obligations, and sanctions) have to be enforced by an authority, whose recognition and legitimacy can stem from one or more sociolegal systems. In Kyzyl Zhar (Kyrgyzstan), these authorities include local government officials, who draw on national-level laws and regulations for their legitimacy, and *aksakals* (elders), whose recognition has diminished in the present era. The case study of Terek village indicates a lack of village-level authority required for the repair of the irrigation channel. The *aiyl okmotu* head attempts to fill this vacuum, and by making reference to the national government system, seeks legitimacy and recognition from villagers. Kuiotash's 30 or so *aksakals* no longer regulate irrigation system management. Since the Soviet Union's collapse, high levels of outmigration and the resulting remittances have enabled villagers to purchase grain, instead of

growing it themselves, and the end of top-down coordination of agricultural production has allowed villagers to take individual decisions, for example, on choice of crop. The attitudes of villagers, including *aksakals*, have changed. The *aiyl okmotu* is by default the authority villagers look to for the organization of activities such as channel maintenance, yet many villagers do not recognize the *aiyl okmotu's* authority in matters related to agriculture.

In Shokhirizm (Tajikistan), authority appears to be concentrated in the former village headman, now *rais* of the WUA. The *rais* draws on multiple sociolegal systems—including informal norms and local power structures, provincial or national law, and projects and concepts introduced by NGOs such as MSDSP or USAID—to maintain his legitimacy and to enforce decisions. In the pre-Soviet period, the *rais's* great-grandfather is said to have commanded the labor of men from the entire valley and beyond to create, and likely to maintain, the slope offtake systems. During the Soviet period, the state financially supported repair of the irrigation channels, and *sovkhoz* and *kolkhoz* workers helped maintain and repair them as part of their general work duties. With Tajikistan's independence, the state ceased to financially support the irrigation systems. This has left Shokhirizm's villagers in an uneasy position. Their 2 channels require significant repair each year, at a high material and social cost. For this reason the *rais* formed a WUA in 2011, in an attempt to mobilize external resources to aid this work. The *rais* recognizes the altered order of things, and seeks recognition for his village from NGOs and donors.

Conclusion

The case studies presented in this article illustrate that the changes occurring in the collective management of hill irrigation systems in Kyrgyzstan and Tajikistan are in many ways similar to those experienced slightly earlier in the Andes (Beccar et al 2002: 9–10), in China's Sichuan Province and Xizang (Tibet) Autonomous Region (Jodha et al 1992: 15), and in Pakistan's Karakorum (Kreutzmann 1995: 109–110). This suggests that an analysis of natural resource management challenges in post-Soviet countries should not limit itself to traditional area-studies categories or focus solely on literature pertaining to the former Soviet Union. The research shows that multiple forms of authority coexist at the local level—government structures, informal political institutions, and externally inspired and funded WUAs. Further research is required to understand how communities and coexisting authorities resolve conflicts and make decisions, and how irrigation rules are being modified by communities in light of social and environmental change. It would also be helpful to know more about how and why NGOs and donors target certain villages and not others.

ACKNOWLEDGMENTS

Acknowledgments are extended to the German Federal Ministry of Education and Research (BMBF), funders of the research program Crossroads Asia: Migration, Conflict, Development. Support was provided by MSDSP Kyrgyzstan's Osh and Kara Kulja offices and by the NGO Nur in Porshinev, Tajikistan. In particular, thanks to my assistants, Aziza Torokeldi Kuzu in Kyrgyzstan and

Nurgul Yazdonkulov in Tajikistan, and to the local officials and villagers of Kyzyl Zhar *aiyl okmotu*, Shokhirizm village, and Tusion and Porshinev *jamoats*. Thanks also to 2 anonymous reviewers and to MRD associate editor Anne Zimmermann. The responsibility for any mistakes remains the author's.

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