14 Managing Water in a Dynamic Setting: The Challenges of Change in Central Asia

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Abstract

This paper summarises research activities related to water and water management carried out mainly in Kyrgyzstan and Tajikistan between 2002 and 2008, and anchors them in a broader regional water management context. Results show that climate change and socio-political transformation processes have heavy impacts on the condition of natural resources as well as on people's livelihoods. While rapid glacier retreat is providing more water for agriculture, river flow modelling suggests a forward shift of the main water discharge from the end of July to June. This may lead to more acute water shortages in the lowlands towards the end of the summer period. Dilapidated irrigation infrastructure, institutional failures, and inappropriate use of water by inexperienced farmers are the main reasons why less than 30% of the water reaches its final destination. The rapid proliferation of Water Users' Associations is an attempt to address these issues, while external actors try to influence water policies and actions at a larger scale.

Keywords: Water management; irrigation; Water Users' Association; transformation economy; climate change; Kyrgyzstan; Tajikistan; Central Asia.

14.1 Water management during the Soviet era and after independence

14.1.1 Water – an eternally pivotal resource in Central Asia

Water has always played and will continue to play a crucial role in Central Asia, particularly in irrigated agriculture and energy production (Molden and de Fraiture 2004). Traditional irrigation practices in the region date back more than three millennia. In Tajikistan, 93% of the total freshwater withdrawn is used for agriculture, but only 83% of it reaches the fields (UNEP/GRID 2002). The total area of irrigated land in the region has increased steadily, almost tripling during the 20th century, and now totals more than ten million ha (Bilik 1990). This tremendous increase is mainly due to the introduction and construction of large-scale irrigation schemes in favourable locations such as the Ferghana and Chuy valleys (Sobolin 1990). During this period water was understood to be a resource provided free of charge by authorities to collective farms and state farms, i.e. *kolkhozes* and *sovkhozes*. In general, water consumption is increasing steadily in the region. In Tajikistan it has increased by 40% over the last thirty years; currently 74% of the water consumed is used in agriculture, with an average consumption of 14–16 m^3 per ha. This high amount could be reduced by up to 25% through more efficient irrigation methods (UNEP/GRID 2000).

14.1.2 Tapping land resources through irrigation infrastructure

During the Soviet era huge investments were made to develop the water sector, including water sanitation, irrigation and energy-generating infrastructure for local and regional needs (Mamatkanov et al 2006). While engineers created large-scale irrigation schemes such as channels and reservoirs, agricultural specialists elaborated specific sowing plans and irrigation norms on a technocratic basis, adapted to local climatic conditions and river flow regimes (Bilik 1990). In Tajikistan and Uzbekistan, the Soviet policy of acquiring a leading position in the world cotton market led to the cultivation of vast arid and semi-arid lowland areas, requiring huge amounts of irrigation water (Schaap et al 2004). This precious resource was abstracted from the Amudarya and the Syrdarya, the two major rivers flowing to the Aral Sea. Ultimately this led to the Aral Sea tragedy (Martius et al 2005; Pala 2005). The vast water resources of the Tajik Pamirs and the Kyrgyz Tien-Shan mountains were identified as having a huge hydro-electric potential.

Accordingly, large-scale power stations and water dams were constructed (Mamatkanov 2000). Water resources were managed through a range of independent institutions (Vinogradov and Langford 2001).

14.1.3 Losing the Soviet heritage

The rapid political, economic and social transformations that took place after 1991 had considerable negative impacts on water management, including already initiated as well as planned construction projects. The functioning of the institutions responsible for water management was affected, too. In agriculture, this led to a rapid and significant deterioration of irrigation infrastructure and a considerable decrease in productivity (Figure 1). Similar problems arose in relation to hydropower, drinking water supply, and sanitation. The shortage of energy led to an energy crisis with frequent power cuts in Tajikistan and Kyrgyzstan, resulting in considerable economic losses. In Tajikistan alone, the winter of 2007/08 saw damage and general loss of revenues estimated at USD 850 million (Rabejanova 2008). Economic losses have also occurred due to the reduction of cultivated irrigated land. In Kyrgyzstan this decrease was almost 13% between 1994 and 1999 (Schaap et al 2004). This heavily affected the country's overall economy and hence the living conditions of the population. In Tajikistan the civil war of 1992–1997 further aggravated the situation.

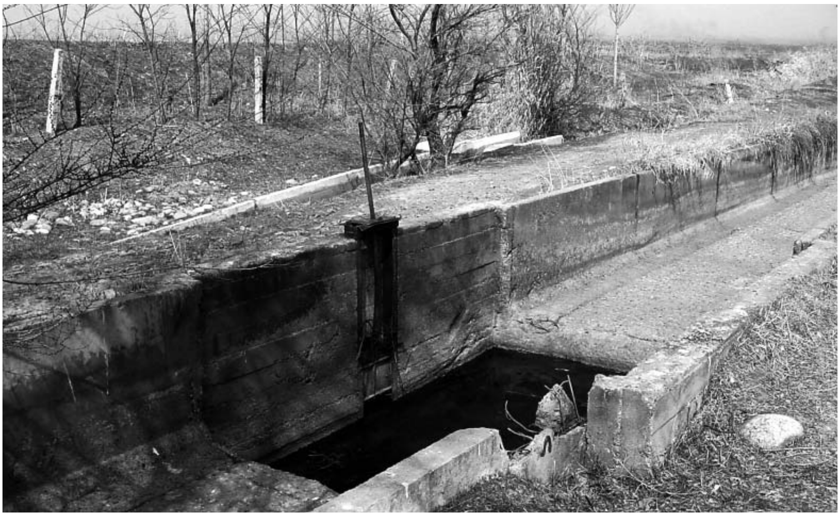

Fig. 1 Widespread broken water distribution devices hinder effective water management in the Chuy Valley. (Photo by Daniel Maselli, Sokuluk Rayon, 21 March 2003)

The dissolving of the *kolkhozes* and *sovkhozes*, combined with land reforms, led to the establishment of many small private farms in Kyrgyzstan and created both winners and losers (Shigaeva et al 2007). The fragmentation of large-scale production units had a deep impact on needs and requirements related to irrigation. The previous large-scale infrastructure was especially designed to provide water in accordance with determined crop norms on large areas up to 7000 ha. This system is no longer appropriate for many small-scale farmers and the diverse agricultural production in which they engage on plots of only 0.1 to 5 ha. While some agricultural fields receive too much water, others remain dry or receive water at too infrequent intervals. In this situation, both the previous technical irrigation infrastructure and the related Soviet water management system became obsolete (Spoor 1995). In Tajikistan, the dilapidation of the national electricity grid forced people to seek alternatives – cutting timber or using remnant forests, sparse trees, and wild bushes such as *teresken*. Wherever possible, micro-hydropower stations were constructed using any spare parts from previous mechanical installations (Hoeck et al 2007).

Since 1991 the governments of Central Asian countries have scaled down the agencies that formerly controlled irrigation and drainage infrastructure. Expenditures for operation and management in Kazakhstan dropped by a factor of 21 during the 1990s and only 31% of the required maintenance in the Kyrgyz Republic received funding (Bucknall et al 2003). The figures are similar for Tajikistan (UNDP 2003). The rapid and dramatic deterioration of infrastructure and services after independence raised questions about future institutional responsibility for rehabilitation and about payment for water and water delivery services (Schaap et al 2004; Herrfahrdt et al 2006). The costs for rehabilitation of on-farm irrigation network operation systems were estimated at USD 100 per ha in 2000 (Wegerich 2000) and are likely to be higher now. As elsewhere, one of the key problems in the sustainable management of scarce water is the unavailability of reliable data on water supply and withdrawals and their seasonal fluctuations. During the Soviet era a well-developed hydro-meteorological measuring and monitoring system was established which later collapsed, leaving water users and water management bodies without up-to-date information.

14.1.4 Managing the new situation

The international community – in particular the World Bank (WB), the Asian Development Bank (ADB) and the United Nations Development Programme (UNDP) – reacted by promoting policies of decentralisation and democratisation. At farm and household level, two types of problems appeared: a technical one due to the mismatch in infrastructure, and a managerial one related to lack of experience. Many household heads were forced to become farmers in order to secure family subsistence, whereas their previous professional activity had had nothing to do with agriculture. Inappropriate use of water due to a misconception ("the more, the better") caused salinisation and waterlogging, leading to reduced soil fertility and reduced agricultural productivity.

One adaptive reaction promoted by the most important international actors was the establishment of Water Users' Associations (WUAs). This form of organisation among household farms was meant to enable better distribution of water resources at the plot level. In Kyrgyzstan, in 2000 WUAs already managed about one quarter of the total irrigated area, amounting to 232,800 ha. In 2003, 300 additional WUAs raised this figure to 450,000 ha, amounting to about 40% of the total irrigated area (Schaap et al 2004). The reasons for creating a WUA appear to be rather diverse, ranging from the expectation of obtaining infrastructural improvement and equipment to the hope of solving immediate irrigation needs; meanwhile, specific training is being provided by external actors (Johnson and Stoutjesdijk 2008). At the national level, governments also tried to respond (see section 14.3.1 below). The Kyrgyz Government has taken further action to address poverty, especially in rural areas, by starting to implement the second phase of the "Water and Land Reform" programme, which aims to stabilise the economy and increase living standards (Herrfahrdt et al 2006). Bilateral donors such as the Swiss Agency for Development and Cooperation (SDC) tried to respond to needs with a water strategy and development projects ("Integrated Water Resources Management in the Ferghana Valley", see Krähenbühl et al 2002). However, not all of these reform efforts have yielded the expected results, as widespread corruption hampers effective support, especially for the poorest. Access to the most productive land and to sufficient water often remains a privilege for those who have good relationships with the responsible authorities as well as political influence.

14.2 State of research and methodological approach

14.2.1 Current status

At the country level, more recent research on water management in Central Asia has focused mainly on institutional aspects (e.g. Micklin 2000; Ul Hassan et al 2004), while bio-physical baseline conditions and technical aspects are frequently neglected. A similar situation occurs in development, where bio-physical aspects are also often not taken into consideration, as in the World Bank's "On-Farm Irrigation" project. More efforts are being made to gain a better understanding of climate change and its possible impacts on water in Central Asia (IPCC 2007; Perelet 2007) and to address transboundary water management issues (Moerlins et al 2008). In general, issues related to water are receiving increased attention at the global level, e.g. in the Human Development Report 2006, which is devoted to the global water crisis (UNDP 2006), and the 5th World Water Forum in Istanbul (March 2009).

14.2.2 General set-up and 'one watershed approach'

Research on water management in Central Asia carried out within the framework of the Swiss National Centre of Competence in Research (NCCR) North-South programme addressed three main questions: How is water used and managed, and where are the technical, socio-economic, institutional and legal bottlenecks? How does climate change impact on river flow and agriculture? How do livelihood strategies impact on natural resource use and management? For strategic reasons, five PhD and nine MSc studies were concentrated in one watershed (Sokuluk River) in Kyrgyzstan, in order to take advantage of synergies and facilitate collective coaching and collaboration. The five PhD studies were conducted by Natalya Ershova on river flow and climate change; Bakyt Askaraliev on water use and management; Justus Gallati on participatory system dynamics; Jyldyz Shigaeva on livelihood strategies and the environment; and Asel Ibraimova on social mobilisation and the legal framework. These studies were complemented by additional PhD-level studies on governance and conflicts in water use in southern Kyrgyzstan, by Christine Bichsel; on land-use change and degradation in western Tajikistan, by Bettina Wolfgramm and Gulniso Nekushoeva; and on the role of knowledge generation in the Tajik Pamirs, by Thomas Breu (see also Breu et al 2005).[7]

14.3 Changes and the dynamics of change after independence

The studies elucidated the tremendous bio-physical, political and socio-economic changes that have taken place, as well as their implications for natural resource management in the region, especially with respect to water use and management. Analysis of coping strategies to mitigate changes at the local level revealed that ensuring minimal access to land and irrigation water for the poor is imperative in addressing rural poverty. Obviously, natural resources and people's livelihoods are not only threatened by socio-economic upheaval, but also affected by environmental dynamics such as climate change. Continued and increasing glacier melting in recent years has impacts on the amount and the timing of river flow. Evidence suggests that it is not the increased quantity of water, but rather the river flow peak shifting forward by one month that may cause problems for livelihoods. This shift will have particularly negative impacts on the entire irrigation system, possibly leading to a lack of water during the period of maximum water consumption, which coincides with the dry summer season.

14.3.1 Political, legal and socio-economic transformation

In order to better manage water following independence, a range of new legal documents were elaborated and approved. The most relevant in Kyrgyzstan are the Law on Water (1995), the Law on Water Users' Associations (2002), and the Water Code (2005). This should help to achieve the ADB goal of establishing 500 WUAs by 2010. Similar efforts were undertaken in Tajikistan, where a new Water Code was approved in 2003 as an outcome of the International Year of Water 2003.

The major economic change at the national level is related to the pricing of irrigation water for farmers. Even though prices per cubic metre are low, payments are not made regularly (Gallati 2008). At the regional level, the major challenge is to accommodate competing transboundary demands for water to be used for energy and agriculture. While Kyrgyzstan and Tajikistan as the 'water towers' of Central Asia depend heavily on revenues from hydropower production in winter, Uzbekistan and Kazakhstan expect water to be released – free of charge – mainly during the growing season from spring to autumn.

Fig. 2
Self-made low-tech waterwheel in the Ferghana Valley used to illegally extract water from a channel in order to irrigate a home garden. (Photo by Daniel Maselli, Batken Oblast, 5 May 2004)

Analysis of the rationale of three development projects aiming to transform inter-community water conflicts along the newly established borders in the Ferghana Valley between 1999 and 2005 showed that water scarcity and ethnic differences are historically, culturally and politically constructed, institutionally embedded, and shaped by power relations. Violence that develops locally is often characterised by multiple interdependencies reaching beyond the boundaries of communities, concealing wider political interests and power relations. Addressing such water conflicts as mere technical or relational issues, and proposing infrastructural solutions or more intensive exchange processes, will therefore fail (Figure 2). Successful mitigation of water conflicts must include multiple dimensions and acknowledge the parties' moral and reflective capacities. It requires critical reflection on the assumptions and choices that underlie both the changes proposed and the aims of conflict mitigation. Overly normative and value-laden models transposed from differing social contexts appear not only to be questionable in terms of their ethnocentrism but may ultimately fail to lead to the desired empowerment and change (Bichsel 2005, 2006, 2009).

14.3.2 Impacts on institutions

Existing legislation should recognise and guarantee collective rights to rural communities and help to implement the subsidiary principle. However, in practice, in Kyrgyzstan the legal and institutional framework does not provide favourable conditions due to lack of adequate financial and institutional support to local communities (Ibraimova 2009). At present, rural communities seldom exercise their collective rights, for three main reasons. First, the Kyrgyz state has Soviet-style top-down law-making processes without participatory mechanisms involving rural communities; hence the existing legal and institutional framework is 'empowering' only from a governmental perspective. Second, there are no effective state incentives to enforce the proposed institutions and organisations at the rural level; bodies prescribed by law exist only on paper unless financial and/or institutional support is provided, either by international donors or successful community members. Third, traditional practices for collective actions in rural areas are not taken into account by government, while new organisations for collective action remain ineffective. However, social mobilisation is an important prerequisite for 'Participatory Irrigation Management' in Central Asia (Ul Hassan et al 2004; Dukhovny and Sokolov 2005).

14.3.3 Climate change – the invisible curse of the future?

Temperature and precipitation data over the past 60 years show a general decreasing trend for precipitation, while the average temperature is increasing (Galkina 2005). Analysis of glacier wastage in the Sokuluk catchment over the last 40 years (Niederer et al 2008) shows a clear trend in glacier retreat between 1963 and 2000. Both the areal loss of 28% observed for the 1963–2000 period and a clear acceleration of wastage since the 1980s correlate with the results of studies in other regions of the Tien-Shan and the Alps (Paul et al 2004). In particular, glaciers smaller than 0.5 km^2 have exhibited this phenomenon most starkly. While they registered a medium decrease of only 9.1% for 1963–1986, they lost 41.5% of their surface area between 1986 and 2000.

Analysis of river flow data for the Sokuluk River indicates a clear increase in recent decades, particularly during the warm summer months. Discharge in July increased by about 4 m^3/s between 1960 and 2000. Annual river flow increased on average by 1.3 m^3/s, which corresponds to about 24% of the average annual discharge of 5.33 m^3/s (Galkina 2005).

Considering the composition of river flow, this confirms the link between temperature increase and glacier melting, which results in temporarily higher river flow and water discharge. The water balance of the Sokuluk catchment shows that more than 33% of precipitation is lost to evapotranspiration, while about 39% of total runoff is generated by snowmelt and 17% by ice melt. Annual precipitation has fluctuated considerably since 1915, making prognosis rather difficult. However, since average annual temperature and average runoff have increased, the sustainability of water discharge is highly unpredictable and becoming increasingly problematic.

River flow modelling further reveals a possible increase in peak flow, causing potential hazards such as mudflows, storm waters, and floods. Moreover, the expected forward shift in the peak flow from July to June – and thus earlier melting of water resources important for irrigation – may either be a blessing for early agricultural production or create a problem for late summer cultivation.

14.3.4 Infrastructural changes

De-collectivisation of state farms has led to a sharp increase in water users in the Sokuluk catchment since 1991. This proliferation complicates water allocation and distribution, a problem that is further aggravated by the fact that distribution channels are often dilapidated (Askaraliev and Ivanova 2006). In the Sokuluk Rayon – which has the largest irrigated agricultural surface (56,600 ha) – 60% of the 965.9 km of earth channels and 55% of the 422.9 km of concrete channels are in bad condition. Only 23% of the initially abstracted water currently reaches its final destination (Askaraliev 2006). Losses are also caused by the many earth channels where water infiltrates. In five villages located in the foothill zone of the Sokuluk catchment (Toshbulak, Saz, Asylbash, Krupski, and Sokuluk), less than 9 km of the 97.7 km of channels are made of concrete, i.e. less than 10%, whereas the national average is 25%.

In principle, while the amount of water available would be sufficient to cover local needs – provided water is appropriately managed through adapted small-scale technologies – at present only 65% of the land is being irrigated. So far most of the planning, monitoring and payment mechanisms elaborated during Soviet times are still being applied, although they are outdated and inadequate (Froebrich et al 2007). This gives rise to tensions and conflicts between users and the authorities in charge. The willingness of farmers to pay for water depends on the quality of services provided, in particular the amount and timing of water delivery (Gallati et al 2006). The lack of a water discharge accounting system hinders more effective management. Therefore, a newly improved device for stabilising and measuring water discharge for different channel categories was developed by Bakyt Askaraliev and patented in 2008.

14.4 Implications, responses and outlook

14.4.1 Policies, institutions and economics

These research results emphasise the importance of institutions and policies in shaping future human–nature interfaces in order to address rapid change more effectively. They demonstrate how social, political and cultural institutions mediate the relations between humans and the environment, giving rise to conflicts as well as offering opportunities (Giese and Sehring 2007; Wegerich 2008). In future, more attention should be paid to gender aspects in integrated water resource management (GWP 2006) as well as to regional cooperation. This is a prerequisite to achieving sustainable management of the Amudarya and Syrdarya rivers, which constitute the two lifelines of the entire region (UNDP 2005).

The obvious economic damage due to inappropriate and ineffective water management, both in agriculture and in hydropower, need to be addressed too. The processes of climate change that are already tangible are likely to further aggravate the situation (IPCC 2007). There is thus an urgent need for effective laws and adaptive strategies, from livelihood to regional levels, to help share responsibility (UNESCO 2006). This will require participatory approaches to secure the ownership of farmers, who are the future key managers and custodians of water resources in Central Asia (Dukhovny and Sokolov 2005). Forgotten or neglected traditional soil and water conservation (SWC) technologies may play a crucial role here.

14.4.2 Livelihoods and ecology

Since independence, people have developed different strategies to cope with change (Shigaeva et al 2007). The ‘accumulation strategy’ applied by wealthy households, which rent or buy additional agricultural land, plays an important role in water management. Short-term profit orientation often hampers sustainable land and water management. This attitude needs to be addressed through appropriate and enforced regulations. Pricing water for agriculture based on consumption is a necessary measure to reduce water consumption and increase the effectiveness of irrigated agriculture. Special attention should be paid to both environmental and health risks related to irrigation, such as salinisation, waterlogging, or the spread of malaria in connection with climate and land-use change (Rebholz et al 2006).

14.4.3 Challenges for development and research

Already visible climate change – and, to an even greater extent, predicted climate change in Central Asia – calls for early reflection about possible mitigation strategies to avoid or reduce further negative effects. A major challenge will be to find ways of coping with predicted reductions in (annual) rainfall and increases in (summer) temperature. This may entail the construction of cheap but effective small-scale water retention devices using local construction materials and requiring little or no external technical support. Development actors are thus challenged to reflect more on how to support the required adaptation of smallholders rather than favour water-intensive large-scale agriculture. More support will be required to increase knowledge regarding appropriate irrigation – in particular, the amount and timing of water – to avoid wasting water or causing environmental damage. Here, innovative forms of information sharing are called for; a multi-level multi-stakeholder-based 'water management information system' could be helpful. At a meso-scale, support for participatory integrated water resource management at watershed level could be a promising future pathway. Here, development-oriented research should put greater emphasis on involving end-users as the real future managers of water in particular and natural resources in general.

Endnotes

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[7] The PhD dissertations referred to in this paragraph are not included in the list of references unless they are referred to elsewhere in this article. However, many of them are available at: http://www.north-south.unibe.ch/content.php/filterpage/id/27. Moreover, this article refers to other publications by these authors that are based on their PhD studies.

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