



WATER AND SOCIAL CHANGES IN CENTRAL ASIA: PROBLEMS RELATED TO COTTON PRODUCTION IN UZBEKISTAN

Rachel Strickman¹ & Miina Porkka²

¹ Department of Environmental and Biological Sciences, University of Helsinki, Finland

² Department of Civil and Environmental Engineering, Helsinki University of Technology, Finland

Decades of water mismanagement in Central Asia have caused a range of problems that have direct and indirect social consequences. Using the IWRM framework, this paper describes how pollution, water scarcity, the destruction of the Aral Sea, and the cotton industry have caused human suffering in Uzbekistan, which was selected based on its wide range of water related problems and good availability of information. This brief overview concludes with a short description of the internal reforms, improved international cooperation, and water management improvements that are being used to address these problems.

1 Introduction

Access to water is a basic human need and should be a fundamental right. And yet, in Central Asia and throughout the developing world, more than one billion people are denied access to clean water (UNDP, 2006). Increasing demand for water for agricultural and industrial purposes, together with environmental degradation and pollution, have made water into a scarcer resource, which in turn makes it even more important that it be managed in a just, rational way. Even under conditions of water scarcity, it is possible to manage water in a socially

responsible manner; but there are many examples of regions where water shortage combined with water mismanagement have transformed water from an environmental issue to a social one.

In Central Asia, as in many other areas, water—or its lack—is a prominent cause of human suffering. (GWP, 2008). Irrigated farming, particularly cotton production, consumes large volumes of water which are withdrawn from the Amudarya and the Syrdarya, the two main rivers feeding the Aral Sea. This unsustainable water use has affected the ecology, hydrology, and general environment in the region, with expanding knock on effects on agriculture, industry and society (UNEP, 2005). The shrinkage of the Aral Sea is the most visible and severe of these negative impacts, but freshwater shortage is obvious in other waters of the basin as

Corresponding author:

Rachel Strickman

Department of Environmental and Biological Sciences,
University of Helsinki,

Kurkisuontie 9 D 37, 00940 Helsinki, Finland

E-mail: rachel.strickman@helsinki.fi and mporkka@cc.hut.fi

well. Water contamination from irrigation effluent is widespread and detrimental to human health (UNEP, 2005). Water scarcity and water pollution are facts of life in the region.

The misuse of water in Central Asia has created many social problems, including economic, civil rights, and health issues. This paper uses the IWRM framework to link the economic and environmental problems of water misuse with their implications for society. Uzbekistan was selected as a focal location within Central Asia for which to examine these questions, because it encompasses a wide range of hydrological regimes and an associated wide range of water-related social problems. In conclusion, the initiatives currently underway in Uzbekistan to meet these problems are described.

2 IWRM & Social Impact Assessment

Solving the social problems that arise from the misuse of water demands that we understand what the problems are and how they are linked to water. Experience has shown that managing and sharing natural resources equitably is extremely difficult. Perhaps the most serious difficulties are in understanding the subtle linkages between action and result. One way to make sure that all these linkages have been considered is to use a mental framework to organize topics and facilitate discussion. One of the most robust of these mental frameworks is integrated water resource management (IWRM). The concept of IWRM has been defined by Global Water Partnership as 'a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems' (GWP, 2000). Although IWRM works best as a planning tool, it is also a useful framework for identifying where existing problems come from and how they are linked to other issues.

One of the basic principles of IWRM is that different uses of water are interdependent. Managing water resources has an effect on the whole system (e.g.

river or sea basin), including land use, agriculture and the environment. Management plans also have economic and social impacts. It is therefore essential that water is managed in a basin-wide context and that any decision making takes into account the relations between economic, social, and environmental impacts. Good governance and public participation are also seen as essential to a good water management plan (Rahaman & Varis, 2005).

The social dimension of IWRM deals with issues such as poverty, health, equity, empowerment and marginalization. All of these issues can be connected, through one or more links, with water. For instance, across the developing world many people are excluded from access to clean water and adequate sanitation by their poverty or their limited legal rights. Denying this access often leads to serious health problems (UNDP, 2006). In many countries, including Central Asian states, women play a key role in agricultural production but seldom have any rights to the land they work (Kandiyoti, 2003). This may lead, for instance, to their exclusion from irrigation system management (UNDP, 2006). The social dimensions of water management are often indirect, but they are nonetheless as important as economic development or environmental restoration.

Different actions and tools are used to quantify social impacts and to help achieve a dynamic approach to planning the management and development of water resources. One of the tools that should be included in a good water management plan is social impact assessment (SIA) (GWP, 2008). Social impacts include all the social and cultural consequences of a certain action that affect people, either directly or indirectly. Social impact assessment is a tool for analyzing, monitoring and managing the social consequences of a development or policy action. An SIA study assesses how costs and benefits of a certain action are distributed between different stakeholders and how vulnerable groups will be able to cope with the changes (GWP, 2008).

Social problems are often linked with environmental changes that derive from a policy or management

action. A framework of Slootweg *et al.* (2001) (Fig. 1) presents the ways by which a specific project can lead to environmental and social impacts. An intervention causes environmental changes which may or may not lead to environmental impacts. In the same way social impacts derive from social changes caused by an action. Social impacts can also be caused by environmental impacts and, on the other hand, social changes may lead to environmental changes. First-order changes, i.e. social and environmental change processes resulting directly from the intervention, can then lead to several other change processes (Slootweg *et al.*, 2001). This feedback mechanism is also presented in the framework.

In Central Asia many social problems are caused in much the same way (Fig. 2). In this case the crucial action was the heavy promotion of cotton production after the Russian conquest, which causes social problems via two routes. First, it has led to serious and negative environmental changes via overirrigation, pollution, and the destruction of the Aral Sea (UNEP, 2005), which has led to serious human impacts. Secondly, the cotton

industry itself has created many social problems, through its unjust and unequal methods of production, coordination, and distribution (ICG, 2005). Although these problems—for instance, the economic exploitation of cotton pickers by farm managers—are not technically the result of water misuse in that they could occur even if water were abundant, the cotton industry is such a massive user of water, and the cause of so many water related problems, that it may be said to be a water-related problem in and of itself. In the sections that follow, the social problems resulting from these issues in the context of Uzbekistan are discussed.

3 Social Problems Resulting from the Misuse of Water in Uzbekistan

Renewable water resources in Uzbekistan are very limited (Table1). Uzbekistan is situated in the basins of Amudarya and Syrdarya, the two rivers feeding the Aral Sea, but only about 10% of the region's total annual river run-off is formed in the country. Yet it consumes, on average, approximately 54% of water resources in the region (UNEP, 2005). In the driest years, the Amudarya

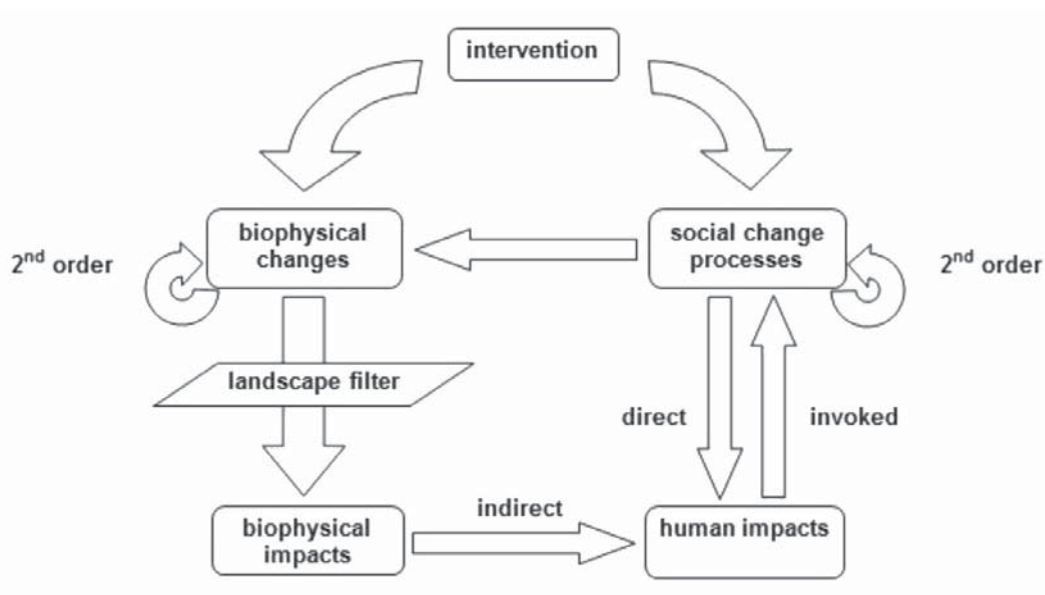


Figure 1. Integrated framework for environmental and social impact assessment. Source: Slootweg *et al.*, 2001.

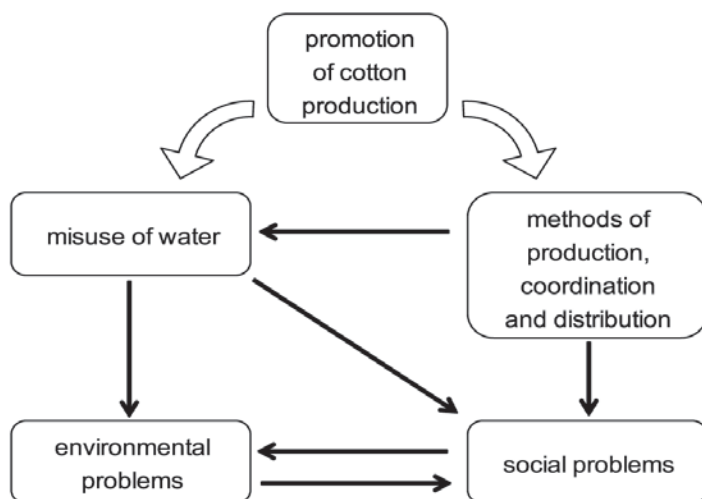


Figure 2. Environmental and social changes related to cotton production in Central Asia.

flow can be less than 10% of the river's total run-off when it reaches the Aral Sea in Uzbekistan (FAO, 1997). The country uses about 134% of its actual renewable water resources, agriculture being the biggest consumer (FAO, 2008). As a result of the discharge of drainage waters from irrigated lands, this notable freshwater shortage is accompanied by poor water quality (UNEP, 2005).

The overuse and contamination of water has caused serious environmental degradation and accompanying social problems throughout Central Asia (UNEP, 2005). Conflict over water, environmental damage, and the special problems resulting from the destruction of the Aral Sea have all caused serious difficulties. In addition, cotton production—the main consumer of water resources— is linked with many social impacts.

4 Sociopolitical Causes of Water-related Social Problems

4.1 Conflict

Central Asian nations have had difficulty coordinating the use of their shared water resources, leading to international tensions and problems for ordinary people. The Interstate Commission

for Water Coordination (ICWC) is charged with assigning water quotas, monitoring water quality, and coordinating water use throughout the Aral Sea Basin. The ICWC suffers from a lack of funding, perceived bias in favour of Uzbekistan, obstructionism, and an inability to enforce its decisions (McKinney, 2003). Other coordination problems include aligning water management schemes and standards, allocating water fairly, discouraging water waste, and international cooperation towards funding the maintenance of infrastructure (McKinney, 2003; Elhance, 1997; Weinthal, 2000). Central Asian nations suffer as well from the history of centralized water management (McKinney, 2003). Upstream development of irrigated agriculture or hydropower can impact downstream users, causing destructive winter flooding or summer drought (Elhance, 1997).

Conflict exists within Uzbekistan as well. The lack of water increases tensions between different stakeholders, social groups, and individual farmers (UNEP, 2005). In some areas, unequal distribution of water is seen as one of the most important problems, and water disputes are common (Wegerich, 2000).

Uzbekistan is keenly aware of its dependence on upstream water resources, which can cause tension between the governments of Uzbekistan

Table 1. Renewable water resources of Uzbekistan. Source: FAO, 2008

UZBEKISTAN WATER RESOURCES	KM ³ /YEAR	%
INTERNAL RENEWABLE WATER RESOURCES		
Surface water produced internally	9,54	
Groundwater produced internally	8,80	
Overlap	2,00	
Total internal water resources	16,34	
EXTERNAL RENEWABLE WATER RESOURCES		
Surface water entering the country	55,87	
Outflow secured through treaties	21,80	
Groundwater entering the country	0,00	
Groundwater leaving the country	0,00	
Total external water resources	34,07	
TOTAL RENEWABLE WATER RESOURCES		
Total renewable surface water	43,61	
Total renewable groundwater	8,80	
Overlap	2,00	
Total renewable water resources	50,41	
FRESHWATER WITHDRAWAL		
Agricultural water withdrawal	54,40	93,20
Domestic water withdrawal	2,77	4,75
Industrial water withdrawal	1,20	2,06
Total freshwater withdrawal	58,37	
Freshwater withdrawal as % of total renewable water resources		116

and upstream nations. However, like other Central Asian nations, Uzbekistan feels that agreement and cooperation are by far the best way to manage water resources, and there has been a heartening lack of armed water-related conflict in the region. The government of Uzbekistan took an important step towards reducing water-related conflicts when it ratified the UN Watercourses Convention (1997) on 14 September 2007. Today, Uzbekistan remains the only Central Asian nation to have ratified the Convention.

4.2 Inadequate Infrastructure

Inadequate water infrastructure has created sanitation, hygiene, and health problems. Since independence, the government of Uzbekistan has struggled to cover the maintenance and operation costs of water infrastructure which were once

the responsibility of Moscow, despite making water security in both urban and rural areas a political priority (ADB, 2002; 2004). The water infrastructure was poorly designed, years of deferred maintenance mean that large volumes of water are wasted, and many areas are not supplied with water at all. In rural areas, only 65% of households have a reliable water supply, with this figure falling to 30% in some districts (ADB, 2002; 2006). Conditions in urban areas are better, but still 30% of households lack water supply (ADB, 2004). As a result, many households must make do with contaminated water which must be fetched manually, often from long distances at great inconvenience and loss of time (ADB, 2004). Water tariffs are low, but although this protects the poor households who do have access to water, this low income for the state exacerbates the funding shortfall that is causing

the overall problem. The sewage and sanitation infrastructure is also decaying or absent, with very serious health implications (ADB, 2004). These water and sanitation problems have contributed to the high incidence of waterborne diseases in rural areas. These include hepatitis A, typhoid fever, and kidney problems (ADB, 2004). These health problems, as well as those described later, place an extra burden of health-care costs on individuals who are likely to be already poor (ADB, 2004). Poor infrastructure has also caused environmental damage, and through this, social problems, as described below.

5 Environmental causes of Water-related Social Problems

5.1 Damage to Ecology, Hydrology, and Soils

The environmental damage resulting from water misuse has caused health, economic, and quality of life problems for many people. Overuse of Uzbek surface water for irrigation and the poor state of the existing infrastructure has reduced the output volume of rivers, and altered water tables, estuaries and floodplains. Irrigation systems are commonly unlined and uncovered, allowing rampant water loss from evaporation and seepage (Small *et al.*, 2001). This in turn alters ecosystems and reduces the economic, cultural, and amenity value of these regions. The destruction of natural resources has destroyed industries like fishing and trapping that depend on those resources for sustainable yield (UNEP, 2005). Although these issues are most dramatic in the downstream reaches of the water basin, they are also causing social problems, such as lost livelihoods and social disruption in upstream areas. As investment in irrigation infrastructure and soil management has decreased, overirrigation has also created problems with waterlogging and soil salinisation, as well as unintended ecosystem change in unmanaged lands (UNEP, 2005). This reduces agricultural production, which causes economic losses and increases poverty (UNEP, 2005).

5.2 Pollution

Pollution is a severe problem with serious social impacts. Agricultural chemicals are massively overused in Uzbekistan, and much of the drainage effluent from fields, along with sewage and industrial wastes, is returned directly to waterways. These return waters are used for drinking, washing, and further irrigation. The proportion of total water volume that consists of these return waters increases as one moves downstream, but pollution problems are also serious in most upstream areas. For instance, concentrations of phenols are greater than the maximum allowable concentration for almost the entire length of the Amudarya. As of 2005, up to 66% of irrigated fields were polluted. Some chemical concentrations exceeded standards twenty or forty-fold. Pollution has reached such a high level that it is affecting the oxidative properties of the environment, to the extent that infrastructure is corroded and destroyed more quickly than usual (UNEP, 2005). Groundwater is also contaminated, with up to 3.5 grams of total dissolved salts per litre. The WHO's international standard is 1 g TDS/L (Small *et al.*, 2001). This general water pollution has caused health problems throughout Uzbekistan. These include diseases of the central nervous system, thyroid, immune system, blood, cardiovascular system, and digestive tract, as well as cancer and infectious diseases. Declining water quality and quantity is one of the main causes of increases in ill-health in the region (UNEP, 2005), despite increased government spending on health (ADB, 2004). However, it should be noted that despite these problems, health conditions in Uzbekistan are still relatively good (UNEP, 2005).

5.3 The Aral Sea Disaster

The degradation of the Aral Sea is perhaps the most serious environmental problem in Uzbekistan, and definitely the most visible. The Aral Sea, fed by the Amudarya and Syrdarya rivers, was once the fourth largest inland sea in the world. It sustainably supported a thriving fishing industry and small scale agriculture until the 1900s, when a shift to cotton and rice cultivation was encouraged by Tsarist Russia (Glazovsky, 1995). This policy

was continued by the Soviet Union. Large scale irrigation schemes drained water from the rivers feeding the Aral Sea, reducing sea volume, while excessive use of pesticides and other agricultural chemicals contaminated the rivers, ground water, and increasingly the Aral Sea itself (UNEP, 2005). Despite increased glacial melting in the mountains, which ought to have swelled the Sea, it has been shrinking steadily from the 1960s. Today it is a fraction of its former volume and has divided into two brackish lakes, the Little Aral Sea which lies in Kazakhstan and the Large Aral Sea which is mostly in Uzbekistan. This environmental catastrophe has caused economic losses, social disruption and health problems.

Uzbekistan's Aral Sea coastal areas were once home to a robust fishing industry, thriving coastal towns, and other industries. These livelihoods have been seriously impacted by the degradation of the Aral Sea. By the 1980's, the fishery had collapsed (Whish-Wilson, 2002) and approximately 60,000 people employed in the fishing industry lost their livelihoods (Ataniyazova, 2003; Carius *et al.*, 2003). Agriculture and pastoralism have been negatively affected by alterations in the water table, local hydrology, salinisation, pollution, more extreme summer and winter temperatures, and storms of toxic dust. Other minor industries such as fur hunting have been curtailed by the negative changes in wetlands and lakes. The severe shortage of freshwater has impacted any industry which requires water, severely limiting economic activity on the coastal zone of the Aral Sea (UNEP, 2005).

The destruction of the Aral Sea has caused serious social disruption. Much of the population suffers from severe stress (Small *et al.*, 2001) and an estimated 10,000 people have been forced to leave the region (UNEP, 2005). Social services and support systems, including health care, have been disrupted (Small *et al.*, 2001).

Social disruption, inadequate sanitation, contaminated water, and atmospheric pollution have caused myriad health problems. There is a severe shortage of freshwater, which has led to problems with sanitation and has allowed

preventable, treatable diseases such as tuberculosis, dysentery, and respiratory illnesses to become more common, although the general state of health is still fairly good (Small *et al.*, 2001; Ataniyazova, 2003). In Samarkand oblast, a region of Uzbekistan, disease incidence has increased threefold (UNEP, 2005). Most water is heavily contaminated with agricultural chemicals and bacteria, and does not reach international drinking water standards but is the only option for local people (UNEP, 2005). Toxic dust is an additional problem. As the chemical-laden Aral Sea dried up, it left behind its salts and contaminants in the dry desert soil. The arid situation and the pollutants themselves have prevented vegetation from colonising the area, so the bare soil is easily eroded by wind. 43 million tonnes of dust are lifted by the wind each year (Small *et al.*, 2001). This windblown dust includes the salts and poisons, creating an inhalable hazard. These contaminants may be to blame for in the increase of anaemia, cancer, circulatory diseases, thyroid problems, and kidney and liver diseases (UNEP, 2005; Ataniyazova, 2003).

6 Economic Causes of Water-Related Social Problems

As the main crop of Uzbekistan, and the most water hungry, cotton is a key part of the water-related social issues in the area. The cotton industry uses around 90% of the nation's total water budget (UNEP, 2005), contributing to the problems of water shortage, waterlogging, and soil salinisation. The industry is still centrally controlled, with mandatory production targets and an artificially low state procurement price (Wegerich, 2000; Guadagni *et al.*, 2005). The state then sells the cotton on to the world market at a much higher price (Guadagni *et al.*, 2005). Production costs have increased while subsidies have fallen, leaving many farmers with economic losses (Kandiyoti, 2003). Shifting to other crops is difficult, as farmers often have to allocate a certain percentage of their land to cotton (Wegerich, 2000).

The methods used in cotton cultivation have negative social impacts as well. Due to a shortage of machinery, cotton is usually planted and harvested

by hand (Jarvik, 2005). Harvesting is mostly done by women (Kandiyoti, 2003), but children and other forced labour such as trafficked men are used as well, despite the 2001 government decree that prohibits those under age 18 from engaging in manual cotton harvesting (U.S. Department of State, 2007). Labourers are poorly paid and working conditions are unhealthy, as workers often inhale harmful chemical and pesticides sprayed on the fields (U.S. Department of State, 2007).

7 Future Directions

It is clear that the misuse of water has caused serious social problems in Uzbekistan. The water problems facing Central Asia are formidable, but the region—crucially—does not suffer from a serious and absolute shortage of water. If water were managed better, it would be possible to alleviate many of the current water problems and possibly even to expand agricultural production. What is being done to improve the situation?

7.1 Improved International Cooperation

Despite its problems, the ICWC has a well-stated mission which, if implemented more vigorously, would be effective in improving interstate water cooperation. This existing framework means that improving cooperation is a matter of enforcing existing legislation and encouraging existing efforts, rather than creating an entirely new system with all the attendant logistical difficulties this entails.

There is also potential to improve bilateral agreements between nations. In 1995, Uzbekistan and Kyrgyzstan along with Kazakhstan formalised their fuel-for-water arrangements whereby Kyrgyzstan supplies summer water and hydropower in exchange for winter fuel. The water and energy schedules are administered according to a framework created by the Executive Committee of the Interstate Council of the Central Asian Economic Community, which encourages integration and development in the area (McKinney, 2003).

7.2 Internal Reforms

Within Uzbekistan, attempts are also being made to reform the fundamental structure of the system, since it is the system itself—rather than ignorance, superstition, or non-compliance with laws—that is causing most of the problems. Although privatisation has happened slowly, and meaningful reforms even more slowly, the loosening of state control is allowing individual farmers and small groups more freedom to decide their own affairs. In 2000, the centrally controlled irrigation systems were turned over to farmers and regional Water User Associations (WUA's) were formed (Zavgorodnyaya, 2002). The WUA's in Uzbekistan were envisioned as managers of the irrigation system, which was previously the responsibility of the large state farms. The WUA's inherited a decayed water infrastructure and are not always entirely fair to every stakeholder (Wegerich, 2000), but despite these problems, members consider WUA's well structured and effective (Zavgorodnyaya, 2002) and they have helped farmers to share water more effectively. They also help bridge the gap between the organisations that make water decisions (such as ICWC) and water users on the ground (Elhance, 1997). Practical issues are met with enthusiasm and farmers feel responsible for their land and the irrigation system, despite serious disenfranchisement.

In terms of the cotton industry and its abuses, Uzbekistan is making efforts to curb human trafficking and child labour. The ILO Conventions on minimum age of employment and elimination of child labour were adopted in 2008, along with a new, comprehensive antitrafficking law that improves support for victims and coordinates efforts between government ministries (Embassy of the United States in Tashkent, 2008). However, the government is unwilling to make meaningful efforts towards allowing farmers more control or loosening controls on cotton trade.

7.3 Practical Water Management Improvements

In Uzbekistan, there are many international and domestic projects aimed at providing specific practical support or to correct technical issues. The Western Uzbekistan Rural Water Supply Project, for instance, improved water and sanitation services in drought hit-areas of Karakalpakstan and Korezm (ADB, 2002). The Drainage, Irrigation, and Wetland Improvement project is increasing the productivity of agricultural land and reducing poverty in Karakalpakstan through improved irrigation and reducing pollution through safe disposal of drainage effluent (World Bank, 2003). The urban poor have also benefited from a project which improved water infrastructure in apartment blocks, thus reducing costs and water waste (ADB, 2006). The ICWC runs educational seminars for farmers to improve agricultural practice (ICWC, 2008). Well-designed technical projects offer exciting opportunities not only to solve pressing practical problems, but to build trust and to reform institutions from the inside out. For instance, the US \$ 25 million Kashkadarya and Navoi Rural Water Supply and Sanitation Sector Project aims to improve sanitation and water supply in two poor rural districts while also building institutional cooperation through training and active involvement policies, and to improve the position of women through selective hiring practices and planning procedures (ADB, 2004). Uzbekistan has a well-educated population and local technical ability even in rural areas is not lacking (ADB, 2004) which helps to move these projects forward.

8 Conclusion

The mismanagement of water in Uzbekistan has led to serious social problems. These problems emanate from environmental, social, and economic causes. Widespread pollution has caused ill health and increased costs to the poor, as has the decaying infrastructure. Ecological damage, with associated lost or damaged livelihoods, has resulted from pollution, water shortage, and overirrigation. Conflict over water resources and poor international cooperation have caused water shortages, floods, and internal tensions. Poverty has resulted from many of these previous issues, and the cotton industry itself creates many environmental problems, as well as being structured in a way that causes abusive practices.

Amelioration of many of these problems is possible, given better water management. Practical measures show great promise for reducing poverty, improving water supply and management, and reclaiming degraded lands. The government of Uzbekistan is working to improve cooperation with other states over regional water sharing. The people of Uzbekistan, despite their problems, are well educated and willing to work towards tackling these issues. It is to be hoped that Uzbekistan can shed its reputation as a parable of the consequences of bad water management, to become an example of the possibilities of restoration and renewal.

Acknowledgements

The authors would like to thank the reviewers for their comments and constructive suggestions.

References

- ADB, 2002. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Republic of Uzbekistan for the Western Uzbekistan Rural Water Supply Project*. Asian Development Bank, April 2002.
- ADB, 2004. *Technical Assistance (Financed by the Japan Special Fund) to the Republic of Uzbekistan for Preparing the Kashkadarya and Navoi Rural Water Supply Project*. Asian Development Bank, August 2004. Prepared by Wallum, P., and Mamatkulov, R.
- ADB, 2006. *Providing Affordable Water Services to Uzbekistan's Urban Poor*. News Release No. 01/06, 27 January 2006. [Homepage of Asian Development Bank], [Online]. Available: <http://www.adb.org/Documents/News/URM/urm-200601.asp>
- Ataniyazova, O., 2003. *Health and Ecological Consequences of the Aral Sea Crisis*, Prepared for the 3rd World Water Forum.
- Carius, A., Feil, M. & Tänzler, D., 2003. *Addressing Environmental Risks in Central Asia: Risks, Policies, Capacities*. United Nations Development Programme/Regional Bureau for Europe and the CIS.
- Elhance, A., 1997. *Conflict and Cooperation over Water in the Aral Sea Basin*. Studies in Conflict & Terrorism Vol. 20
- Embassy of the United States in Tashkent, 2008. *2008 Trafficking in Persons Report*. [Homepage of The Embassy of the United States in Tashken], [Online]. Available: <http://www.usembassy.uz/home/index.aspx?&=&mid=879> [2008, 9/9]
- FAO, 2008. *AQUASTAT online database* [Homepage of Food and Agriculture Organization of the United Nations], [Online]. Available: <http://www.fao.org/nr/water/aquastat/data/query/index.html> [2008, 8/15].
- FAO, 1997. *AQUASTAT country profiles: Uzbekistan* [Homepage of Food and Agriculture Organization of the United Nations], [Online]. Available: <http://www.fao.org/nr/water/aquastat/countries/uzbekistan/index.stm> [2008, 8/15].
- Glazovsky, N.F., 1995. "The Aral Sea Basin" in *Regions at Risk: comparisons of threatened environments*, eds. Kasperson, J.X., Kasperson, R.E., & Turner, B. L. II, United Nations University Press, Tokyo, pp. 92-139.
- Guadagni, M., Raiser, M., Crole-Rees, A. & Khidirov, D., 2005. *Cotton Taxation in Uzbekistan. Opportunities for Reform*. ECSSD Working Paper No 41. The World Bank, Washington DC, USA.
- GWP, 2008. *Global Water Partnership ToolBox for Integrated Water Resources Management* [Homepage of Global Water Partnership], [Online]. Available: <http://www.gwptoolbox.org> [2008, 6/30].
- GWP, 2000. *Integrated Water Resources Management*. TAC Background papers No. 4. Global Water Partnership, Stockholm, Sweden.
- ICG, 2005. *The Curse of Cotton: Central Asia's Destructive Monoculture*. ICG Asia Report No 93. International Crisis Group.
- ICG, 2002. *Central Asia: Water and Conflict*. ICG Asia Report No. 34. International Crisis Group.
- ICWC, 2008. *ICWC Training Center* [Homepage of Interstate Commission for Water Coordination Training Center], [Online]. Available: <http://tc.icwc-aral.uz/> [2008, 9/9].
- Jarvik, L.A., 2005. "Uzbekistan: A Modernizing Society", *Orbis*, vol. 49, no. 2, pp. 261-274.
- Kandiyoti, D., 2003. "The Cry for Land: Agrarian Reform, Gender and Land Rights in Uzbekistan", *Journal of Agrarian Change*, vol. 3, nos. 1 & 2, pp. 225-256.
- McKinney, D., 2003. "Cooperative Management of Transboundary Water Resources in Central Asia" in *In the Tracks of Tamerlane—Central Asia's Path into the 21st Century*, eds. Burghart, D., and Sabonis-Helf, T., National Defense University Press, 2003.
- Noble, A., ul Hassan, M. & Kazbekov, J., 2005. "Bright Spots" in *Uzbekistan, revising land and water degradation while improving livelihoods: Key developments and sustaining ingredients for transition economies of the former Soviet Union*. Research Report No. 88. International Water Management Institute, Colombo, Sri Lanka.
- Rahaman, M.M. & Varis, O., 2005. "Integrated water resources management: evolution, prospects and future challenges", *Sustainability: Science, Practice & Policy*, vol. 1, no. 1.
- Slootweg, R., Vanclay, F. & van Schooten, M., 2001. "Function evaluation as a framework for the integration of social and environmental impact assessment", *Impact Assessment and Project Appraisal*, vol. 19, no. 1, pp. 19-28.
- Small, I., van der Meer, J. & Upshur, R.E., 2001. "Acting on an environmental health disaster: the case of the Aral Sea", *Environmental health perspectives*, vol. 109, no. 6, pp. 547-549.

UNDP, 2006. *Human Development Report 2006*. Beyond scarcity: Power, poverty and the global water crisis. United Nations Development Programme, New York, New York, USA.

UNEP, 2005. *Aral Sea*, GIWA Regional Assessment 24. University of Kalmar, Kalmar, Sweden.

U.S. Department of State, 2007. *Country Reports on Human Rights Practices: Uzbekistan*. United States Department of State; Bureau of Democracy, Human Rights and Labor, Washington DC.

Wegerich, K., 2000. *Water User Associations in Uzbekistan and Kyrgyzstan: Study on Conditions for Sustainable Development*. Occasional Paper No. 32. Water Issues Study Group, School of Oriental and African Studies, University of London.

Weinthal, E., 2000. "Central Asia: Aral Sea Problem", *Foreign Policy in Focus*, vol. 5, no. 6.

Whish-Wilson, P., 2002. "The Aral Sea environmental health crisis", *Journal of Rural and Remote Environmental Health*, vol. 1, no. 2, pp. 29-34.

Zavgorodnyaya, D., Holm-Müller, K. & Wehrheim, P., 2002. "Organisational efficiency of Water Users' Associations in Uzbekistan", *Deutscher Tropentag 2002*, 9.-11.10.2002, University Kassel, Witzenhausen.

This publication is available electronically at
www.water.tkk.fi/global/publications