TECHNICAL FOCUS PAPER

Integrated water resources management in Central Asia:

The challenges of managing large transboundary rivers

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Global Water Partnership

Global Water Partnership (GWP), established in 1996, is an international network open to all organisations involved in water resources management: developed and developing country government institutions, agencies of the United Nations, bi- and multilateral development banks, professional associations, research institutions, non-governmental organisations, and the private sector. GWP was created to foster Integrated Water Resources Management (IWRM), which aims to ensure the co-ordinated development and management of water, land, and related resources by maximising economic and social welfare without compromising the sustainability of vital environmental systems.

GWP promotes IWRM by creating fora at global, regional and national levels, designed to support stakeholders in the practical implementation of IWRM. The Partnership's governance includes the Technical Committee (TEC), a group of internationally recognised professionals and scientists skilled in the different aspects of water management. This committee, whose members come from different regions of the world, provides technical support and advice to the other governance arms and to the Partnership as a whole. The Technical Committee has been charged with developing an analytical framework of the water sector and proposing actions that will promote sustainable water resources management. The Technical Committee maintains an open channel with the GWP Regional Water Partnerships (RWPs) around the world to facilitate application of IWRM regionally and nationally.

Worldwide adoption and application of IWRM requires changing the way business is conducted by the international water resources community, particularly the way investments are made. To effect changes of this nature and scope, new ways to address the global, regional and conceptual aspects and agendas of implementing actions are required.

A **Technical Focus Paper** is a publication of the GWP Technical Committee aimed at harnessing and sharing knowledge and experiences generated by Knowledge Partners and Regional/Country Water Partnerships through the GWP Knowledge Chain.

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Contents

Acronyms

ASBmm	Aral Sea Basin model
BWO	Basin water organisation
CMO	Canal management organisation
CWC	Canal water committee
IWMI	International Water Management Institute
IWRM	Integrated water resource management
NGO	Non-governmental organisation
RESP	Rural enterprise support project
SDC	Swiss Agency for Development and Cooperation
SIC ICWC	Scientific-Information Center of the Interstate Coordination Water Commission of Central Asia
UNESCO-IHE	UNESCO-IHE Institute for Water Education
WUA	Water users' association

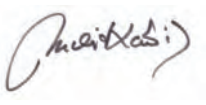
Foreword

This Technical Focus Paper is the second in a series of papers that provide a critical review of progress made in planning and putting integrated water resource management (IWRM) into practice. The papers synthesise the challenges, the successes, the setbacks, and the direction for further integration. They provide valuable insights from which others can learn lessons and apply them to their particular and often unique circumstances.

This paper focuses on IWRM experiences in Central Asia where the major rivers – the Amudarya and Syrdarya Rivers – flow from the headwaters in Kyrgyzstan, Tajikistan, and Afghanistan to the downstream Fergana Valley in Kazakhstan, Turkmenistan, and Uzbekistan, and are a part of the Aral Sea Basin. Water demand is dominated by energy requirements and irrigation, which are central to economic life in the region. There is a long history of irrigation in the region, the influence of the Soviet Union, and some 15 years' post-independence experience of introducing IWRM in the Fergana Valley. The paper describes building new infrastructure and, equally important, reforming institutional structures from the 'top-down' and from the 'bottom-up'. It also addresses the successes and the immense challenges still facing the region, particularly the transboundary water issues where nation States have differing views and priorities for water use.

This success so far in putting IWRM into practice is largely due to the commitment of those leading the national water organisations and so our thanks for this publication go to Dr Anatoly Ryabtzev and Dr Amirkhan Kenshimov in Kazakhstan, Janishbeck Bekbolotov and Barataly Koshmatov in Kyrgyzstan, Said Jakubzod in Tajikistan, and Abdurakhim Jalalov and Dr Shavkat Khamraev in Uzbekistan. They set the pace for maximising the benefits of IWRM and putting the principles into practice in Central Asia. They mobilised many thousands of water and agrarian practitioners to adopt more productive water management practices. This approach is now seen as the way forward for effective, equitable, and sustainable water management under the conditions of growing water stress in Central Asia.

I am grateful to the the authors Viktor Dukhovny, Vadim Sokolov, and Dinara Ziganshina for this excellent publication. My thanks also to the GWP Technical Committee members for their invaluable comments and suggestions during the drafting stages.



Dr Mohamed Ait Kadi
Chair, GWP Technical Committee

Nino Chkhobadze
Chair, GWP CACENA

Executive summary

The countries which make up Central Asia – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan – are all interconnected by shared water resources, mainly from the Amudarya and Syrdarya Rivers. Most of the population of Tajikistan, Turkmenistan, and Uzbekistan depend directly or indirectly on irrigated agriculture and 90 percent of the region's energy needs come from hydropower. Together these countries face limited water resources, increasing demand for water as populations and economies grow, and competition and increasing risk of conflict over water among the different water users. Like many regions across the world, Central Asia is seeking ways of making the best use of limited water resources, and integrated water resources management (IWRM) is seen as the means of achieving this.

Central Asia has a long history of managing water because of its importance to the economic development of the region's population. In the 1950s this economic development was dominated by the USSR, but since independence, States have developed their own strategies which now must be realigned by mutual agreement to better manage their shared and limited resource.

The region's agrarian sector continues to undergo radical reforms as the State and collective farms are moved into private hands within a market-based economy with its inherent benefits and volatile risks. IWRM planning initially began in the Fergana Valley with a 'top-down' approach as decision-makers realised that significant institutional and legislative changes would be required, but this failed to engage the lower end water users. To resolve this, the 'top-down' approach was combined with a 'bottom-up' approach as a process of 'hydrographisation' began, which changed water management from within administrative boundaries to watershed boundaries, and water users' groups were formed and encouraged to take on water management functions within a restructured water management framework.

Experience in the region over the past 15 years suggests that IWRM can provide the foundation for increasing water security. The successes were due in part to a good understanding among water professionals of the need to make better use of the available scarce water resources. Generating driving forces was important to provide triggers for change and to help promote further development and progress. Political support was also vital as officials became aware of the visible benefits of IWRM reforms. The outcomes of this were reduced water wastage, increased productivity, and a water management sector that experienced a more democratic involvement of stakeholders with less influence from government officials and professionals.

The paper draws many lessons from this experience about introducing IWRM at many different levels of management – from interstate, to national and district level. These lessons addressed:

- disseminating information to a wide range of audiences over large areas (approximately 1 million hectares)
- the importance of measuring and monitoring the impact of interventions
- managing supply and demand
- the importance of good governance.

Developing capacity in all its dimensions was also a vital ingredient. Not least was the demand for experienced staff at all levels. This was difficult to satisfy as the current labour force is reaching retirement age and many young people are seeking more lucrative employment in other sectors of the economy. Incentives are needed to attract the best people into water management.

The paper finally addresses the issue of transboundary water management. One example cited is the conflicting interests of releasing water for commercial hydropower generation in one country at times when it does not coincide with the water needs of downstream irrigation in another one, and so it flows to waste. The need for interstate cooperation in order to negotiate the trade-offs is clearly vital if scarce water resources are to be used to best effect.

A key challenge for water managers in Central Asia is to form a critical mass of driving forces at different levels. The number of IWRM adopters is growing, but the involvement of stakeholders at all levels and increasing the number of IWRM adopters will be crucial for success. This can be done, but it will need incentives, motivation, and stimulus to ensure that IWRM reaches the stage when the process will be self-sustaining without strong external support and promotion.

1 Central Asia's water challenge

1.1 The Central Asian region

Central Asia lies between the Ural Mountains to the north and the Hindu Kush to the south, and between the Caspian Sea to the west and the Tien Shan mountain system (near the border with China) to the east. The region covers 4 million km² (10 percent of the Asian continent and twice the combined areas of France, Germany, Great Britain, Italy, and Spain). It stretches 2,400 km from west to east and 1,280 km from north to south. The territory comprises Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan (Figure 1). The combined population is about 65 million and if northern Afghanistan, which is part of the Aral Sea Basin, is included then the population reaches 74 million.

Figure 1. The countries of Central Asia around the Aral Sea

Central Asia is an arid region. Steppe and desert cover over 75 percent of the land area, but the high mountain ranges along the southern, eastern, and north-eastern borders play a key role in making the region suitable for farming.

More than 6,000 rivers (over 10 km long) originate in the mountains, including the great Amudarya River and the Syrdarya River. The vast Turan lowlands stretch out between these rivers. There are densely populated oases located mainly along the upper and middle reaches and the irrigated areas in the lower reaches and deltas. These areas are surrounded by deserts that are moving as a result of natural processes that sometimes change the direction of rivers. In the past there have also been human interventions that have been destructive to rivers.

Water resources are predominantly transboundary in nature. Most of the region's surface water resources are generated in the mountains in Kyrgyzstan, Tajikistan, and Afghanistan. These waters flow into the two main rivers to countries downstream – Kazakhstan, Turkmenistan, and Uzbekistan – which are a part of the Aral Sea Basin. Water resources are critically important to the region's economy, its people, and the environment. Irrigation, for example, is vital for agricultural production and most of the population of Tajikistan, Turkmenistan, and Uzbekistan

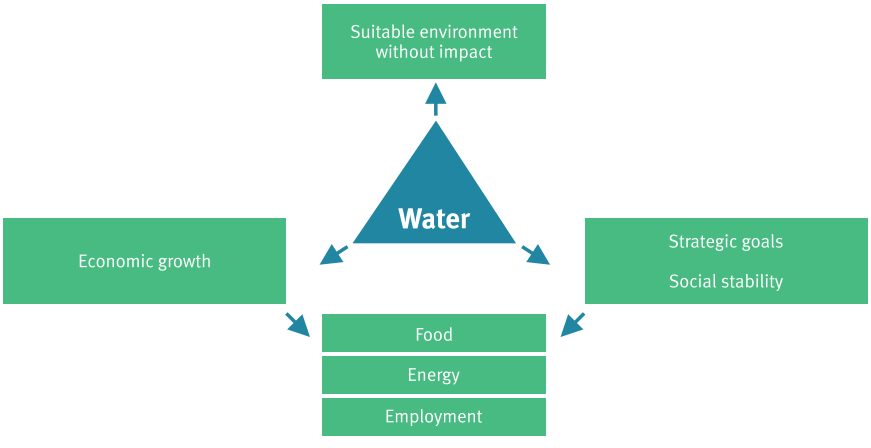
depend directly or indirectly on irrigated agriculture. Water is also important for energy production – hydropower energy satisfies more than 90 percent of the total electricity needs in Kyrgyzstan and Tajikistan, and is also an export commodity. The competing demands of agriculture in downstream countries and hydropower generation in upstream countries fuel serious political disputes in the region, putting water at the heart of regional security and stability.

1.2 Water resource challenges

The countries which make up Central Asia – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan – are all interconnected by shared water resources, and together they are facing major water problems. Water resources are limited, demand for water is increasing as populations and economies grow, and competition and potential conflict over water increases among the different water users. Like many regions across the world, Central Asia is seeking ways to make the best use of limited water resources. Confidence in the usefulness, accuracy, and timeliness of this approach is growing among water practitioners involved in a number of large-scale projects at both lower and middle levels of water management. The similarities between IWRM and traditional Muslim and ethical rules of water use prompted the desire of many people to initiate and implement this approach and particularly to involve water users in the management process. This is considered important in connection with the unfinished restructuring of agriculture and water management organisations in the transition towards a market economy. It is in sharp contrast to the previous top-down perspectives of water planning and management.

Experience so far in Central Asia, particularly in the Fergana Valley, suggests that IWRM can provide the foundation for increasing water security. This means sustainably providing water to all sectors of the economy, including social development, and meeting the requirements of the environment (Figure 2). Water security links the dynamics of economic growth with social and environmental stability.

Figure 2. The elements of increasing water security



The Fergana Valley is one of the most socially tense regions in Central Asia. It is shared by the three administrative provinces of Kyrgyzstan, Tajikistan, and Uzbekistan. The IWRM has managed not only to reduce the total water intake for all needs, but also to significantly increase the total volume of agricultural production and the related industries. It is noteworthy that during two periods of acute water shortage, in 2008 and 2011, limited water availability was successfully managed over 130,000 hectares of irrigated land.

Based on this experience of developing and improving water management in the Fergana Valley over a 15 year period, this paper sets out the lessons learned and the way forward for the Central Asian region. It briefly describes the water history of the region from Soviet times through to independence, and the water challenges that came with the significant changes in politics, water management, and administration. It discusses the reconstruction, modernisation, and development of new facilities and new lands for irrigation, and the equally important components of organisational and legal reforms, finance, and technical improvement. Also described are the 'soft components' of 'social mobilisation' and 'human development'.

The paper emphasises that putting IWRM into practice is not just about investment in infrastructure. It makes the case that such investment will only succeed within an 'IWRM environment', which requires the support of many stakeholders and a willingness among the whole complex of managers and decision-makers to cooperate and to orient their thinking towards future water demands. The success so far in achieving an enabling environment in Central Asia is the central theme of this paper, particularly the significant challenges of managing transboundary water resources. Progress is being made, but much still needs to be done – it is a work in progress.

2 The roots of water management in Central Asia

Central Asia has a long history of water management because of its importance to the economic development of the region's population (Dukhovny and de Schutter, 2011). Some of the first water control structures appeared in the region several thousand years ago, at the time when the Nile flooded ancient Egypt and 'rope' irrigation (underground tunnels called 'ropes' or *'qanats'*) was widely used in ancient Iran. In Central Asia, water has always been the basis of civilisation and the formation of States. The statement by Prince Massalskij VI, who was Director of the Department of Land Improvement of the Russian government in 1913, illustrates this:

> *Of all the monuments of hoary antiquity in Central Asia, the most attention is paid to ambitious irrigation facilities in the form of canals, often resembling fairly large rivers in regards to extension and water abundance. The great importance of irrigation water which creates life and culture in the dead deserts is well known to the population, which from time immemorial has been accustomed to look at the revival of land through irrigation as a charitable deed.*

During this time it was appreciated that large-scale construction of water projects alone was not able to create the basis for the quality of life that was expected from bringing water to the land. GK Rizenkamph, an engineer and scientist, when leading the development of the virgin lands in the Hungary Steppe, outlined an integrated approach to water resources development, which was implemented half a century later. He wrote in 1915:

> *The task of the creators of irrigation systems is quite complicated. The irrigation network is the canvas on which life will embroider its stories; and in the process of*

> *creation, it is essential to see very clearly all aspects of future life. Development of the irrigation system is not an end in itself: it is a part of the universal whole – the revival of the desert – hence the main challenges arise, and the irrigation system should be organically linked to other aspects of life. A key requirement is to ensure the most efficient organisation of all life, and not simply focus on the construction of the irrigation network; it is necessary to achieve maximum efficiency in general, not in just one specific component.*
>
> *It is necessary not only to design an irrigation system, but also to plan the development of the project area, which should include the organisation of a system of roads, industrial sites and shopping centres, as well as the most appropriate energy sources for future factories and plants. For that it is necessary to prove that the designed irrigation system is blended in with the overall organisation of the future life and is a part of a well thought out whole.*

Rizenkamph and his associates worked with these principles to design and build large hydraulic hydropower complexes. The first was the Farkhad hydro system on the Syrdarya River in the 1930s. At the same time, construction began for Bekabad city and two large industrial complexes producing steel and cement. Similarly, the hydropower complex at Kairakkum was built on the same river in the 1950s. The main feature of both enterprises was that they should operate in an integrated manner within the framework of incorporated institutions.

The pinnacle of applying this integrated approach came with the development of a new zone in the Hungary Steppe shared (at that time) by three republics of the former Soviet Union – Kazakhstan, Tajikistan, and Uzbekistan. The project was initiated by the Soviet Government in 1956. The water complex of the Hungary Steppe covered over 1.0 million hectares of desert lands and was supplied with water from the Syrdarya River via the Farkhad Dam and three large canals. The whole system was based on principles which are now the main features of IWRM.

In 1958, the USSR Council of Ministers issued the decree which outlined the establishment of a construction industry enterprise and the organisation of maintained State farms (*sovkhozes*) in the Hungary Steppe. During the construction of the irrigation infrastructure, modern irrigation techniques, such as automated control, were introduced along with vertical and closed horizontal drainage, lined canals, and other anti-seepage measures. To accomplish all this, the entire management was entrusted to a single organisation, *Glavgolodnostepstroy*.

In addition to the irrigation and drainage infrastructure, attention focused on constructing industry, roads, railways, power, water, gas and heat supply systems, and maintenance companies, and the other infrastructure necessary for the State farms' sustainability. Social infrastructure – shops, hospitals, schools, catering facilities, rural clubs, and more – were also constructed.

Glavgolodnostepstroy created subordinated organisations for providing operation and maintenance services, and for managing agricultural activities on the State farms. It also provided credit, equipment, seeds, fertilisers, and mechanisation services.

By 1970, the area was producing 370,000 tonne of agricultural produce annually with a value of Russian Roubles (RUB) 180 million. In 1980 this had increased to 1.8 million tonne with a value

of RUB 488 million[1]. Cotton was the main crop; others included vegetables, horticulture, melons, livestock, and poultry.

This project was a good early example of targeted economic improvement under the influence of irrigation. In this system all kinds of water resources and the management of water and land were integrated. There was close alignment of all levels of the water hierarchy and the needs of all water users were taken into account. Experience of this project convincingly demonstrated that, with proper control and management, it is possible to significantly improve the natural and economic conditions in a former desert.

Another example of an integrated approach to water management in the former Soviet Union was the 'Scheme of Complex Use and Protection of Water Resources'. In western practice this is known as a 'Basin Master Plan'.

The complex schemes focused on economic development in areas selected by the Soviet Union's State Planning Committee. In reality, however, the plans were not backed by the required capital investments. As a result the irrigation infrastructure was not completed and attention focused on scattered measures to improve water use. Consequently, the desired reduction in per capita water consumption was not achieved. This increased water scarcity in the basin, especially in dry years. Nevertheless, the present independent Central Asian republics use water allocation principles that were originally approved by the Soviet State Planning Committee on the basis of those schemes (Dukhovny and de Schutter, 2011).

Previous attempts to integrate water management in the region helped to create an understanding among water professionals of the viability of this approach and how it could positively shape and influence water policy and practice.

The Soviet era had a positive influence upon the present and future development throughout the region:

- The high level of water education and scientific research work established a sound base for building up water resources management potential.
- Water professionals in the different republics of the former USSR integrated their work using common uniform standards, rules, methods, and approaches, and these established the ground rules for future cooperation.
- In the six to eight years before the collapse of the USSR, the Soviet Government focused on plans to improve the socio-economic and environmental situation in the Aral Sea Basin, (establishing two basin water organisations [BWOs]), and allocated considerable investment for infrastructure and social rehabilitation projects.

These created the required pre-conditions for a smooth transition from a command economy to a market-oriented one. Independence has provided new opportunities for development, but, at the same time, it has also disrupted the economies in the various States. All five States have rapidly moved away from the command economy and, although four countries have proclaimed their status as republics,

[1] At 1989 prices these amounts are equivalent to US$ 321.4 million and US$ 871.4 million respectively.

their political structures, aspirations, and ideals were quite different from any well-known political model and from each other.

The agrarian sector in Central Asia is now undergoing radical transformations, including the restructure and transfer of large State and collective farms into smaller private or leased farms. This has created a number of problems. Farms are now run by new people who do not have the broad agricultural experience for efficient crop production and irrigation. In the past, agriculturalists worried only about weather conditions, uncertainties of water flow, diseases and pests, and changes in agricultural output prices. Nowadays, the degree of risk has increased significantly because of changes in public policy and agrarian institutional structures, incomplete infrastructure, weak State support, and poorly developed markets. Farmers now have to find their own input suppliers, establish relations with buyers, and cope with price fluctuations for agricultural outputs and inputs (fertilisers, fuel, chemicals, etc.) Thus, irrigated agriculture has lost some of its profitability, which has not been helped by falling agricultural commodity prices worldwide. This has seriously affected farm incomes and employment in the rural sector, causing significant social damage.

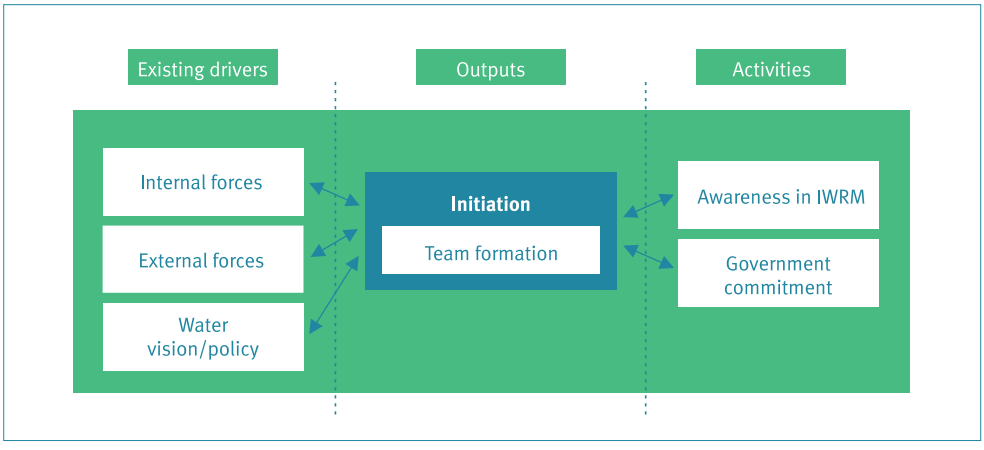
2.1 A 'top-down' approach

The implementation of IWRM planning in Kazakhstan and Uzbekistan, supported by UNDP projects, needed to start at the top – hence the initial focus on a 'top-down' approach through national governments.

In Kazakhstan

Kazakhstan was a pioneer in this; the process beginning in 2000 based on the pathway set out in Figure 3. Kazakhstan started to develop all the pre-requisites for the transition towards IWRM. Water experts and decision-makers realised that to ensure development and implementation processes it would be necessary to carry out a number of significant institutional, legislative, and information changes. Between 2000 and 2003 the key role in water management was legally assigned to the Committee for Water Resources of the Ministry of Agriculture and eight basin management authorities. By 2003, new water legislation had been formulated.

Figure 3. Classic scheme for initiating and mobilising IWRM planning (CapNet, 2005)



IWRM planning was first introduced in a few places. First, at the international level, the Government of Kazakhstan announced, at the World Summit on Sustainable Development in Johannesburg, that it agreed to prepare a plan to put IWRM into practice by 2005. This received the support of the international community and donors represented by the Government of Norway, UNDP, and the Global Water Partnership (GWP). In the course of an official visit to Kazakhstan by the Prime Minister of Norway, Mr KM Bondevik, in May 2004, an agreement was concluded to financially support the development of an IWRM National Plan for Kazakhstan. The Committee on Water Resources, in cooperation with the various ministries and departments, was tasked with developing the plan (UNDP, 2006).

A multi-sector approach was required in order to manage water resources in an integrated way, which meant developing links and structures to coordinate the various major water-consuming sectors and to bring them into the planning process from the beginning.

It was important to have wide participation since most water management problems were experienced at the lowest levels. Water management changes needed to be directed at individual activities and intensive consultation with all stakeholders was essential.

A Task Force was set up comprising international and national experts. An interdepartmental Task Force was established to liaise with government structures. The group comprised representatives of all relevant ministries and departments invited by the Committee for Water Resources. Workshops, roundtables, and training courses were organised by the Committee for Water Resources of the Ministry of Agriculture with participation from:

- Emergency Control Ministry
- Ministry of Economy and Budget Planning
- Ministry of Public Health
- Ministry of Environment
- Ministry of Energy and Mineral Resources
- Committee of Forestry and Hunting of the Ministry of Agriculture
- Fishery Committee of the Ministry of Agriculture
- Department of Farming of the Ministry of Agriculture.

The Committee for Rural Development of the Ministry of Agriculture was required to raise public awareness and improve the knowledge of the main project implementers. In 2005, a Concept of Transition to IWRM was developed and published for consultation. Its purpose was to present proposed outline plans and principal components. It was then sent out for comment to all interested parties, such as government agencies, institutions, local governments, NGOs, and leading experts in the country and in the Central Asian region for comments and observations.

The plans were drawn up by a team working under the direct supervision of the First Deputy Chairperson of the Committee of Water Resources. Following on from the concept, the first version of the National Plan was prepared and submitted to all stakeholders for consideration in November 2005.

A significant success factor in this initial process was the political support and commitment at the highest level of government. Such political support enabled:

- priority water management problems to be solved at the interdepartmental level
- effective planning coordination (the interdepartmental group received political support for the formation and operation)

- a water resources development vision, taking into account political goals compatible with other national development goals and vice versa, to be enunciated, and water resources management and objectives to be taken into consideration in the political agenda
- sustainable water management approaches to be included in the national development plans, activities, and political statements of other sectors
- the political effects of the IWRM plan to be embedded throughout the entire process rather than at a formal end stage (thus ensuing ongoing improvement of the works)
- decisions to be made according to the suggested plans as well as legislative and institutional reforms
- an IWRM plan to be adopted and implemented
- government funds to be allocated and donor assistance mobilised.

Decree No 978, of 11 October 2006, of the Government of the Republic of Kazakhstan "On agreement between the Government of the Republic of Kazakhstan and UNDP concerning the project 'National Plan of Integrated Water Resources Management and Water Efficiency for the Republic of Kazakhstan'" approved the development of the programme 'Integrated Water Resources Management and Improvement of Water Use Efficiency in Kazakhstan till 2025'.

Kazakhstan demonstrated, after completing the plan for IWRM, how to gain acceptance by all beneficiaries, including the government, in the form of a national long-term programme.

The 'top-down' approach in Kazakhstan covered the national and basin levels. It helped to lay down the legal and institutional frameworks for the activities of a national regulatory body and the basin units. It adapted existing structures and management techniques for the future development of IWRM. Some progress was made in improving water management information systems and in developing a national programme for improved water management. But this project did not work well below the basin level in involving end water users in IWRM. Of the 177 items in the plan only three dealt with water management issues below the basin level. National water councils and basin water councils were still led by administrative officials rather than by elected stakeholders.

In Uzbekistan

Using the same 'top-down' approach, the UNDP funded the 'IWRM and Water Efficiency Plan for Zarafshan River Basin' in Uzbekistan. This project also covered the basin and national levels. The Zarafshan River Basin already had an institutional foundation and favourable conditions for IWRM because basin management administration, *Zerdolvodhoz*, had been established there in the early 1930s. Initially, *Zerdolvodhoz* served two provinces – Samarkand and Bukhara – and then partially served the Jizzak and Kashkadarya provinces. The project had three components:

- improved legal and institutional framework for IWRM in Uzbekistan through the Government's Project Advisory function and modernised national water legislation
- improved communal water services and utilities within the Zarafshan River Basin by developing a strategy for meeting MDG goals for improved public water supply between 2010 and 2015; achieving a 90 percent centralised water supply and 13 percent sewage systems for rural and 70 percent for urban areas; with all being equipped with water measuring devices
- IWRM and a water use efficiency plan for the Zarafshan River Basin.

As in Kazakhstan, this project contributed to improving IWRM governance, but in practice it did not cover all levels of water management and all economic branches to meet the water

requirements of end water users. Most importantly, it did not achieve the expected improvements, enhanced capacity, and increased management efficiency.

National policy dialogues on IWRM and water supply and sanitation under the European Union Water Initiative implemented by the United Nations Economic Commission for Europe and the Organisation for Economic Co-operation and Development have also focused on inter-sector coordination at the national level. These initiatives were useful in creating an initial understanding of IWRM at the upper levels, but they could not provide specific mechanisms for practical IWRM integration at all levels without addressing both the governance and management dimensions of IWRM.

The water situation is constantly changing and it needs specialists or water users with extensive knowledge and experience of maintaining infrastructure, financial and organisational administration, and technology and management in order to adapt. Local knowledge and experience is also important, particularly in relation to extreme and unique local situations. That was why the main efforts now needed to be directed to establishing managerial tools and building capacity.

2.2 Introducing a 'bottom-up' approach

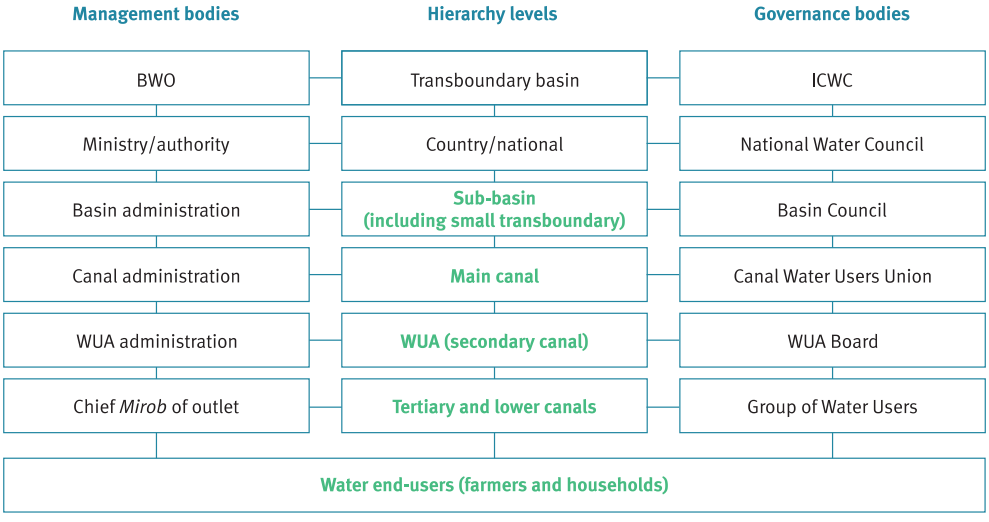
A multi-level perspective formed the backbone of IWRM in the Fergana Valley (IWRM-Fergana) project. It was implemented by national teams from Kyrgyzstan, Tajikistan, and Uzbekistan on the command areas of the Aravan-Akbura canal in Kyrgyzstan, Khodja-Bakirgan canal in Tajikistan, and the South Fergana canal in Uzbekistan (Figure 4). The area included over 116,000 hectares of irrigated land served by a canal system. The Swiss Development Cooperation (SDC) provided financial assistance and technical assistance came from the International Water Management Institute (IWMI) and the Scientific-Information Center of the Interstate Water Coordination Commission (SIC ICWC) in Central Asia. They provided methodological and organisational guidance for project implementation (Dukhovny et al., 2008).

Figure 4. Fergana Valley – the area for IWRM implementation

The multi-level approach was to cover several levels of water management hierarchy – starting with the end water users and former on-farm network of *kolkhozes* (collective farms) and *sovkhozes* (State farms) up to main canal management and beyond into small transboundary river basins. The aim was to manage the interdependencies between various stakeholders with the overall goal of contributing to more secure livelihoods, increased environmental sustainability, and greater social harmony.

The project used a range of tools to deal with organisational, legal, financial, and engineering measures. The joint activities of stakeholders at all levels were based on agreed procedures and methods for equitable and stable water allocation under the control of water users. The project revised the institutional set-up for water delivery management according to hydrographic boundaries (Figure 5), linked several levels of water hierarchy, established cross-sector integration, linked different types of water, and shifted from supply to demand management (Figure 6).

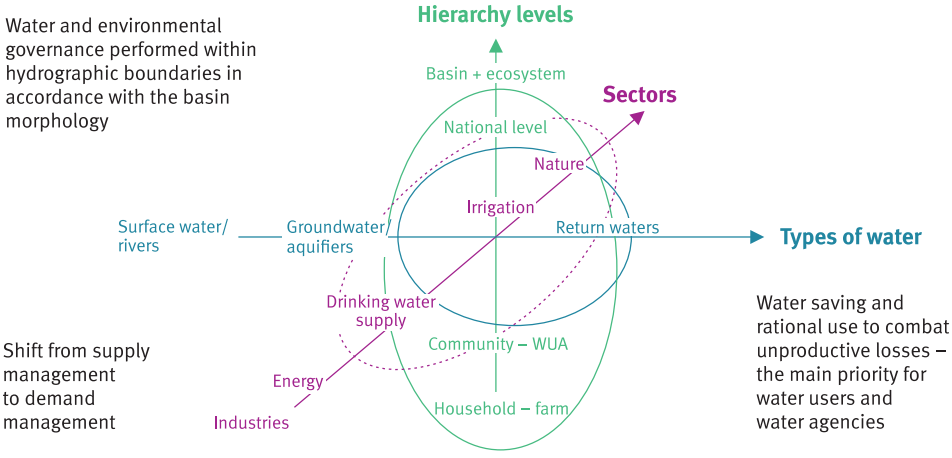
Figure 5. Levels of water hierarchy in the Fergana Valley



New institutions and 'hydrographisation'

The water management institutions were set up according to hydrographic principles at various levels. This is known in the region as 'hydrographisation' (Mirzaev and Ergashev, 2011b). It involves setting up institutional structures which enable water delivery systems to be managed within hydrological units rather than within administrative boundaries.

Figure 6. Consistency of IWRM in the Fergana project



Hydrographisation was applied because it helped to reduce water losses and control water delivery accurately and with security. It provided a basis for the uniform and equitable distribution of water among all end-users. This was implemented in the Fergana Valley along two lines – management and governance. First, the canal management organisations (CMOs) were linked by contracts to the administration of water users' associations (WUAs). The second involved the establishment of canal water committees (CWCs), boards of WUAs and water users' groups.

Establishing WUAs produced considerable progress in stakeholder involvement in water-related decision-making processes (Figure 7). This not only reduced administrative dominance, but it also prevented the possibility of water organisations using their power to take over management responsibilities. Public monitoring and water accounting systems were organised through proper stakeholder participation, which included regular monitoring by representatives from the CWC to ensure fair and equitable water allocations among the different sections along the major canals.

Hydrographisation and public participation enabled unproductive water losses to be identified and eliminated, including the problems of poor and unreliable supply at the tail end of canals. This linked all levels of the water hierarchy and organised the control of water delivery and allocation. Those functions are now mainly performed by water management organisations in partnership with their public committees or councils as well as WUAs.

The introduction of hydrographisation along the South Fergana canal, the Big Fergana canal, and Big Andijan canal are illustrated in Table 1.

Figure 7. Dynamics in the development of WUAs in the Uzbek part of the Fergana Valley

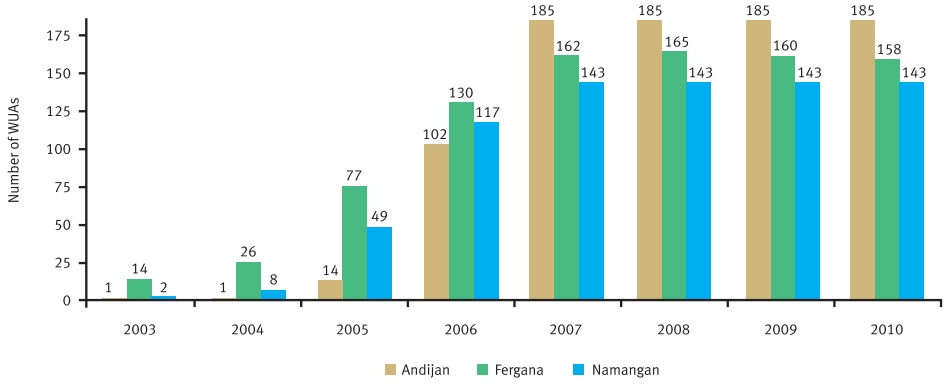


Table 1. No of WUAs and areas irrigated along canals in the Fergana Valley (2010)

Indicator	South Fergana canal	Big Fergana canal	Big Andijan canal
Average area (ha)	2,413	1,666	1,796
Number of WUAs	37	93	49
Hydrographic WUAs (%)	85	56	38

Although water is delivered by main canals from the river, a feature of irrigation in the region is that additional water flows in from small rivers running within the command areas. This water and irrigation system is rather unique in terms of morphology, water consumption, hydro-module zoning, and secondary water sources. Managing water under such conditions is as much an art as a science and it relies on professionals who have had long-term practical experience in managing such systems.

Although hydrographisation is a logical step in managing water within catchments, it is a process that is not well understood or accepted by some. The approach has its critics in those who advocate a so-called 'polycentric approach' that emanates from the assumption that irrigation systems have often more than one source for water delivery. On this basis, some are likely to reject hydrographisation and invoke a mixed structure of water delivery systems (Wegerich et al., 2012).

2.3 Improving efficiency through end-user outcomes

The IWRM-Fergana project is designed primarily to reduce water losses by using improved management tools to bring about reform and help water management institutions and water users to better manage available and limited water resources. Various management instruments were used, such as a management information system for main and secondary distribution

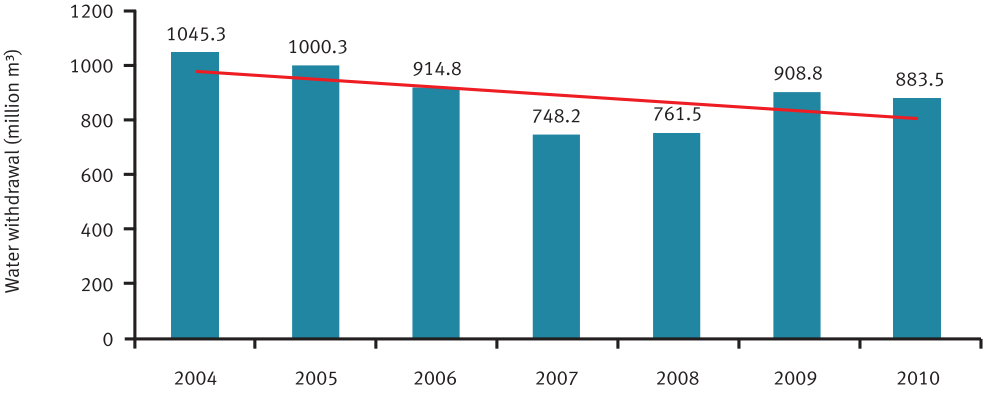
canals, updated hydro-module zoning to assess irrigation rates and scheduling, daily planning of water distribution among users, and hydrometric services for water users (SIC, 2007; SIC and IWMI, 2006).

The reforms resulted in significant reductions in water withdrawals from rivers. For example, the total water withdrawal for the South Fergana canal in Uzbekistan decreased by more than 15 percent during the eight years of project activities (Figure 8).

Within the project area, indicators of water use efficiency and water productivity at the farm level showed improvements (Mirzaev and Ergashev, 2011a). These led to improvements in financial sustainability for farmers and WUAs. Other improvements included:

- overcoming water deficits during 2007/2008 without loss of crop yield and total crop production
- reducing seepage losses by 10 percent at the WUA and water consumer levels when compared to former water distribution practices
- transferring water to the WUA balance sheets by registering structures at key canal junctions in the WUA irrigation network and constructing off-takes at every farm.

Figure 8. Total water withdrawn for irrigation along the South Fergana canal



Significant reductions in water consumption per hectare were observed in all pilot canal areas over a period of eight years (Table 2). This indicator was applied more widely to neighbouring areas outside the project.

Table 2. Changes in water consumption in selected canals between 2004 and 2010

Pilot canal	Water consumption (000 m³/ha)	
	2004	2010
Aravan-Akbura canal	8.11	7.88
Khodja-Bakirgan canal	14.04	7.15
South Fergana canal	11.35	8.45

The uniformity and stability of the water supply increased in the pilot zones. In the Aravan-Akbura canal zone, water supply uniformity increased from 59 percent to 90 percent, water supply stability to 87 percent, and unproductive losses along the canal decreased from 47 percent to 31 percent.

In the South Fergana canal the stability of the water supply exceeded 92 percent in 2011 (in comparison with 60 percent in 2002), the uniformity of the water supply was almost 92 percent, and unproductive losses fell to less than 10 percent.

In the Khodja-Bakirgan canal zone, where inflow is not regulated by reservoirs like the other two canals, total annual water use decreased from 113 million m^3 to 83 million m^3 because of improved water ordering and delivery routines.

At the heart of the improvements were the economic and financial stability of the water management organisations and the availability of equipment and qualified personnel. The project enhanced the financial discipline within WUAs and created conditions for improved financial sustainability, thus raising the authority of the WUAs among the water users. Payments from water users for WUA services were reported to have risen by 75 percent in 2010 and 2011 when compared to WUAs outside the project area.

Fee collection in a number of WUAs within the project area reached US$ 15–30/ha. In comparison, the average for the Fergana Valley was US$ 5/ha. In Kyrgyzstan and Tajikistan at the main canal level, a flexible economic system was developed through a combination of budgetary financing and payment for water supply. At the WUAs' and end-users' level, a financial budgeting system was developed and introduced, fixed assets were added to the WUA balance sheet and depreciated, and reserve funds were formed. There was an annual increase in the volume of services provided and funds received; accounting and reporting in the WUA was also streamlined. Transition to the payment for WUA services depending on the volume of water supplied was carried out in all the pilot areas.

Attention was also given to improving water and land productivity on individual farms and plots. In all three countries, a framework was introduced for assessing the situation on irrigated farms and for transferring innovative solutions through the new system of interrelations between the different bodies. A chain of extension services for farmers was created and this had a significant impact on the efficiency of irrigation water use and productivity (Jumaboev et al., 2013).

The amount of irrigation water used to grow cotton was significantly reduced compared to the average at the provincial level. Reductions were 30 percent in Kyrgyzstan and Tajikistan, and 59 percent in Uzbekistan (Figure 9).

Cotton crop yields increased at the project sites (Figure 10). This was made possible by examining both irrigation and agronomic issues. This approach allowed the project to develop recommendations to ensure the efficient use of water and all other resources. Productivity in the project area was considerably greater than the average in the province.

Figure 9. Comparison of water use for cotton at project sites with the average water use at the provincial level

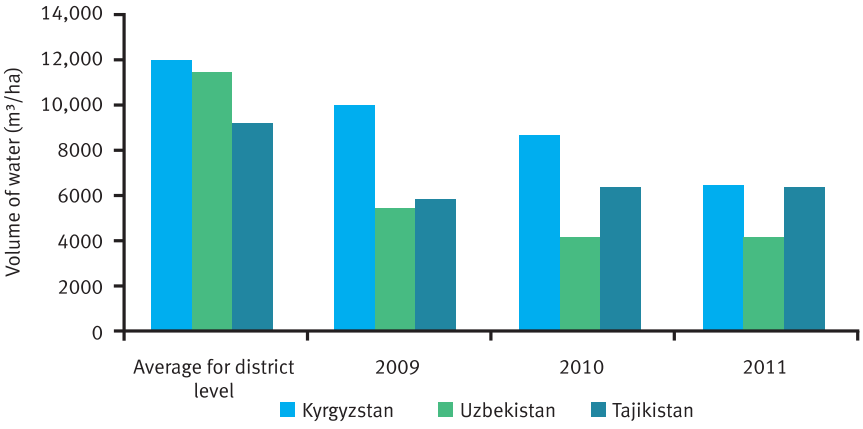
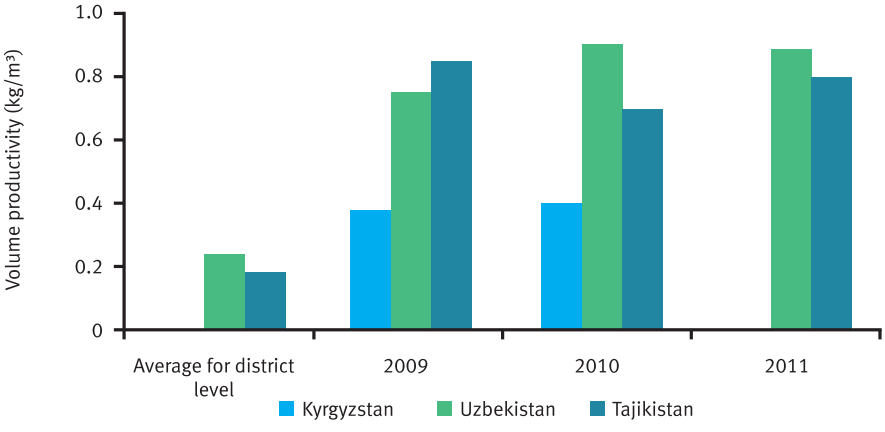


Figure 10. Comparison of cotton yields at project sites with the average yields at the provincial level



3 Key lessons learned and ways forward

The approaches developed and tested within the IWRM-Fergana project were specific and results-oriented. Although the degree of success varied across scales and countries it was considered that the viability of an IWRM approach was proven. In this section we draw lessons from this experience – both failures and successes – and outline the way forward for putting IWRM into practice across the region.

The scale and scope of IWRM implementation can be seen through the hierarchical and sector focus of the key IWRM projects implemented in Central Asia (Table 3). Three key lessons can be drawn from this.

Table 3. Water management hierarchy levels in different IWRM oriented projects

Project	Levels of hierarchy							
			Sector					
	International	National	Irrigation	Water supply	Hydropower	Ecology	Canal management	Other water users
National IWRM plan in Kazakhstan	available	available	available	available	none	available	none	available
IWRM in Zeravshan Basin	none	available	available	available	none	available	none	available
IWRM in Fergana Valley	partially[2]	available	available	none	none	available	available	available
RESP 2 Uzbekistan	none	available	available	none	none	none	partially	available
WAREMASP[3] Uzbekistan	none	available	available	none	none	none	none	available

3.1 From irrigation to other sectors and ecosystem needs

Past and ongoing projects have clearly focused on irrigated agriculture as the dominant water user. Some 85 to 90 percent of available water resources is used for irrigation on farms, *dehkan* (small) farms, household plots (Turkic – *tamarka*), and rural settlements which require stable and secure supplies.

Problems in coordinating projects

Two projects are being financed by SDC – one dealing with irrigation and another with rural water supply – within the same territorial boundaries in the Fergana Valley. Both projects had to deal with the issues of operations along big canals. The rural water supply project aimed to provide water for drinking purposes to villages and individual farms that do not have centralised water supply systems. The water for this purpose is taken from irrigation canals, and water management organisations have to plan special releases along the canal 365 days a year. The absence of coordination between the two projects complicates the operational functions of the institutions established under the irrigation project, and provokes an inefficient use of water because only 5 to 10 percent of these targeted releases are used efficiently.

[2] At the level of two small transboundary rivers.
[3] WAREMASP – a project on IWRM implementation in the irrigated areas with pumping systems for water delivery in the Fergana and Zeravshan Valleys supported by the Asian Development Bank and SDC.

3.1.1 Working at different levels

Working at different levels can help to ensure better cross-fertilisation, coordination, efficiency, and sustainability (GWP, 2004). But a feature of IWRM implementation in Central Asia so far is that virtually all past efforts were concentrated at the national and basin levels (GWP CACENA, 2006). Only the IWRM-Fergana project went further and dealt with water management at the lower levels (main canal, WUAs, and farmers) and created interrelations between the levels.

The vision for the IWRM-Fergana project was to introduce activities at all levels and was formulated and approved by the national water authorities in Kyrgyzstan, Tajikistan, and Uzbekistan. Recommendations were made to introduce IWRM at a number of levels.

Interstate level

Recommendations included:

- Strengthening the role of BWOs and transferring all structures along the river to their control. Establishing interstate basin public councils comprised of key stakeholders, including local governments and the owners of all major hydro schemes, representatives of environmental protection agencies, and delta committees.
- Increasing the accuracy of all water accounting, including groundwater and return flows. These recommendations met with opposition from national water authorities and hydropower authorities as each wanted to maintain their authority and their own national interest. This required strong political involvement and almost seven years of negotiations at the ministerial level to resolve.
- Establishing river water users' committees on each small river. This measure was only successful for the Khodjibakirgan River (between Kyrgyzstan and Tajikistan) and the Shahkimardan River (between Kyrgyzstan and Uzbekistan) at the local community level with the participation of provincial water organisations from each State. In all, more than 20 small river basins have now requested a similar approach.

National level

Recommendations included:

- Transferring the Main Water Resources Administration, Uzbekistan and the Water Resources Department of Kyrgyzstan to direct governmental authority or restoring the Ministries of Water Resources
- Strengthening the role of the Fergana Valley Main Canal Management Authority and the small river basin committees which report to it
- Converting the Irrigation System Authorities, which are units in the structure of the basin management organisations, into bodies responsible for water demand management
- Improving the legal framework:
  - securing a right to water for every water user in the form of a minimum volume of water per unit area (in agriculture), per produce (in industry), and per capita (in public utilities), based on biological and technological needs and focused on potential water productivity
  - establishing yearly targets for water conservation with relevant capital investment plans for all levels and sectors of the water hierarchy
  - creating a National Public Commission to provide assistance in improving water management.

IWRM concept is used as a 'slogan'

In the USA, the IWRM concept is used as a 'slogan' to implement it in various forms – from small to multi-sector projects, and under different headings such as 'Interstate river commissions', 'Ecosystem management', and 'Watershed approach'. In 2012 many initiatives were registered under this slogan. But common to them all was the involvement of stakeholders; their union under the slogan along the river basin or catchment area and the collaboration between the agencies and organisations within a basin or river commission striving for environmental independence. But one thing was clear – IWRM requires a more systematic and economic approach. (Layzer and Shulman, 2013)

Province and district level

Recommendations included:

- Establishing public councils for small river basins and canals, and WUA support departments in basin management organisations
- Improving the economic and financial viability of WUAs; establishing WUA support funds in local banks and creating favourable conditions for loans
- Creating water and land commissions at the district level to monitor land and water productivity.

Dissemination

Recommendations included:

- Expanding the implementation of IWRM to the whole Fergana Valley in Kyrgyzstan, Tajikistan, and Uzbekistan – approximately 1 million hectares
- Intensifying the development of knowledge transfer systems for farmers and WUAs based on the experience of IWRM-Fergana and water productivity projects in order to cover all irrigated areas in the Fergana Valley
- Disseminating the complex technical, managerial, financial, and organisational guidelines and recommendations from the IWRM project.

Agencies and donors may have other priorities...

Although all the countries prepared their visions for the expansion of IWRM with support from international agencies, donors also have their own priorities and choices. For example, the Rural Enterprise Support Project (RESP-2) funded by the World Bank and SDC envisaged disseminating and upscaling the IWRM-Fergana experience. The main goal was to create conditions for the World Bank to allocate a loan that would address irrigation system rehabilitation. The project only focused on implementing hydrographisation of WUAs within seven provinces and providing capacity-building programmes. It did not address the other interconnected issues of managing water, such as main canal management, the managerial tools needed at the WUA level (such as updating rates of water consumption, daily water scheduling, and extension services for information distribution to water users) and the issues of social mobilisation among key stakeholders. As a result there was no visible reduction in water intake in any of the seven provinces, nor were there any observed increases in agricultural production. There was also no organised monitoring of the stability and equity of 'top-end tail-end' water delivery.

Such partial dissemination of the IWRM experience without sufficient evaluation of the outcomes discriminated against the potential success of the IWRM approach. This rather fragmented implementation failed to make the connections between water management levels and these are unlikely to improve if these limited interventions are scaled up to include the entire country.

3.1.2 Measuring and monitoring impact of interventions

When undertaking reforms and changes in day-to-day activities in the water sector, the focus needs to be on practical outcomes and results achieved rather than on the process. All changes (even institutional) need to be measured with relevant water-related indicators, such as 'more drops of water saved per any other action'. A good balance is needed between social equity, economic effects, and ecological sustainability.

More than ten projects with IWRM in their titles were examined and only one of these projects adopted indicators of water use improvement. Only the Fergana Valley project measured water use and provided evidence of a significant reduction (15 percent) and increasing yields and water productivity. All the other projects either did not monitor water use or did not intend to do so.

3.2 A holistic and systematic approach to IWRM

An IWRM approach needs to consider social, economic, and environmental spheres of influence – not managing, but rather tracking changes based on multilateral monitoring and organising information for use in adaptive management.

Every person and every social unit – family, community, and WUA – as well as administrative territorial units of economic and political systems are connected to water. These elements define a complex set of factors, aspirations, plans, needs, resources, and their interactions, which need to be considered when building an integrated, systemic, and holistic approach to water management.

A holistic approach does not imply that putting IWRM into practice should be done by a single organisation. This is not only undesirable, but is practically impossible because of the enormous number of actors, links, connections, relations, factors, consequences, water sources, and their consumers inside and outside the water sector. Evers and Nyberg (2013) listed a number of complex features that are important when implementing IWRM in large river basins.

Some 15 years' experience in Central Asia confirmed the appropriateness of this list:

- There is a need to integrate natural and social systems. The Scientific-Information Center of the Interstate Coordination Water Commission of Central Asia (SIC ICWC) and UNESCO-IHE created a computer model, 'ASBmm' (Aral Sea Basin model), combining both hydrological and socio-economic data, in order to examine a range of future scenarios within the basin.
- The existence of different management units (small, medium, and large) and their interrelationships need to be taken into account.
- There is a need to manage water-related issues crossing administrative borders and units.
- There is a need to account for many different workspaces and objects, beginning with the main rivers and finishing with the end water users.
- There is a need to account for the availability of (and the often contradictory) management objectives and measures.
- There is a need to involve all stakeholders and the public, or their representatives, in policy-making and water governance.

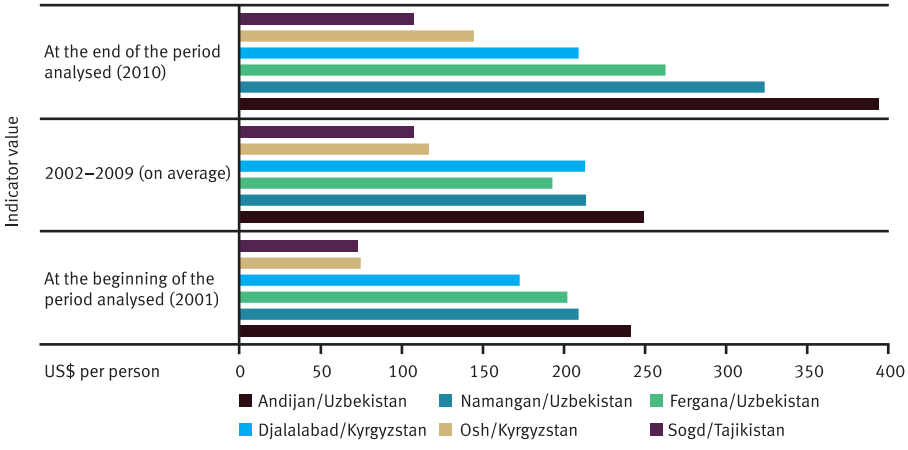
In arid zones these difficulties are exacerbated by competition between sectors, which can become regional political issues involving powerful interests. This can create instability and insecurity for water delivery processes and result in the stakeholders' desire to solve these problems, not by integration, but by actions that are based on self-interest and security at a national and even the local level.

Considerable attention was paid to social mobilisation and integration as a component of IWRM. Lubel and Edelenbos (2013) speak about widespread social integration, but experience in the region suggests limiting social integration to the levels of rural and urban water consumers, their associations, water management organisations at different levels, and secondary (associated) water users. At present social integration among management levels, at the regional, sector, and national scales are not considered to be realistic. Penetration into this social sphere including decision-makers was limited to monitoring, analysis, and feedback.

Permanent monitoring and analysis of many socio-economic indicators to assess the impact of management decisions was organised across the entire Fergana Valley.

Figure 11 shows the monitored improvements in gross agricultural product in all provinces where project interventions were conducted.

Figure 11. Changes in the gross agricultural production in the Fergana Valley 2001 to 2010

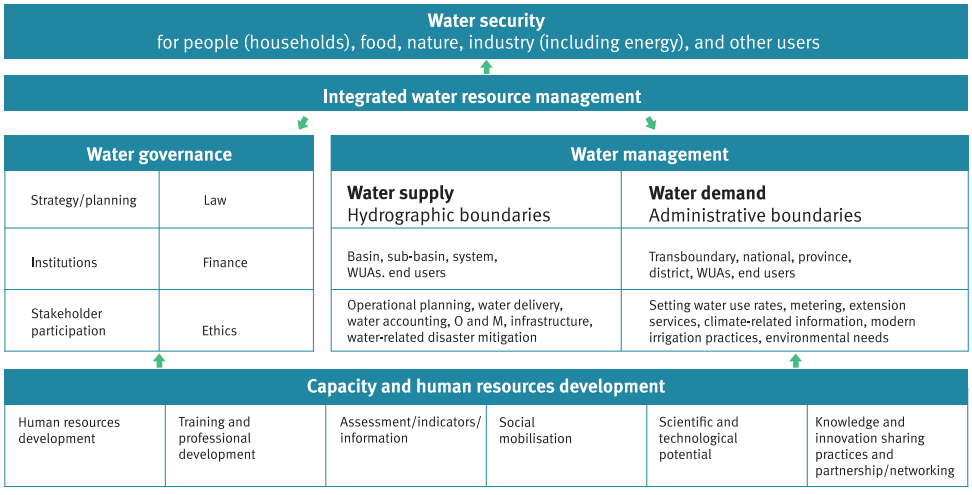


Source: Hydrological study in the Fergana Valley (SIC ICWC, 2012).

Water governance creates the 'rules of the game' and provides mechanisms. In contrast, water management deals with implementing, making rules operational, and applying them and the procedures for water allocation, delivery, and conservation. It also covers the interaction with other related activities (Dukhovny and Sokolov, 2005) (Figure 12).

Governance provides the foundation for successful management. It has its own specifics at all levels and it reflects the specifics of the entire management system that has evolved in a given country. Hence there is no 'blue-print' solution for either governance or management (Dukhovny et al., 2008).

Figure 12. Key elements of water governance and management



3.2.1 Managing supply and demand

Institutional water reforms in the region illustrate the greater focus on augmenting water delivery rather than managing water demand. Currently water management organisations and their various divisions are responsible for both water delivery and water use, so they pay less attention to managing demand, which is managed within administrative units rather than hydrographic boundaries. The fact that hydrographisation is not yet completed across the region could be explained by the lack of understanding that water delivery institutions need to follow hydrographic boundaries. This misunderstanding creates confusion and duplication and a separation of duties. For example, hydrographisation assumes that the implementation of water delivery planning follows the chain 'farmers' requests – WUA – canal managers – basin irrigation system administration – basin water organisation'. In this set-up, irrigation system administrations are redundant bodies and unnecessary intermediaries in the water delivery chain. But within the IWRM-Fergana project this administration takes on the function of water demand management. However, relevant recommendations developed for governmental bodies as a result of the project activities have yet to be taken into account.

Water delivery management

Water can be supplied from transboundary, national, basin, or local sources or a combination of sources. But within the hydrographic boundaries water delivery management is normally coordinated by a single organisation to ensure that water in an acceptable/agreed quality and quantity is delivered to all users and the environment on time. Although centralised or combined systems can be difficult to manage, they can be more cost-efficient compared to autonomous ones.

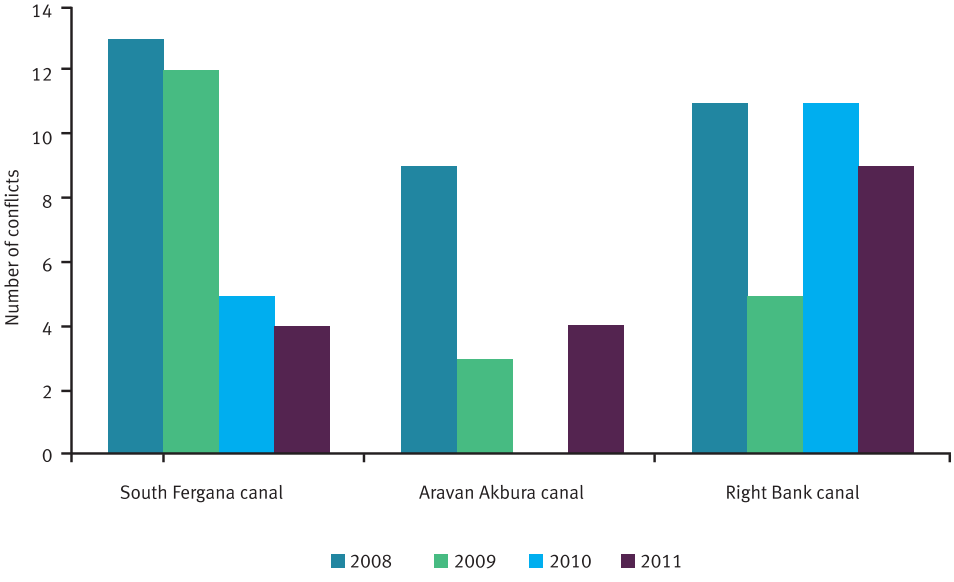
Based on past experiences of water delivery systems in the region, good water management includes:

- Annual, seasonal, monthly, ten-day, and daily planning that links together water requirements with the water delivery network capacity and the different water sources. This is based on the average long-term needs with the possibility of adjustment in accordance with the specifics of the year/season, including climatic and other features. Setting up ten-day (or weekly) and daily planning, and distribution of water at WUAs, as well as setting limits and control measures, are especially challenging.
- Water delivery systems differ substantially. For example, in rural communities (*mahalla* committees) water is distributed by *mirabs* according to each community's rules and established regulations. Another type of water delivery is the combination of a constant (weekly or ten-day) supply for first, second, and, sometimes, third order canals and a variable supply, which is dependent on daily operational schedules and the capacities of the distribution canals. In such a situation, water rotation is permanent and is often applied to canals of higher order, particularly in dry years/seasons. A municipal water supply, which should follow changes in daily and seasonal water requirements, is a completely different system. The mandatory element of such a network is the availability of balanced storage and the ability to control the operation of pumping units from wells or a centralised system.
- Setting up water accounting for end-users and throughout the entire water delivery chain. Flow measuring devices are needed in order to control water delivery schedules and enable adjustment when there are deviations from planned modes. Automated accounting systems for a water delivery network are most desirable. These can be in the form of SCADA (supervisory control and data acquisition) systems, or organised network operations based on needs with automated accounting only for end-users. In the absence of an automated system it is important to organise accounting systems that monitor the amount of water transferred from one level to another in the management system in order to ensure the stability of the water supply and the accuracy of water metering.
- Providing essential services, such as cleaning, repair, and maintenance, and keeping the entire delivery network infrastructure in good working condition. But this 'simple' engineering measure is not always implemented because of a lack of funds, machinery, or labour. At the WUA and farm level this problem is partially solved by involving the local population in the form of *khashar* or public works. But it is important for management to retain specialised works, such as cleaning and flushing drainage, repairing gates, and lifting facilities, as well as automation and accounting systems.

A significant outcome of improved consultation and stakeholder involvement along the pilot canals was the reduction in disputes as the struggle for water at the borders of administrative areas between the provinces and districts disappeared. Disputes emerged rapidly in the region following independence as land was privatised and redistributed in the early 1990s and large numbers of small land owners needed access to State-owned canals. Access was often only possible across the fields of neighbouring farmers. Disputes arose over delivery (volume and timing), overuse and alleged stealing. This was exacerbated by poorly maintained on-farm networks, which were previously repaired by government water organisations. The result was a deteriorating infrastructure, inefficient water use, poor agricultural outputs, and widespread animosity among the rural population.

The decrease in the number of conflicts and disputes along the pilot canals (Figure 13) as a result of project interventions was evident in the years of different water availability and was attributed to hydrographisation and public participation in decision-making. The WUA members are owners of the on-farm water processes and function as an effective dispute resolution organisation. They also ensure rapid dissemination of technical knowledge and have served as 'test-beds' for democratic decision-making and building social capital.

Figure 13. Conflicts and disputes in the pilot canals during the period 2008 to 2011



Water demand management

The goal of water demand management is to reach the potential or economically feasible level of water and land productivity based on a 'bottom-up' governance approach. Although the main area of demand management interventions was at the water users' level, there was a role for this at the national level. The key elements of demand management implemented included:

- Setting technically reasonable water use rates to correspond with modern water use practices and actual local conditions. The hydro-module zoning, which has been in use since the 1980s, was updated. Based on FAO's (1992) CROPWAT, new irrigation norms were generated in accordance with new hydro-module zoning (Figure 14). This takes into account the specific features of irrigated contours at the secondary canal and farm levels. Updating the irrigation rates based on the new zones reduced water delivery to the farms by between 25 and 30 percent when compared to the 'old' hydro-module zoning, and crop yields were slightly increased above the average for the province. The improved crop yield was the result of increased support from the extension service under the project's supervision, providing proper recommendations on appropriate crops, farming, irrigation, and soil fertility practices.

Figure 14. Updated hydro-module zoning for five districts in the Fergana province of Uzbekistan (The different colours show areas with different soil fertilities and levels of groundwater)

- Organising meteorological data services for water management departments, WUAs and farmers to provide ten-day and daily information on changing weather conditions and climatic parameters. This will assist in properly assessing evapotranspiration for a given locality and making decisions about times for and rates of irrigation. Unfortunately, the project only installed two automatic meteorological stations because of limited finances.
- Introducing advanced methods for the real-time scheduling of water distribution among off-takes to irrigation contours. This was done to achieve stability in water distribution from the main canal to the WUAs' irrigation networks and reduce operational losses. The practical application of daily water distribution planning at the WUA level enabled water losses to be reduced by between 7 and 10 percent by reducing the mismatch between water delivery and distribution (Table 4).

Table 4. Reductions achieved in water losses by using daily water distribution plans for WUAs (WUA 'Akbarabad' case study, Uzbekistan)

Indicator	2007	2008	2009	2010
Water losses along distribution canal RP-1 in WUA 'Akbarabad' before project interventions (distribution based on ten-day scheduling)	31% of total intake			
Water losses after implementation of daily scheduling	21%	21%	21%	23%

- Introducing a computer-based daily water distribution model, including geographic information systems elements, at the WUA level. This model improved decision-making when conditions changed around the irrigation contours (water availability, weather parameters). It enabled timely corrections[4] to water distribution schedules along WUA off-takes. The model was tested in the WUA 'Akbarabad', and showed that the WUA operator quickly learned how to use the model to good effect. By 2012, daily water distribution

schedules were being adopted and used in practice on an area of about 100,000 hectares within WUA irrigated contours across the Fergana Valley.

- Install water measuring devices for all water users (Figure 15). Initially, many gauging points were built and calibrated in the WUAs at key points along the irrigation network. Gauging devices were then built at users' off-takes with users taking part in their construction. The activity included training for the construction and operation of water measuring facilities in order to extend water metering to the lowest level of the water hierarchy. Part of the costs of the installations was carried by the users. The project also developed and disseminated special registers of 'request-delivery' for water volumes from the canal management organisation to the WUA and from the WUA to the water users to fix agreed water volumes.

Figure 15. Construction of water metering devices at the WUA level, Kyrgyzstan

- Cultivating a common interest in saving water among the water users. To achieve this, farmers were integrated into the water users' communities, such as *mahalla*, urban neighbourhoods, WUAs, and unions of farmers along the canal. Group members elected a leader who organised water distribution and water amounts, according to specific field and crop conditions.
- Adopting up-to-date irrigation management practices to improve soil moisture uniformity and reduce unproductive losses at the field level. This increased water productivity from 47–53 percent to 70 percent in an area of more than 100,000 hectares.
- Developing knowledge transfer and extension services to WUAs and farmers. These were directed at making the most efficient and sustainable use of resources in irrigated agriculture.

To ensure wider dissemination of the knowledge gained from project implementation, a system was set up to assess needs, develop new technologies, and translate knowledge using language acceptable to farmers. This was established in the period 2008 to 2011 as part of the Water Productivity Improvement project. The system included four key actors: (i) research institutions (knowledge generators); (ii) information centres; (iii) information and knowledge

[4] The primary base for the daily water distribution plan is the seasonal water use plan, with the water delivery limits set in accordance with a deficit of water level for a given vegetation period. If a change in water availability in the main source is expected for the coming ten-day period, the canal management organisation informs the WUA in advance, and, in turn, the WUA corrects the daily water distribution schedule for the coming ten-day period.

disseminators (extension service); and (iv) farmers (knowledge implementers). The main task was to ensure information and knowledge flowed to and from farmers in a continual and user-friendly way.

Figure 16. Farmers' field school in the Tajik part of the Fergana Valley

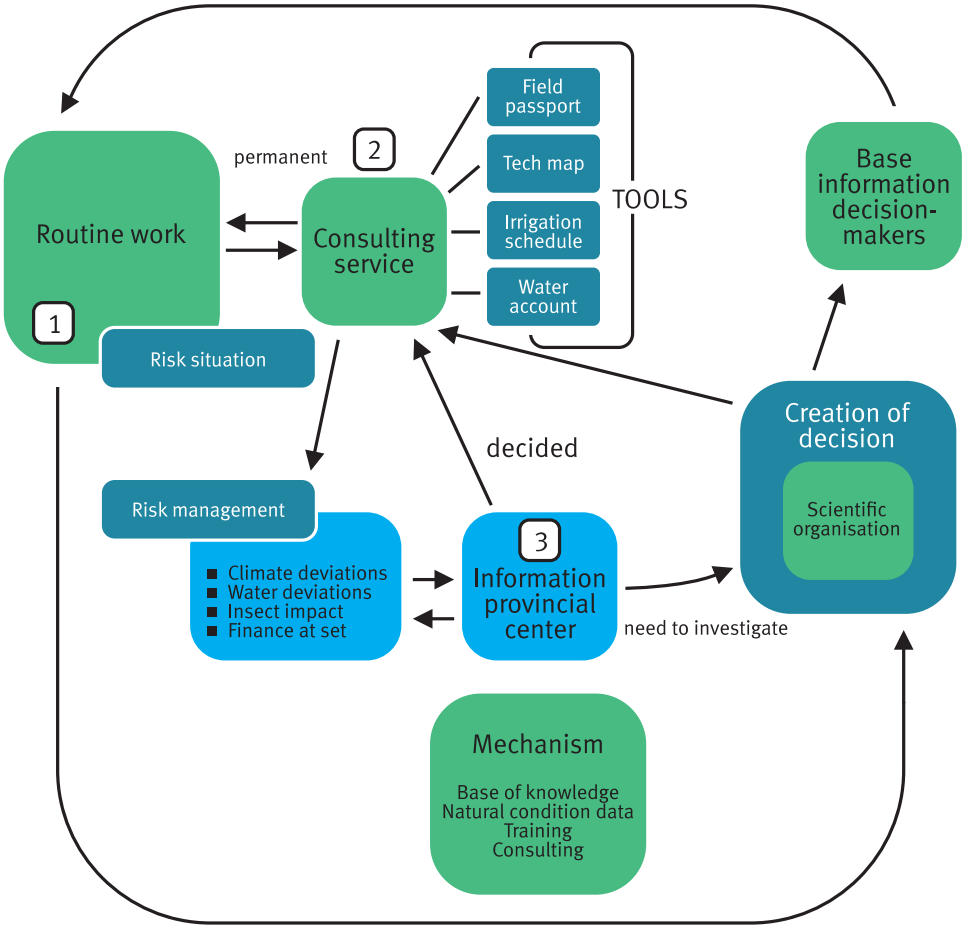
Figure 17. Workshop in Fergana on water and gender

The project established information centres in water management organisations with skilled and experienced staff. A system for the effective communication of new ideas and approaches to farmers was developed using knowledge disseminators (extension service specialists), who included researchers from local universities. Information centres provided knowledge disseminators with materials, provided locations for conducting workshops, and, in coordination with research institutions, prepared templates for documentation. They also helped to find the most appropriate ways to transfer new approaches and skills to farmers.

The various interactions among the key IWRM system partners within the extension service are illustrated in Figure 18. Information from the provincial centre is prepared based on recommendations from research centres and universities and adapted to local conditions. The information from the research institutions is based on analysing farmers' requirements and undertaking research to find appropriate solutions.

Information centres also ensured feedback from the agricultural production level to public agencies at the provincial and national levels by summarising the effectiveness of various activities and detailing the shortcomings which constrain the achievement of planned targets and the preparation of proposals for decision-makers. This has led to an increased understanding of grassroots' problems at the provincial and national levels and improved understanding of IWRM. The outcome of this feedback has been a number of revised State regulations and even revision of the law on water use.

Figure 18. Interactions among key IWRM system partners within the extension service



Environmental requirements and climate adaptation measures

The need to maintain environmental equilibrium, in which water plays a crucial role, is widely accepted, but practical implementation is slow and needs to be taken more seriously.

In the project pilot zones, the main goal for nature conservation was to control water protection zones along water delivery networks and hydro-structures. Provincial hydrogeological reclamation expeditions, which are included in the water management institutional structure, have responsibility for controlling the reclamation of irrigated lands and preventing degradation.

3.2.2 Good water governance

Good governance is essential for the effective implementation of IWRM. Water governance sets the rules of the game (both formal and informal), establishes institutions, and engages stakeholders in water-related decision-making in a transparent, inclusive, equitable, coherent, and integrative way. Governance arrangements differ across countries and even across vertical hierarchies within a country. In Central Asia, the water sector reforms took into account those local specificities. Water governance includes the following elements:

- policy and planning
- legal and institutional frameworks
- financial incentives
- stakeholder engagement
- water ethics.

These elements of good governance, as related to IWRM implementation in Central Asia, are described in more detail in Table 5.

Table 5. Readiness of Central Asian countries to adopt IWRM principles via good governance

Actions to achieve good governance	Central Asian countries				
	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
IWRM recognition in national legislation	accepted	accepted	accepted	no information	accepted
Recognition of hydrographisation	accepted	accepted	accepted	no information	accepted
Completion of hydrographisation	100%	100%	no information	no information	70%
Recognition of the public participation	accepted	accepted	accepted	no information	accepted
Public involvement	formal	formal	formal	no information	formal
Recognition of water committees	accepted	accepted	accepted	no information	accepted
Operation of water committees	formal	formal	formal	no information	formal
Effective financial mechanisms	no information	no information	no information	no information	no information
Encouragement of water saving	no information	weak	no information	no information	weak
Law on water users associations	accepted	accepted	accepted	no information	no information
Completion of WUA establishment process	accepted	accepted	no information	no information	accepted

Long-term planning and strategy development

Since independence, numerous exercises have been undertaken to introduce long-term planning (Dukhovny and de Schutter, 2011). However, disagreement among the countries has prevented development of long-term planning options.

The 'Regional Strategy of Water Resources Development and Use', developed in 1998 by five national working groups under the umbrella of the Executive Committee of the International Fund for Saving the Aral Sea (IFAS), was specifically authorised to develop a long-term strategy. However, this was not implemented because it did not contain any specific long-term quantitative and qualitative indicators. This is similar to the events in 1994 when the 'Concept of Socio-economic and Environmental Development in the Aral Sea Basin' was approved by the Central Asian governments, but not implemented.

The lessons learned show it is necessary to elaborate a regional strategy with more clear and tangible indicators for implementation. Such a strategy would include:

- indicators of water withdrawals from surface, ground, and return water sources for each country and each zone for five-year periods
- parameters of flow regulation of main reservoirs and, accordingly, monthly releases
- the range of possible changes in the basic parameters especially for dry years
- water conservation goals in each country for five-year periods
- joint actions on climate change adaptation, including extreme events and risk management
- requirements for sanitary and environmental flows
- the role of IWRM in achieving these targets.

Improving legal and institutional frameworks

The legal framework is a set of documents, such as codes, laws, and regulations that define the rules and procedures. Implementing enacted laws and regulations depends on a well-functioning institutional system with a clear understanding of legal prescriptions and an effective apparatus for law administration and enforcement. Hence, it is important to have good laws on IWRM, but it is even more important to work on their implementation.

In Central Asia, countries have taken different approaches, but they are committed to pursuing institutional and legal reforms based on IWRM principles. Most prominent are the new water laws – Water Code of Tajikistan in 2000, Water Code of Kazakhstan in 2003, Code on Water of Turkmenistan in 2004, and Water Code of Kyrgyzstan in 2005. In Uzbekistan the 1993 Law on Water and Water Use was updated in 2009 with elements of IWRM. Among these water codes, those of Kazakhstan, Kyrgyzstan, and Uzbekistan are the most progressive.

Kazakhstan The 2003 Water Code includes provisions related to basin water management and the establishment of a basin council as an advisory body that involves all stakeholders. It introduces a new concept of environmental flows with a view to achieving a balance between ecosystem sustainability and the competitive demand for water. The National IWRM and Water Efficiency Plan for 2009–2025, which outlines a set of legal, financial, institutional, and technical measures to enable favourable conditions for IWRM implementation, was prepared and completed in 2009. On the basis of that, the Global Water Partnership (GWP) was supporting the process, and in 2014 the State programme of water management was approved by the government.

Kyrgyzstan The 2005 Water Code also takes the principles of IWRM seriously. It introduces basin water management, transfers decision-making power to the lowest appropriate levels through the establishment of WUAs, improves provisions for drinking water, dam safety, and environmental protection, and spells out the economic value of water resources. However, implementation challenges are significant. Most importantly, the Code has yet to be put into practice because of financial, institutional, and human resources constraints. Experts agree that the 2005 Water Code needs to be revised and strengthened by more specific regulations as well as financial and human capacities in order to play a prominent role in enabling a more favourable environment for IWRM implementation.

Tajikistan Legal and institutional reforms to enable IWRM implementation are under preparation. In 2011 the government approved the principles for water sector reforms aimed at establishing:

- basin water management (as a replacement for water management within administrative units)
- a single coordinating body for national water management
- water operation control through relevant agencies
- water users' participation in water management at the highest appropriate level
- water management by four river basin organisations.

In practice, the institutional revision of water management began in November 2013 when the Ministry of Energy and Industry was transformed into the Ministry of Energy and Water Resources and the Land Reclamation and Irrigation Agency was established.

Turkmenistan A considerable number of steps have been undertaken to reformulate the existing legislative and regulatory frameworks on water and environmental governance. Thus, the 2004 Water Code outlines the main rules for water resources management and conservation, sets the boundaries of jurisdiction, and defines the responsibilities of the main public authorities for water management. It foresees the establishment of water zones to protect waters from pollution, obliges water users to use water rationally, and requires the Ministry of Water Economy to design general and basin schemes for the integrated use and protection of water resources. The 2010 Law on Drinking Water seeks to improve the population's access to safe drinking water, although water quality monitoring is rather scattered, uncoordinated, and geared towards specific sector interests. Currently, the inter-ministerial expert group established within the National Policy Dialogue is developing a new water law to advance IWRM implementation.

Uzbekistan The existing legal instruments in Uzbekistan provide for the transition to basin water management and the rational use of water for the needs of the population and the economy. Further improvements in water and land use, through better drainage and an increase in the efficiency of the agricultural water supply by modernising irrigation, are envisaged. After a long debate, the 1993 Law on Water and Water Use, the key piece of water legislation, was amended in 2009 to include provisions for the establishment and operation of WUAs. Currently, the Ministry of Agriculture and Water Management, in cooperation with UNDP, is drafting a new water code that seeks to incorporate the main principles of IWRM to address current and future water-related challenges.

In summary, the Central Asian countries are gradually introducing IWRM principles into their legal frameworks. Because of financial, technical, and human resources constraints, the countries are also experiencing difficulties in putting their laws and policies into practice and ensuring that these instruments are effectively enforced and monitored. The biggest challenge is to ensure that secondary legislation is available and coherent. Currently there are situations in

all countries where regulations and bylaws are either absent or impose contradictory requirements. For example, there are mismatches in the provisions of some legal and regulatory documents that deal with the establishment of WUAs and their operation in Uzbekistan. According to the Law on Water and Water Use, WUAs were to be established as non-governmental organisations that are accorded favourable tax treatment. But tax police struggle to reconcile the provision of services by WUAs (generally treated as a commercial activity) with their not-for-profit status and in some cases refuse to exempt WUAs from the duty to pay certain taxes. Therefore, even though there is progress in the formal acceptance and practical implementation of IWRM in Central Asia, the legal and institutional framework needs to be further strengthened and improved.

Financial and economic mechanisms

One of the most important factors of IWRM sustainability is the development of financial and economic mechanisms for water management. For example, it is essential that water management organisations, WUAs, and water users remain financially feasible. For the stable operation of the entire water infrastructure it is important that the government and water users cover not only current costs, but also depreciation and modernisation costs. Salaries of most water managers are significantly lower than specialists in other sectors such as energy and communications. The level of water funding is now only 60 to 70 percent of the 1990 level. Without proper financing the water sector cannot sustain its operation and maintenance responsibilities, renew infrastructure, and implement risk mitigation actions. Key measures to ensure the financial sustainability of IWRM institutions include:

- introducing a volumetric method of payment for water delivery services and water as a resource
- differentiated payments depending on the nature of water use; e.g. for irrigated agriculture – at least 5 percent of farm net profit
- introducing the 'polluter pays' principle
- water saving fully covered by the user; social justice is achieved through cross-subsidisation
- introducing premium incentives for water saving by water users and water management organisations and penalties for overuse, as well as preventing a budget decrease in dry years
- penalties for violating environmental flows and observance of regulations should follow the rules of payment for environmental services.

Stakeholder engagement and water ethics

The greater involvement of various actors can ensure that water governance processes and their outcomes are more open, inclusive, and effective. Public participation can change poor administrative procedures, such as when water demand is managed according to the interests within certain administrative boundaries or to sector interests. Stakeholder involvement can ensure that the principles of equity, equality, and stability in water delivery and use are respected in practice.

The lessons learned so far show that, for effective public and stakeholder engagement, it is most beneficial to establish participatory water institutions, increase understanding and support from water management organisations and water users to sustain these institutions, raise public awareness, and promote local leadership and ownership.
There were attempts to create National Water Councils as platforms for coordinating the activities of different ministries, agencies, and other organisations on water issues at the

national level. But ensuring that all stakeholders are truly represented and that the councils operate on a regular basis is not an easy task. For example, the National Water Council in Kyrgyzstan (established in 2003) stopped functioning in 2009 and only resumed operating in February 2013.

The Water Codes in Kazakhstan and Kyrgyzstan provide regulations for the establishment of the basin councils – advisory bodies that involve all stakeholders – to facilitate participatory water management and better coordination among agencies dealing with water. In Kazakhstan, several basin councils were established during the period 2005 to 2008 and it is reported that some of them operated effectively. In Kyrgyzstan, only two basin councils – for the Talas River and Kugart River Basins – were formally established, but they are still not functioning regularly. Some progress was made within the National Policy Dialogue in establishing the Chu River Basin council, with its first meeting conducted in February 2013.

Participatory water management at the lowest level was largely introduced by establishing WUAs. Relevant laws were enacted in Kyrgyzstan, Tajikistan, and Kazakhstan (for the establishment of cooperatives of rural consumers of water). After a long debate, the 1993 Water Code of Uzbekistan was also amended in 2009 to include provisions for establishing and operating WUAs. But a great deal needs to be done to ensure that water users and their associations are equal partners in the water management landscape, both in law and in action. Not all WUAs were established according to hydrographical boundaries and so their sustainable financial operation needs to be ensured through proper supporting measures and enabling regulations.

The IWRM-Fergana project also introduced new forms of stakeholder participation and integration at the main canal level. Canal water users' unions were formed, while canal administrations brought together water supplier organisations along the main canals. To integrate water suppliers and agricultural water users, governing boards were established for canal water committees (CWCs). In order to integrate all key stakeholders in the area of the main canal, such as water operators, users, local authorities, environmentalists, water suppliers, energy generators, and NGOs, the Council of Canal Water Committees was formed. The IWRM-Fergana project also initiated the integration of stakeholders in water demand management to improve water and land productivity through the formation of a Water and Land Commission at the district level.

Putting these new water governance arrangements into practice at various levels has produced many challenges. Even WUAs, which were established as non-governmental organisations and presumably have to serve their members' interests, experienced difficulties in doing so. Sometimes this was a consequence of the establishment being initiated through 'top-down' approaches and water users and WUA staff not being prepared to operate under the new conditions. It is important to select a good manager for a WUA, based on the opinions of 'elders' (respected leaders of rural communities), local *mirabs*, and the majority of WUA members. Special units within water management organisations to support WUA operation are needed, but so far these units only operate in Kyrgyzstan.

The IWRM-Fergana project was successful in establishing and strengthening WUAs because of its extensive social mobilisation activities. By monitoring WUA members' attitudes and engagement, social mobilisers acted to solve problems that caused dissatisfaction. They increased the degree of democracy, and gradually reached a stage where water users felt ownership for WUA operations. The role of social mobilisers, who trace the changes and emerging risks and help communities to adjust to new circumstances, has gained even more

importance in the light of a constantly changing natural, hydrological, and economic environment in Central Asia. Social mobilisers, together with extension services, provided the lead in managing risks by accumulating knowledge and skills on water, farming, and reclamation, and transferring them to end-users.

Experience to date suggests that active public participation provides a mechanism for integration, such as constant coordination of water management participants and water users, ensuring unity of action, and continuous coordination of efforts and measures. The mechanisms adopted included:

- weekly meetings of members of CWCs
- daily monitoring of the WUAs and their acceptance of water by the canal water committee chairman together with the canal chief of water distribution
- joint monitoring of water used by CWCs and the WUA management
- monthly real-time discussions with *mirabs*, mobilisers, management, and staff of the CWCs on the performance of the WUA and water management organisations using the financial and water use indicators
- regular training conducted by the project management together with basin irrigation system administrations and stakeholders.

Finally, all stakeholders, including water professionals and the public, must together generate the spirit and behavioural model for water ethics, the roots of which date back to the best canons of the traditional and religious sanctity of water in oriental customs. Stakeholder collaboration both develops and depends on common values and attitudes. The governance dimension of IWRM needs to ensure that water is governed in a way that serves the society and not just individuals or vested interests. Water, after all, is a public resource and belongs to everyone.

4 Developing capacity

4.1 Requirements for effective capacity development

IWRM is a multi-level and multi-faceted system which depends for its successful implementation on the available capacity for both water management and governance. Capacity has five dimensions: individuals (knowledge, skills, and attitudes), organisations (management functions, operational capacity, and human, financial, and information resources), the enabling environment (political, legal, and economic frameworks and budget incentives), partnerships (between distinct organisations and in a broader context) and communities (local communities, communities of practice, professional associations and networks, multi-stakeholder platforms, online groups, and other forms of knowledge sharing) (Lincklaen Arriens and Wehn de Montalvo, 2013).

Capacity development in this broad sense is about putting IWRM into practice by regional and national water management organisations and their international partners. But much more needs to be done to further increase capacity, especially in such areas as human resources development; improving computerisation, communication, and access to information systems; social mobilisation and transparency of information; building scientific and technical capacity to improve water use and management systems; and knowledge and innovation sharing practices and partnerships.

Human resources development

Currently, the total water management sector staff in Central Asia, excluding WUAs, is about 70,000. Annually the sector needs to recruit about 2,000 young professionals plus another 1,500 are required to service WUAs. The educational institutions and universities can produce these numbers, but the problem is that only 10 to 15 percent of those trained come to the sector; the rest search for more profitable jobs elsewhere. Employment in the water sector is not considered to be either prestigious or well-paid. To attract professionals, this has to change. The salaries of operational staff need to be increased so they are at least 20 to 30 percent higher than the national average for similar professionals.

The water sector is also facing an ageing labour force. Given that the water sector is attracting insufficient graduates and the existing highly skilled professionals are reaching retirement age, the potential loss of institutional knowledge is considerable. Furthermore, modern approaches to water management are not always easily accepted by older personnel, who require continuous training and knowledge exchange. Basic education is important, but contemporary challenges require water professionals and organisations to be adaptable to constantly changing circumstances. This in turn demands flexibility and adaptability within the professional development organisations. According to some estimates, professional development training is required at intervals of 7 to 10 years for 1,500 engineers annually in Uzbekistan alone. Taking into account the WUAs' requirements could double this number. Significant additional investment in skills and recruitment is, therefore, required to refresh and build the workforce for the future.

A continuing process of IWRM capacity development is required to meet the training needs of the region with a total 5,000 specialists a year. SIC ICWC's experience in this area suggests some important lessons for producing this capacity:

- Professional development organisations need to be demand-driven. Experience shows that training needs may differ even within the same target groups in different countries or regions within a country.
- IWRM capacity development needs to deal with all levels of the water hierarchy and be institutionally secured through the establishment of training centres and extension services. This was the main reason in 2010 for establishing the regional training centre, SIC ICWC, to provide top and middle level water professionals. This was followed by several national training units within the umbrellas of national water agencies in Kazakhstan (Almaty), Kyrgyzstan (Bishkek and Osh), Tajikistan (Hodjent), and Uzbekistan (Urgench, Andijan, Fergana, and Akbarabad). Some progress was made in establishing knowledge centres and extension services for farmers and in initiating special programmes for rural women within regional projects.
- Teaching materials need to be systematised and tested. SIC ICWC, with support from UNESCO-IHE, has developed educational materials (curricula) for four training blocks: (i) Integrated water resources management , (ii) Improvement of irrigated agriculture, (iii) International water law and policy, and (iv) Regional cooperation on transboundary rivers. Water professionals worked in partnership with educational institutions to ensure that all materials were well prepared in terms of content and methodology.

Improving computerisation, communication, and access to information

Developing capacity in the water sector includes establishing user-friendly databases (regional, national, basin, and local), knowledge bases (curricula, guidelines, and other practical and

informational materials), analytical tools, and models. Progress in this direction was made by establishing a regional information system and portal. This work was undertaken by the region's national water authorities, basin water organisations (BWOs) 'Amudarya' and 'Syrdarya' under the coordination of SIC ICWC, and with financial support from SDC. The CAWater-Info Portal (www.cawater-info.net) embraces large volumes of information including a knowledge base and regional information system. The main purpose of the information system is to build up a single system for accounting for the land and water resources in the Aral Sea Basin with the possibility of assessing the effectiveness of their use and to make forecasts. Thus, this system enables regular assessment of water use efficiency and allows managers to detect unproductive losses. Computer technologies and decision support systems are not widely used in the region, especially at the basin and local levels. Even the central apparatus of national water authorities could benefit from a more advanced use of modern tools such as geographic information systems (GIS), remote sensing, and analytical models. More work needs to be done to establish and improve communicative, informative, and analytical tools at the local, basin, and national levels.

Social mobilisation and transparency of information

To strengthen the capacity of the water sector, a system of social mobilisation and dissemination of water-related information needs to be established. This system would increase transparency in decision-making for water and ease the acceptance of innovations by key stakeholders and the public. Through social mobilisation, key stakeholders and the public can organise themselves to work collectively in newly established bodies, such as WUAs or basin councils, to produce their own development plans and strategies rather than them being imposed from outside. Through information dissemination, water management organisations can be alerted to new challenges, suggest measures to address those challenges, and encourage better water management practices. Hence, specialist personnel are needed who can deal with social mobilisation in water management organisations at the basin and sub-basin levels.

Building scientific and technical capacity to improve water use and management

IWRM requires the integration of science and industry in the quest for more advanced technologies and locally tested and adapted solutions. It is necessary to enhance linkages between training, applied research, and best practices in the region and worldwide through study tours, invited international lectures, joint regional and international training, and drawing lessons from projects to promote advanced and locally adapted experiences. Capacity development needs to be informed by research-based and field-tested evidence.
The IWRM-Fergana project provides the best example of such comprehensive and research-driven work where capacity in IWRM was built through social mobilisation, training for different target groups (farmers, WUAs, and main canals organisations), field research, and the strengthening of institutional and legal frameworks.

This task also requires that research institutions, universities, academia, and the entire scientific community be constantly involved in the IWRM implementation process; and in parallel build their own capacity on IWRM through interactions with practitioners. Development of drought-resistant crop varieties, assessment of water, agriculturally related risk management, and the impact of a non-sustainable water sector on agricultural development should receive particular attention.

Knowledge and innovation sharing practices and partnerships

Finally, it is crucially important that the various water organisations – national and regional water institutions, educational and academic institutions, development agencies, and international organisations – work in partnership in order to create learning opportunities and assist with the generation and acquisition of new knowledge, skills, and attitudes. A broad range of knowledge and innovation sharing platforms needs to be available and promoted.

Capacity development and education can also promote and create conditions for communication and interactive dialogue among representatives of the Central Asian republics in order to foster peaceful cooperation on transboundary waters and gain consensus on water issues. Joint regional projects and training seminars provide excellent opportunities for informal communication and mutual learning. Countries also need to invest in future water leaders by supporting young water specialists to complete MSc and PhD programmes on IWRM abroad. A number of young professionals have already completed their education at universities in Germany (LUCA and ClinCa projects), the Netherlands (UNESCO-IHE), the UK (University of Dundee), and other countries. Unfortunately, local universities in the region are not yet ready to meet those needs, but some steps to enforce them have already been taken (see: http://en.dku.kz/index.php?title=Main_Page#Interdisciplinary_Master.27s_program).

The Central Asian experience shows that IWRM capacity development is a slow process that needs to be driven by local demand and have sustained support. This requires long-term commitment and strong leadership, which can be a catalyst for change. Today it is recognised that leadership can be exercised by individuals at all levels (Lincklaen Arriens and Wehn de Montalvo, 2013). The region must do its best to fully engage the biggest resource in the region – its human capital.

The GWP CACENA (Caucasus and Central Asia) network, with the inclusion of CapNet-UNDP (the international network for capacity development in IWRM) contributions, is playing a very effective role in disseminating IWRM knowledge in the region.

4.2 Drivers for IWRM sustainability

Water resources management cannot be locked in the frame of the narrow organisational, managerial, and economic aspects of water management and irrigated agriculture. Water resources determine, or at least affect, the way in which political, economic, societal, and natural systems function. The reverse is also true: these systems enable favourable conditions for good water management. Water managers and decision-makers need to consider these inter-linkages and reciprocal influences and how they impinge on water resources management.

The success and sustainability of IWRM depends on the complex dynamics of internal and external forces (Figure 19).

4.2.1 Destabilising forces

Demography and migration

The average annual population growth rate in Central Asia is between 1.2 and 2 percent despite the fact that a significant part of the population lives in rural areas (except for Kazakhstan), and

of this rural population a significant portion – more than 4 million people – are temporary labour migrants. Such indicators in rural areas create pressure on the whole social situation and on water in particular. Water demand increases because of greater municipal needs, and also because of the desire of rural inhabitants to maintain a share of irrigated lands. There are land resources available, but water is the limiting factor.

Climate change

Climate change has two implications – water requirements will increase because of the anticipated increase in temperature, and water availability will decrease in the long run as a consequence of glacier retreat.

Urbanisation

Rural populations are continually moving to cities and this can lead to reductions in the areas under irrigation as cities grow in size.

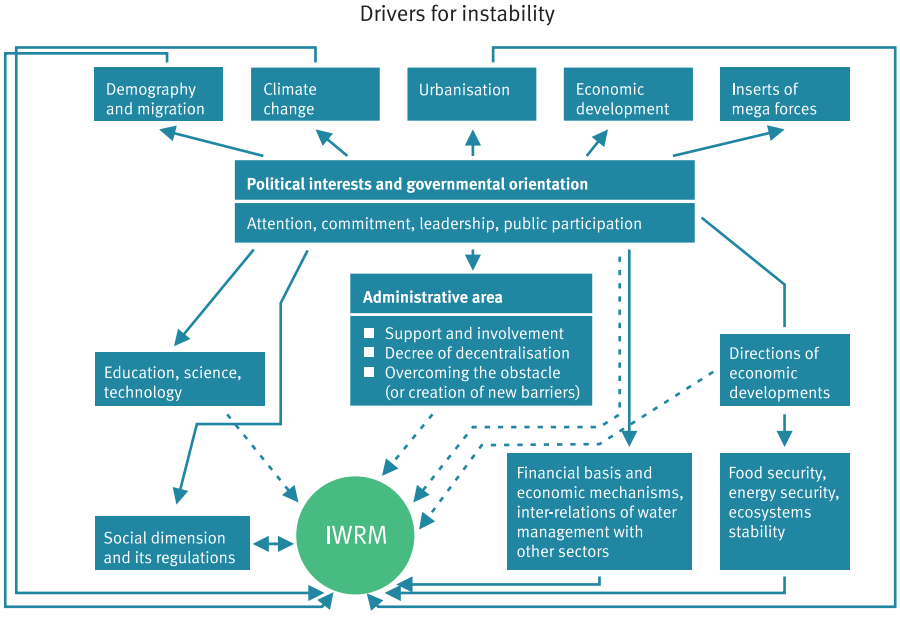
Economic growth

The need for economic growth is understandable. It ensures employment and the well-being of people and nations, but it needs to be achieved in a sustainable manner.

Vested interests

Vested interests play an increasing role in Central Asia, taking solutions to regional issues out of the region (e.g. Naryn hydropower cascade).

Figure 19. External factors that influence IWRM



4.2.2 Stabilising forces

The main stabilising forces include the responsible attitudes of national governments and local administrations, balanced economic growth, improved financial and economic mechanisms for the water and agricultural sectors, a good social environment, and scientific, educational, and technological capacity.

Politics and governments

The political set and governments face the urgent need to appreciate future water challenges and develop appropriate national strategies for the benefit of people and nature, taking into account the interests of riparian countries. Transboundary resources have to be seen not as a limiting factor, but as a stimulus for regional cooperation. Adherence to cooperation rather than the idea of absolute sovereignty needs to prevail. This is especially important for Central Asian countries that are closely interconnected through physical infrastructure, such as waterways, roads, and transmission lines, as well as having a common history, cultural roots, and traditions. Governments will need to take the lead in supporting the water sector and irrigated agriculture and ensuring that everyone has equitable and stable access to water without compromising the needs of ecosystems. They have to ensure that water resources are managed for the public interest and not for the vested interests of individual groups or corporations.

Administrative authorities

Administrative authorities will need to ensure that water policies and strategies are implemented through a range of mechanisms, including increased decentralisation and support. Existing bureaucratic barriers and the reallocation of funds from the water sector to other areas will need to be eliminated. It is especially unacceptable to divert capital investments targeted for water, land reclamation, and reconstruction. It is necessary to establish a regime of shared responsibility for effective water management. It is extremely important that local authorities increase their roles and positive influences in coordinating the diverse interests in agricultural production (including banks, input suppliers, and tax authorities) and work together on land and water productivity or, in other words, to gain 'more crop per drop'. This work can succeed only if all involved understand their roles and responsibilities.

Economic development

Economic development will be informed by the long-term assessment of water and land resources. Equally, the water sector has to adapt to new directions and the redistribution of productive forces. An example from Karakalpakstan, located in the lower reaches of the Amudarya River, illustrates the need for flexibility and adjustment to new conditions and circumstances. In dry years, such as 2001 and 2008, water supply below the Takhiatash hydro facility dropped to between 35 and 50 percent of the normal supply. This was primarily a result of the poor flow regulating capacity on the river, large channel losses, and poor operation of the upper reservoirs for hydropower production. In such circumstances, the districts of Karakalpakstan could not reliably receive even 50 percent of their water because water distribution networks constructed in the Soviet era had severe leakages and required significant water flow just to fill the canal reaches. Proposals to change the old policy of water distribution and to shift to smaller water limits for provinces (within 5 to 6 km^3), review crop patterns, prioritise water allocation for the most densely populated areas, and refocus the sparsely populated northern areas on grazing, have not yet been accepted.

Moreover, countries must develop national plans for the long-term development and reconstruction of irrigated agriculture with a view to achieving food and energy security. From this perspective, crop planning on irrigated lands in each basin is an optimisation problem that can easily be solved if there are reliable data on current and future trends of certain types of agricultural products. In particular, water saved can be an alternative to developing new water resources or constructing more reservoirs. The IWRM-Fergana project experience demonstrates that institutional and cognitive solutions can save water at a cost of as little as US$ 0.1/m^3; significantly cheaper than solutions involving building more infrastructure.

Improved financial and economic mechanisms for water and agricultural sectors

Such mechanisms are still to be developed in Central Asian countries, but they can encourage farmers and others to make better use of available water resources. The introduction of financial and economic measures requires tight discipline and monitoring by banks, local authorities, water management organisations, and water users.

The social environment

This predetermines employment and poverty levels as well as access to drinking and municipal water supplies. Local communities, involving both men and women, can help ensure that IWRM organisational structures fit within locally established traditions and are accepted. Only in close cooperation with local communities can newly established participatory management bodies, such as WUAs and canal councils, receive true recognition and acceptance. It is important to pay due regard to clan, traditional, and community spirits as well as the unquestionable authority of elders, which can influence institutional settings and responses. Hence, regular public opinion surveys are essential both for community organisations and water management authorities at all levels.

Scientific, educational, and technological capacity

These are key capacities for integrating academic knowledge and practice through training, and adapting knowledge and experience to local needs and advancing innovations. The initial concept of IWRM implementation in the Fergana Valley was, in fact, developed with the involvement of research organisations and academia. In the stakeholders' meetings during project implementation, local provincial universities were involved. These institutions also recommended water and land productivity improvement techniques that had been tested and adapted to local conditions.

4.2.3 How can IWRM impact beyond water management?

Raising awareness about IWRM

IWRM, as a result-oriented approach, can bring many social, economic, and environmental benefits to a region. So, raising awareness is especially important at the beginning of IWRM implementation. A range of seminars with local, national, regional, and international partners helped to establish an initial understanding of IWRM in Central Asia.

Continuous collection of information and assessment

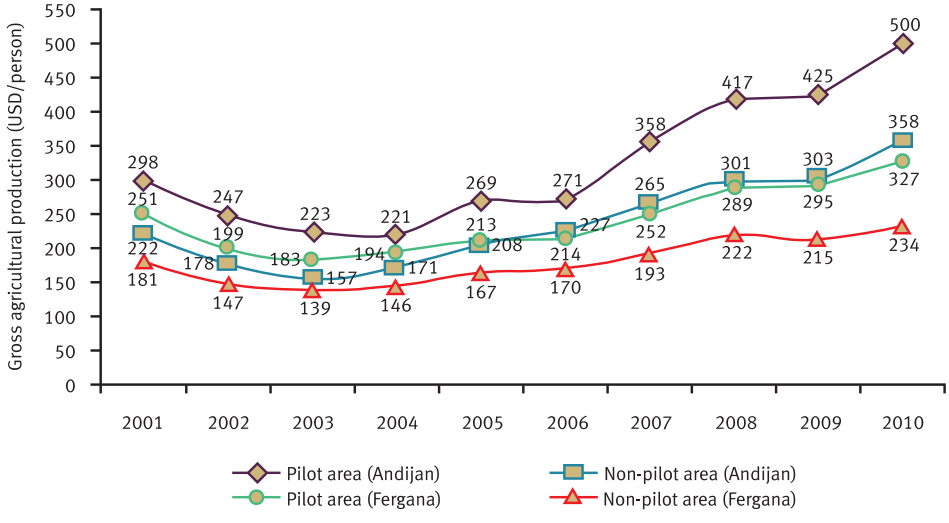
Efforts were made to accumulate information beyond the immediate water sector by using the Central Asian Regional Information Base and Portal (www.cawater-info.net). This enabled decision-makers and key stakeholders to access information, monitor major trends and changes in political and administrative arrangements, and to share and learn from international and local experiences and 'best practices'. Unfortunately, because of a lack of funding this system is no longer freely accessible.

Conducting workshops, dialogues, seminars, and discussions

These were conducted at various levels with actors outside the 'water box'. National coordination groups with representatives of key national ministries and agencies were formed in which IWRM issues were discussed in the broader context of national development. In Uzbekistan, for example, the Cabinet of Ministers actively participated in the activities of these groups. Special training on IWRM for representatives of all sectors is also important. In the Fergana Valley more than 16,000 people have been trained on the principles and mechanisms of IWRM in the last 5 years. IWRM-related information and knowledge dissemination was expanded well beyond the project areas.

Understanding the 'bottom-up' push and endeavours to expand the impact of IWRM helped to cultivate the process and achieve tangible results well beyond the boundaries of the immediate intervention. This was proven in the Fergana Valley when achievements in the pilot zones were compared with the overall performance in the provinces. Overall growth of productivity in the provinces lagged behind the pilot zones yet displayed similar positive patterns (Figure 20).

Figure 20. Comparative evaluation of changes in gross agricultural output value per capita in the pilot areas and outside the pilot areas in the Andijan and Fergana provinces



These comparative assessments are instrumental in demonstrating the impact of IWRM for stakeholders and decision-makers. Although decision-makers are not easily convinced they nonetheless can contribute to creating a critical mass of driving forces for change.

5 Transboundary dimensions

The nexus thinking and IWRM principles are aligned, both advocating for cross-sector integration and coordination. It is particularly useful to harvest the opportunities of coordinated and integrated actions between water, energy, food, and ecosystems from local to transboundary levels. However, establishing a sound IWRM approach across multiple levels and at the interstate basin level is the most difficult task. At the national level, IWRM direction is more or less straightforward and for all its complexity it is aimed at improving the efficiency of water use and the associated natural, social, and economic resources. Largely based on this, it is possible to assess whether or not IWRM achieves its goals and objectives. It is also easier to get political support for IWRM implementation within a single country. With political support, cross-linkages and coordination become a daily task for professionals and practitioners from various sectors as well as the main responsibility of a coordinating body. Therefore, the nexus approach built on IWRM can be achieved at the national level.

But it is quite another matter to deal with the transboundary nexus, where the divergent sector interests of two or more riparian countries have to be accommodated. GWP suggests that establishing basin organisations can provide a mechanism to overcome barriers in water allocation and water use and bring about change. However, experience of the Aral Sea Basin shows that this is not the only criterion. Political will, for example, is essential if change is to occur.

Immediately after the collapse of the Soviet Union, Central Asian countries established the Interstate Commission for Water Coordination (ICWC) with executive bodies – BWO Amudarya, BWO Syrdarya, the Secretariat, and SIC ICWC – to coordinate and strengthen cooperation in jointly managing transboundary water resources in the Aral Sea Basin. The agreements of 1992, 1993, 1994, and the 1995 Nukus Declaration, signed by the Heads of State, consolidated a number of provisions that would ensure the effectiveness of this interstate mechanism (IFAS, 1997). It would enable conditions for the implementation of joint commitments and guarantee the sustainability of water supply for national and sector interests. However, as Patricia Wouters (2012) rightly notes:

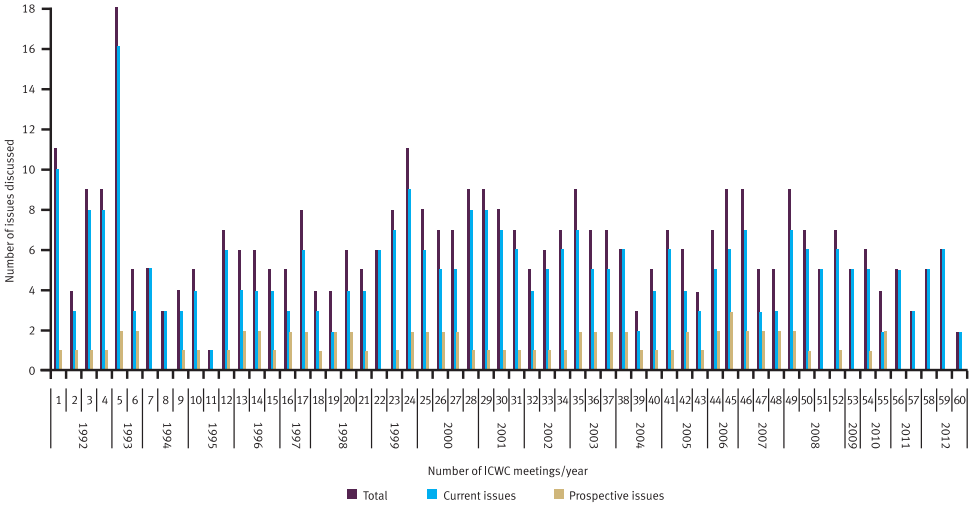
> *While most of the region's shared waters are managed on the basis of international treaties, cooperation across such vast basins with diverse political and economic interests continues to be a real challenge. The numerous agreements concluded in the Aral Sea Basin suffer from inadequate implementation, although regional institutional mechanisms play an important role in promoting joint activities. The ongoing controversies over hydropower projects between upstream and downstream State, and external involvement in transboundary water issues significantly influence the way in which the water resources of the basin are managed.*

This is exactly to the point. In the first years of independence, while the forces to cooperate prevailed, ICWC and its executive bodies formalised some IWRM principles in agreements among the countries. This was also when the 'Main Provisions of Regional Water Strategy', incorporating IWRM principles, were developed (accounting for and linking the needs of all

sectors and establishing a unified information system with a focus on water saving, damage prevention, and consideration of environmental requirements).

Later on, the forward-looking activities of ICWC and other regional bodies began to wane, facing growing contradictions with the commercial interests of the owners of hydropower facilities controlling releases from reservoirs and giving unconstrained priority to hydropower generation over all other uses. Only the Andijan and Tyuyamuyun hydro facilities, which are in the hands of Uzbekistan, and the Chardara Reservoir, owned by Kazakhstan, operated with irrigation in mind. Other hydro facilities gave priority to electricity generation, and irrigation and the environment were supplied with the leftovers. The growing competition over water and loyalty to the doctrine of absolute sovereignty had a negative effect on regional water cooperation – some countries were reluctant to participate in regional projects and to support a regional information system and training activities. The ICWC meetings were dominated by operational water allocation issues, leaving aside prospective matters (Figure 21). The deterioration in interactions among the countries of the region is well documented and is available at www.sic-icwc.uz.

Figure 21. Operative and prospective issues discussed at ICWC meetings during 1992–2012



Several lessons can be learned from the 20 years of transboundary water interactions in the Aral Sea Basin.

The availability of interstate bodies and agreements, common information systems, and common approaches to addressing technical issues do not guarantee lasting cooperation between countries if serious political and economic controversies exist.

Nonetheless, it was possible to maintain contacts between lower and middle level professionals through joint activities, such as regional training, information exchanges, regional projects to improve water use efficiency, and sharing best practices. These sustained contacts and interactions helped to bring about joint solutions in planning, operational control, and execution of works in extreme situations.

Attempts to link long-term political solutions and short-term commercial deals based on market prices for energy and electricity have failed. The 1998 Syrdarya Agreement illustrates this. Long-term commitments on river regimes and water allocation among riparian countries need to be separated from commercial arrangements that reflect fluctuations in market prices. The desire to make water supplies available to hundreds of thousands of water users on a commercial basis can blur the national concerns over the desire for water and food security across the countries of the region.

Regional organisations provide a platform for institutionalised interactions on transboundary waters in a basin, but existing institutional structures need to be strengthened to ensure better inter-sector coordination and public involvement. Intentions to establish a basin-wide advisory body, which brings together all stakeholders for each river basin organisation, were incorporated into a new draft agreement for the organisational structure for the region, but all parties have yet to sign up to this.

Donors play a crucial role in supporting the efforts of governments for cooperation in the region. The Dutch government with the UNESCO-IHE Institute for Water Education jointly funded a regional capacity-building project to train national trainers, to prepare educational materials (curricula) for all countries, and to develop a tool to assess scenarios of possible regional and national development. From 2004 to 2010, the Asian Development Bank supported a regional dialogue among the countries to strengthen the legal framework of cooperation and develop drafts of new water agreements. The German Society for International Cooperation (GIZ) supported the development of projects to improve the environmental situation in river deltas. In addition to the IWRM-Fergana project, SDC funded the establishment and maintenance of the Central Asian Regional Water Information Base and Portal and the automation of the main hydro unit structures along the Syrdarya River. Some other international agencies and donors provide fragmented contributions to capacity building. Of these, the EU, UNDP and World Bank are the most active.

However, the recent trend in donor assistance was to move away from implementing regional projects focusing on main rivers to local and bilateral projects on small rivers, such as the Chu, Talas, Khojabakirgan, and Isfara. Donors have significantly decreased their support to regional organisations and regional projects and have preconditioned their assistance with the requirement that all countries of the region have consented to their implementation. There is growing concern that donors now only support national projects rather than working with regional organisations to support projects which benefit the region as a whole. The consequence of this is to discourage regional interactions and cooperation across national boundaries.

How to break through the impasse?

Wouters (2012) calls for supremacy of the rule of law. However, the ambiguity and elasticity of international water law and its key substantive rules – equitable and reasonable use – provide no easy and concrete answers for the riparian countries. Often riparian countries self-assess their unilateral actions as equitable and reasonable, without due regard to other riparians' claims and concerns. Even when there is a decision of the International Court of Justice prescribing riparian countries to agree on equitable and reasonable arrangement for their particular circumstances – such as in the *Gabcíkovo–Nagymaros* case, for example – countries are reluctant to do so.

However, international water law has the potential to serve as a useful mechanism to promote peace and cooperation over transboundary waters. To do so, its three main pillars – equitable and reasonable use, no significant harm, and duty to cooperate – have to be made operational and thoroughly implemented.

The principle of equitable and reasonable use bears the greatest degree of uncertainty because the concepts of 'equity' and 'reasonableness' are rather subjective and their meaning and use are dependent on the position and criteria of each party. However, if considered jointly with the obligation 'not to cause significant harm' and 'duty to cooperate', equitable and reasonable use may be made more operational.

The term 'reasonable' is seen to refer to water requirements in terms of quality and quantity as well as to river regimes regulated by hydro facilities (intake and discharge of river water). These provisions represent the initial requirements of riparian countries on shared water courses. It would seem logical that if a riparian country asserts a new entitlement to water use and allocation or requires a change in existing uses it should prove the reasonableness of its claims. The next step would be to agree on the 'equity' of these claims in a basin-wide context, with the inclusion of an assessment according to the 'no significant harm' rule and other relevant factors. The duty to cooperate through a package of procedural rules, such as information exchange, consultation, notification, and environmental impact assessment, can provide a platform for this determination that should be shaped by evidence rather than a subjective understanding of equity and reasonableness. If equitable and reasonable use rules do not provide a single answer, then the duty to cooperate must serve as a basis to search for a solution and making it operational.

Wouters (2012) further states, "When rules are violated, legal consequences follow. In extreme cases, such as actions which threaten peace, breaches of the peace or acts of aggression, the UN Security Council is empowered to take action to maintain or restore international peace and security (Chapter VII, UN Charter)." It is yet to be contemplated whether or not threats to food and water security can be interpreted as threats to peace. But given the growing water stress around the world, it seems appropriate to protect the right to water as the collective right of billions of people at the global level through UN institutions, such as the Security Council and Human Rights Council. Currently, the UN involvement with water issues is largely limited to conducting conferences and assessments under the UN-Water umbrella. Meanwhile, news about threats to water security are coming also from the developed world, with Australia and the USA experiencing severe droughts, and from major river basins such as the Mekong Basin.

Under these conditions, attitudes to water at the global level need to be more clearly defined with specific mechanisms in place to address water security. Strengthened international water law actively promoted and used by global leaders will lay an essential foundation for IWRM implementation at the transboundary level to avoid the clash between national water and food security interests and commercial exploitation.

Is it possible to create a positive nexus among water, food, energy and environmental security?

Providing access to water for drinking and municipal purposes is defined as the top priority in the national legislation of most countries. Hence, inter-sector competition occurs over water for food, water for ecosystems, and water for energy and other industrial users.

In Central Asia, water for food production is mostly required in the summer growing season; and this use is consumptive. Changing to less water-consuming grain crops has helped to decrease summer water needs for irrigation. Along the Syrdarya River, this shift accounts for a reduction of more than 500,000 m^3 when compared to 1990 water consumption. In contrast, water for electricity generation is required all the year round, but more so in the winter when demand for electricity can double. Water for ecosystems is also needed throughout the year. For rivers to keep up their natural capacity it is essential to provide at least minimum sanitary flows. For rivers in Central Asia this is a constant flow of 100 m^3/s along the entire length of the Amudarya and Syrdarya Rivers in accordance with Schemes of Complex Water Resources Use and Protection. Sufficient flow of an acceptable quality of water is provided to delta ponds and wetlands to create favourable conditions for fishing, bird migration, and zooplankton. The challenge is to combine these interests and ensure that the water supply is stable.

The Syrdarya River provides an example of the interconnections between river flow regulation, hydropower cascade from reservoirs, and water allocation among different planning zones in different countries below the reservoirs (Figure 22). The Syrdarya River flows through the Naryn cascade, which is a series of reservoirs, the biggest of which is the Toktogul reservoir. The Andijan reservoir is on the Karadarya River, the Charvak reservoir on the Chirchik River, and two reservoirs – Kayrakkum and Chardara – are on the Syrdarya River.

During the Soviet period, the Syrdarya Basin was managed as an integrated economic unit. The federal Soviet Government conducted compensatory schemes to regulate trade-offs among republics concerning agriculture, energy, and other sectors. Economic priorities dictated that water was allocated to optimise agricultural production, and hydropower was a second priority. With independence, this integrated system broke down. Each country began to redefine its economic priorities and became acutely aware of their resource inputs and outputs. It was evident that their respective goals were in conflict regarding water use. Ownership of the Naryn cascade and Kayrakkum water reservoir was passed to the commercial energy authorities of Kyrgyzstan and Tajikistan. This significantly affected irrigation water management as the companies focused only on power generation and giving priority to water releases in the winter (Figure 23).

Table 6 compares the changes in river water regime along two principal sections of the Syrdarya River between Uchkurgan, that stands at the end of the Toktogul cascade, and the Kayrakkum reservoir, and between the Kayrakkum and Chardara reservoirs for 1991 (Soviet times), and 2004 and 2008 (post-independence) – all water scarce years.

Table 6 shows not only the reduction in the availability of water for irrigation during the energy mode (the regime where water accumulated during the summer is released in the winter), but also shows the instability of the water delivery process. In the dry year of 1991 the minimum 10-day irrigation water withdrawals along the Toktogul–Kayrakkum section was 83.1 percent in Kyrgyzstan, 96.9 percent in Tajikistan, and 80.4 percent in Uzbekistan. The same picture was seen along the Kayrakkum–Chardara section: 97.5 percent in Kazakhstan, 104 percent in Tajikistan, and 78.2 percent in Uzbekistan. Thus, water withdrawals did not fall below 78 percent of the normal flows. During 2008, however, fluctuations during the ten-day periods along the first section were nearly 40 percent, and 17.5 percent along the second section. This instability was attributed to the lack of willingness of the hydropower infrastructure owners – Kyrgyz Energy and the Ministry of Energy of Tajikistan – to reconsider hydropower production priorities.

Figure 22. Schematic diagram of the Syrdarya River Basin

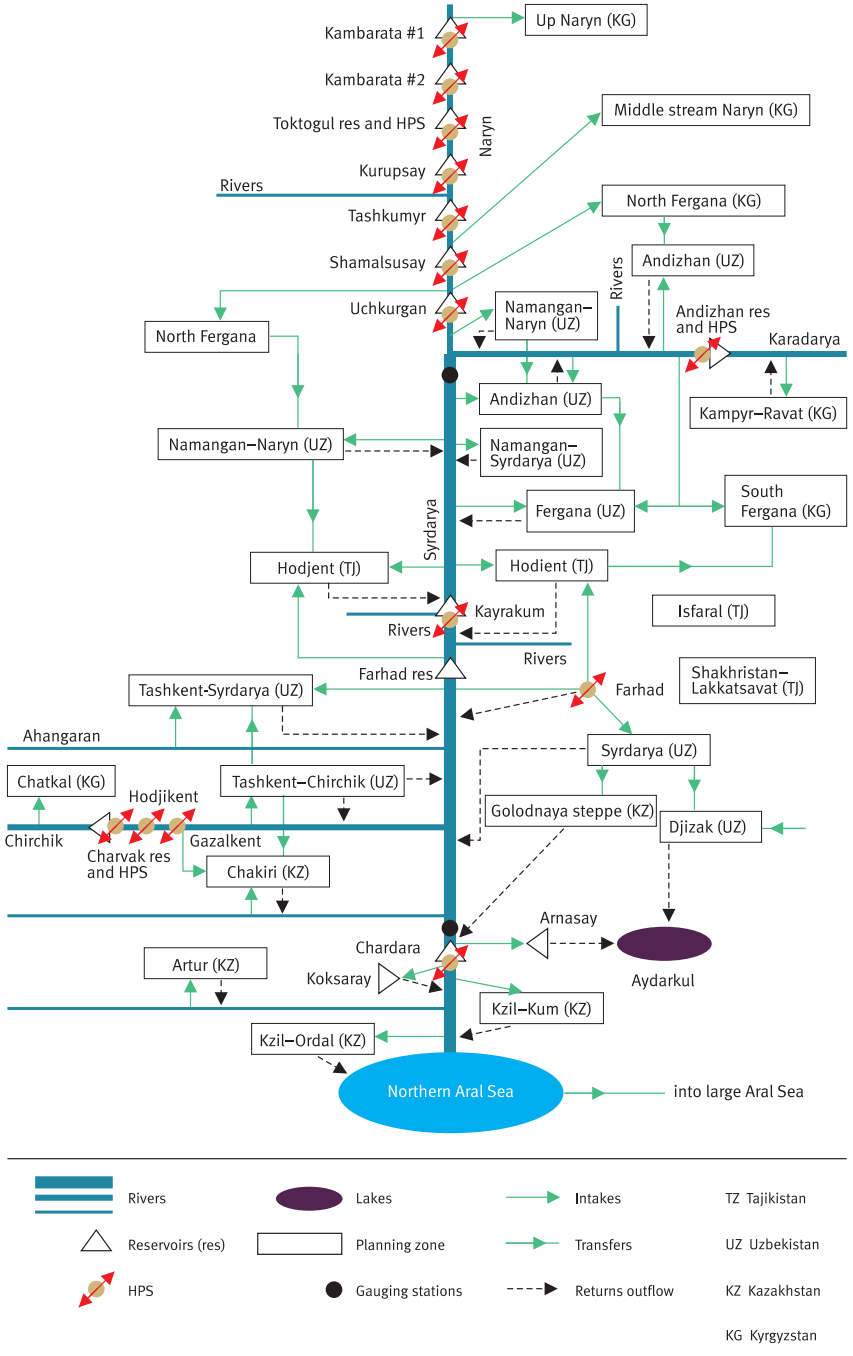
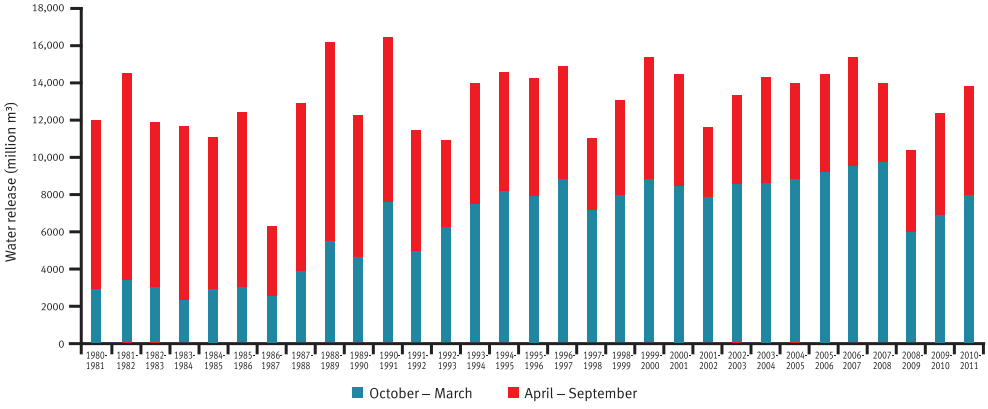


Figure 23. Water releases from Toktogul reservoir by season



The productivity of irrigated lands depends on stable water supplies. But the requirements for hydropower cause fluctuations in river flows that are difficult to manage downstream for irrigation. For example, Kyrgyz Energy regulates energy generation through the operation of the Uchkurgan hydropower station located at the end of the cascade. They manage water releases every hour through the turbines and this means that river flows downstream from Uchkurgan dam fluctuate hourly by as much as 150 to 200 m^3/s. There are also times when, for a few hours each day, there is practically no water flowing in the Naryn and Syrdarya Rivers. Such uncertainties make it very difficult to regulate flows into the three main canals located downstream from Uchkurgan which serve 500,000 hectares of irrigated land in the Fergana Valley. Attempts to reach an agreement with Kyrgyz Energy on this matter have so far failed. So at present the priority given to hydropower generation is preventing the creation of a positive nexus among water, food, energy, and environmental security.

It is possible to regulate the Naryn-Syrdarya cascade in a way that satisfies the needs of hydropower, food, and ecosystems. The rules and regulations are already drafted, but have not been put into practice. Only if there is political will and an adherence to international law will this happen.

Table 6 Comparison of water availability in the Syrdarya during growing season

Indicator	Year	Volume (million m3)	Water availability (%)		
			Average	Maximum	Minimum
Toktogul–Kayrakkum section					
Total delivery	1991	5,405.2	103.03	122.9	84.1
Wet year	2004	4,952	103.1	137.7	75.1
Dry year	2008	4,152.2	83.4	95.2	57.0
Kyrgyzstan	1991	178.0	93.5	121.3	83.1
Wet year	2004	164.9	66.9	76.7	57.4
Dry year	2008	132.7	66.4	70	52.3
Tajikistan	1991	756.6	130.5	165.7	96.9
Wet year	2004	763.0	88.7	114.1	69.2
Dry year	2008	524.4	76.5	105.2	67.8
Uzbekistan	1991	4,470.5	100.2	122.2	80.4
Wet year	2004	4,025	103.7	158.1	70.5
Dry year	2008	3,495.1	85.4	101.8	53.9
Kayrakkum–Chardara section					
Total delivery	1991	6,907.8	89.8	104.0	78.2
Wet year	2004	6,750	101.4	107.9	52.8
Dry year	2008	4,535	67.5	71.5	50.3
Kazakhstan	1991	804.3	104.3	146.6	97.5
Wet year	2004	640.9	88.3	135.3	42.0
Dry year	2008	673.1	84.15	140.0	29.9
Tajikistan	1991	1,292.2	115.4	158.9	104.0
Wet year	2004	1,014.2	83.1	100.5	56.0
Dry year	2008	738.1	60.6	76.5	43.5
Uzbekistan	1991	4,811.4	82.2	100.7	78.2
Wet year	2004	5,094.0	108.2	170.7	72.9
Dry year	2008	3,124	66.4	82.1	46.5

6 Conclusion

The development of IWRM, especially in the IWRM-Fergana project, is recognised internationally, thanks to the wide dissemination of this experience in publications and at numerous forums and conferences.

With hindsight, much of the practical success of introducing IWRM into Central Asia was because of water scarcity and a long understanding among water professionals of the need to make better use of available water resources. Generating driving forces was important to provide triggers for change and to help to promote further development and progress. Political support was also a vital element as officials became aware of the visible benefits of IWRM reforms.

'Water management champions' were a key success factor. Since the inception phase of the IWRM-Fergana project, a team of like-minded promoters of the IWRM approach was formed and included principal partners from GWP CACENA – SIC ICWC, IWMI, and SDC – and officials from water authorities at the national and provincial levels. Highly qualified professionals on the ground and respected leaders of local communities with rich experience in social and agricultural activities were also engaged.

The challenge for further IWRM implementation in Central Asia is to form a critical mass of driving forces at different levels. The involvement of stakeholders at all levels and increasing the number of IWRM adopters is crucial in achieving this. It would involve incentives, motivation, and stimulus to ensure that IWRM is self-sustaining. It is estimated that if 25 to 30 percent of all stakeholders engage with IWRM principles this would produce the critical mass to sustain and create further growth. Currently, IWRM is adopted on only 5 percent of the total irrigated area in the region. Thus, the need is to engage another 20 to 25 percent of IWRM adopters to reach the stage where the process will be self-sustaining without strong external support and promotion. As the drive to implement IWRM increases the following outcomes are expected in the years up to 2017:

- IWRM to be fully understood and accepted by almost all Central Asian governments (National Water Authorities) and key stakeholders
- IWRM procedures fully documented and presented in the form of know-how packages, applicable to different stakeholders at all levels of water management
- an IWRM knowledge chain created to support the process of capacity development.

Driving forces will help to increase capacity and the ability to use the power of IWRM for sustainable development and increased water security. This will include:

- satisfying household water and sanitation needs in all communities
- supporting sustainable economic productivity in all sectors of the economy (including irrigation and energy)
- sustaining development of urban zones and cities
- maintaining healthy rivers and aquatic ecosystems
- adapting to change to deal with issues such as climate change, and natural and man-made disasters.

Finally, a word about the importance of an ethical dimension of water governance and the wider acceptance of IWRM in the region. The main ethical rule proposed is: *do not hold water resources at the expense of others' rights to hold the same water resources*. A code of practice for IWRM implementation in arid zones would help to set the benchmark and establish written rules for ethical behaviour in water use and management. This would not be legally binding and is not intended to replace the provisions of national laws or regulations, but it could provide practical (heuristic) guidance and set out professional standards of behaviour. The working definition for an IWRM Code of Practice may be:

> *Principles, values, standards, or rules of behaviour that guide the decisions, procedures, and systems of water management organisations in a way that (a) contributes to the welfare of key stakeholders, (b) respects the rights of all constituents affected by its operations, and (c) fosters the realisation of the collective goals of public interest.*

It is recognised that IWRM is a concept that is constantly being adapted to change. But it has to be fully supported by a critical mass of adopters to give it a chance to truly succeed.

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Global Water Partnership (GWP) Secretariat
PO Box 24177,
104 51 Stockholm, SWEDEN
Visitor's address: Linnégatan 87D
Email: gwp@gwp.org
Websites: www.gwp.org, www.gwptoolbox.org

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