# Chapter 5
# Current and Future Challenges of Water Security in Central Asia

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**Abstract** The notion of water security in Central Asia has evolved throughout the years in an attempt to control an extensive transboundary river network which divides the region between upstream (Kyrgyzstan, Tajikistan) and downstream (Uzbekistan, Kazakhstan, Turkmenistan) countries. In Soviet times, the belief in engineering and technical supremacy over nature was applied in the installation of numerous hydraulic facilities and mechanical interventions. Water for energy was provided by a series of hydropower stations upstream, while downstream, extended supply and drainage networks and large pumping stations served mainly cotton monoculture. After independence in 1991, water security in the newly established downstream states became synonymous with sufficient irrigation volume for agricultural production, while upstream, water security was interpreted as increased hydropower capacity. Still, however, the transboundary nature of water resources in Central Asia determines to a large extent the need for coordinated national policies and compromises between the Central Asian countries for the attainment of water security in the region. The current study indicates the geophysical, institutional, and historical challenges to be met for the mutual understanding of water security among these five countries. The newly introduced river basin management approach is presented as a crucial reform that may improve common initiatives in water resources management between the riparian countries. Attention is given to the increased effort to be made by interstate and regional organisations in the implementation of feasible and effective solutions for better allocation of transboundary water resources in Central Asia.

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World Water Council (ed.), *Global Water Security*, Water Resources Development and Management, https://doi.org/10.1007/978-981-10-7913-9_5

## 5.1 Introduction

Central Asia (CA) is one the few regions in the world where water security is inextricably linked with energy, food, and the environment. The geophysical diversity of CA encompasses great mountain ranges and abundant freshwater sources but also steppes and arid landscapes, which fosters diverse notions of water security in the region.

The countries of Tajikistan and Kyrgyzstan host the mountains of Karakoram, Pamir, and Tien Shan, called the 'water towers' of CA and hosting some of the largest glaciers in the world outside of the polar regions (Davies 2017). A vast river network is formed in these two countries which crosses the entire region before flowing into the Aral Sea. The downstream countries of Turkmenistan, Uzbekistan, and Kazakhstan are situated on large plains along these rivers, which have been mainly converted to extensive irrigated lands; they are also endowed with abundant hydrocarbon (coal, oil, and gas) resources (Sehring and Diebold 2012).

All CA countries have undergone a Soviet Union past in which water security was clearly understood as a multidimensional factor dependent on energy, agricultural, and environmental aspects (Freedman and Neuzil 2015). In the Soviet era, the water-rich upstream countries provided water for irrigation to downstream countries in spring and summer. In exchange, they were supplied with coal, oil, and gas for heating and electricity in the winter months. Upstream countries also received staple crops and other agricultural and industrial products.

However, major intensification of agricultural production, focusing mostly on cotton production, and over-abstraction of surface water in all of CA, came at a high price for the environment, of which the best-known example is the degradation and shrinking of the Aral Sea. The degradation of the natural environment and mainly water resources in CA had major repercussions for water, energy, and food which are still apparent today (Malsy et al. 2012).

National aspirations and the struggle for state-building following independence in 1991 shifted the concept of water security from a regional approach to country-focused policies, in which geopolitical interdependence seemed to be of secondary importance (Zakhirova 2013). In the upstream countries, water security is mainly interpreted as energy independence, reduction of disasters stemming from water, and sufficient agricultural water for irrigation and pastoralism. For downstream countries, water security mostly means intensified agriculture, fisheries, and pastoralism, and reduction of water scarcity incidents. However, the transboundary water resources in CA are of paramount significance for the development of the energy, water, and agriculture of the entire region and still imply the need for a regional conception of water security (Rasul and Sharma 2014). National water security for each CA country will be difficult to achieve without consent and compromises between upstream and downstream neighbours.

This study initially addresses the regional context of water security by considering the Aral Sea Basin, which is the drainage area of the major Central Asian rivers and encompasses a population of around 60 million people (Food and

Agricultural Organization 2013). The notion of water security and regional interdependence created by the region's common Soviet past is presented to better illustrate the current situation in CA countries. The geophysical and socio-economic differences, as well as the objectives, priorities, and strong interdependencies between upstream and downstream countries, are further depicted. In turn, the current shift from an administrative to a basin management approach in the region is addressed, and the pertinent institutional and technical parameters arising from this transition are mentioned. Finally, policy recommendations to curb the future challenges to water security in CA are presented.

## 5.2 Soviet Legacy and Regional Interdependence

The Central Asian countries are among the most water-intensive economies in the world, with mean water withdrawals of 2200 $m^3$/y per capita and nearly 90% of water diverted for irrigation purposes (Sehring and Diebold 2012). As early as the 1930s, a cotton monoculture known as the 'dictatorship of the white gold' (Kulchik et al. 1996) was established in Turkmenistan, Uzbekistan, and to a lesser extent Tajikistan. CA was transformed into the main cotton-producing centre for the entire Soviet Union. In the early 1960s, agricultural mechanisation took place in the entire region, which intensified irrigation systems. Irrigated farming was strongly prioritised in Soviet times to cover the needs of the highly water-demanding cotton crops through the construction of numerous reservoirs, extensive water supply and drainage networks, and large pumping stations.

Irrigation management was partly supervised by the individual Soviet republics, but the entire process was centralised in Moscow, in the Ministry of Land Reclamation and Water Resources (Horsman 2003). Moscow was the final arbiter that directed the procedure and settled disputes between the states (Weinthal 2002). In the Soviet period, water was not considered a source of dispute between the five separate Soviet republics of CA, and internal borders were disregarded. As Weinthal (2002) asserts, 'During the Soviet period, the Central Asian republics did not worry about who had clear legal rights to the use of fresh-water resources in the Aral basin, because the water system was considered a purely domestic resource within the territorial borders of the Soviet Union.' However, in some cases Soviet republics did contest decisions of the central administration on water allocation issues (Wegerich et al. 2016).

The intensified irrigation which started in Soviet times has put much strain on the surface and groundwater sources of the Amu Darya and Syr Darya basins, the two largest rivers in CA. As more water was diverted than the region's renewable water resources could resupply, major shrinking of the Aral Sea ensued. It also resulted in other massive environmental problems, such as progressive evaporation and salinisation, which were often associated with pollution and over-irrigation (Oren et al. 2010).

By the early twenty-first century, more than 90% of the Aral Sea had been drained, with dramatic impacts on the entire region, now considered one of the worst man-made environmental disasters in history. Only a decade ago did Kazakhstan begin efforts to mitigate the effects, reviving about 20% of the initial lake size (Kazakhstan Green Energy 2017). As shown in Fig. 5.1, the Aral Sea originally occupied an extensive area of 68,000 km$^2$. The current size, the zones of irrigation development, and the basins of major rivers are also delineated.

Water management in the Soviet period was organised according to 'water-use regions' or 'irrigation districts' depending on the different type and use of water supply systems. Some districts were fed only with groundwater from deep drillings, and others from large pumping stations which diverted river discharge to irrigation canals, while in other cases a conjunctive use of surface and groundwater was applied (Thurman 2001). In many cases, the irrigation zones (districts) crossed republican boundaries (Wegerich et al. 2012; Pak and Wegerich 2014). In the Syr Darya basin in the Ferghana Valley, for instance, there were six irrigation districts, of which three were transboundary. The transboundary districts incorporated irrigated areas from nearly all the CA countries (Fig. 5.2). For example, the Chakir District incorporated irrigated areas in Kazakhstan, Kyrgyzstan, and Uzbekistan, while the Mid-stream District incorporated irrigated areas in Kazakhstan, Tajikistan, and Uzbekistan (Wegerich 2015).

As noted above, each irrigation district had a different focus in utilisation of and access to water resources. The different water management approaches reflected


**Fig. 5.1** Aral Sea basin. *Source* Food and Agricultural Organization (2013)


**Fig. 5.2** Irrigation districts in the Syr Darya basin. *Source* Wegerich (2015)

different understandings of water security in each district. Some districts, for instance, believed that groundwater sources and large drillings could provide better water security than irrigation canals. Consequently, after the Soviet dissolution, the impacts on water security in the Syr Darya basin varied according to the facilities that existed in each district. Nevertheless, concerns about water security arose in the entire region when the increasing desiccation and salinisation of the Aral Sea led the Gorbachev government to publicly admit to the 'Aral problem' and seek solutions (Micklin 1991). At that time, some conflicts over water and land were already arising at the local level in the form of sporadic clashes between communities (Tishkov 1997).

The transboundary irrigation districts ceased their existence after the collapse of the Soviet Union in 1991. New administrative boundaries for water resources management were drawn, making water management a matter of competence of national authorities. Intensified irrigation practices have continued until today, although at a slower pace due to the lack of funding of maintenance and operational services.

Similar issues arose related to the region's production of energy, mainly from hydropower plants (HPPs) in the water-rich upstream countries of Kyrgyzstan and Tajikistan, and from hydrocarbon resources in downstream Uzbekistan, Turkmenistan, and Kazakhstan. In the Soviet era, the seasonal fluctuations associated with hydropower were compensated for by a Central Asian regional energy system. The Central Asia Power System was established in the 1970s and included all five Central Asian Soviet republics. As in irrigation, internal borders were disregarded, and the Central Asia Power System could meet the needs of the whole region. In summer months, the upstream countries were responsible for releasing water and generating electricity for the whole region. In return, they received fossil fuels and surplus electricity in winter from the hydrocarbon-rich downstream countries. The high regional demand for irrigation was met throughout the summer,

while winter energy shortages in the upstream countries were similarly compensated. For instance, during this period, 60% of Tajikistan's electricity needs were covered by imports from other Soviet Republics (World Bank 2013a). Through this system, the region was provided with sufficient power generation at low costs, transforming CA into a 'breadbasket' and a main cotton production centre.

After independence in 1991, the centrally planned water and energy management systems from the Soviet period had to be reconfigured to work in a regional economic complex. Energy allocation between the countries became a source of conflict due to the price differences between upstream hydro energy and downstream fuel-produced energy. A reconfiguration of the energy interdependence among the Central Asian countries was attempted in the 1990s through multiple bilateral agreements. In February 1992, the five new republics signed the Almaty Agreement, which recognised their equal rights and responsibilities in ensuring rational use of water resources and agreed that only joint management actions can solve the region's water problems. The agreement in essence was a continuation of the Soviet system of water allocation. With the agreement, the Interstate Commission for Water Coordination of Central Asia was established to set quotas and to facilitate implementation, with decisions on key issues to be made by consensus among the five states. The Central Asian republics also agreed (in a declaration in 1995) that they would continue to recognise all signed agreements and quotas that regulated the allocation of water. However, these declarations were not legally binding, and the agreed water allocation has been violated multiple times (Petrov 2015).

In the late 1990s, the system failed to deal with growing tensions over resources. International frictions emerged around the implementation phase, which hampered electricity trading in the region. Today, a situation has emerged in which regional optimisation is no longer a goal, and energy production seems to be more a subject of national interest.

The national ministries still retain many of their Soviet-administration features, but with much less resources available (Bichsel 2009). The states tackle the problem as a zero-sum game, each state trying to gain the most at the expense of the others. As a result, cooperation between the five Central Asian states to create a stable regional water management system has so far been very limited. Instead, the CA countries have chosen to address issues related to water management through short-lived, bilateral barter agreements. Such agreements seem to only partly and temporarily solve the core issues of water management, as in the case of water pricing, where disagreements occur frequently (Horsman 2003). Moreover, national water management policies tend to focus on routine administrative burdens, with limited focus on long-term objectives (Abdullaev and Rakhmatullaev 2016b).

It can be said that the transition to national sovereignty in CA has shown evidence of 'hydropolitical vulnerability' (Møller 2004) and a lack of institutional capacity to manage a smooth transformation from centralised to nation-based water management (Petersen-Perlman et al. 2012).

## 5.3 The Present Situation of Water Security in Central Asia

### *5.3.1 Overview of Water Security Status*

Since independence in 1991, the five Central Asian states have had to deal with the Soviet legacies of cotton monoculture, large but ageing infrastructure, and environmental degradation, as well as economic challenges and increasing international disputes over resources. The desire of each country to unilaterally exploit its natural resources has further aggravated regional frictions. There are large imbalances in the region when it comes to the spread of water and energy resources and arable land. Upstream Tajikistan and Kyrgyzstan are rich in surface waters, and 81% of the overall water resources in the region are controlled by these two countries. But they are poor in hydrocarbon resources, which the downstream countries of Uzbekistan, Turkmenistan, and Kazakhstan have in abundance. Uzbekistan and Turkmenistan have 23 and 44%, respectively, of the region's natural gas deposits, while Kazakhstan is one of the world's top 20 oil producers. But all three downstream countries face water scarcity, with Turkmenistan the worst-off at only 300 $m^3$/y per capita available (Alford et al. 2015).

Kyrgyzstan and Tajikistan have used their weight in water resources to become forerunners in hydropower generation. Hydropower accounts for over 90% in these two countries. The downstream countries have mainly used their water inflow for irrigation. Agriculture is a key component of the CA economies and accounts for 90% of total water withdrawal in the region (Rahaman 2012). Agriculture is dominant in the downstream areas: of the 7.4 million hectares of irrigated land in CA, 4.3 million are in Uzbekistan and 1.6 million in Turkmenistan (Alford et al. 2015).

The two main rivers of the region, the Amu Darya and Syr Darya, are the most important water sources for the livelihoods of 60 million inhabitants in CA. Both rivers originate in the mountain ranges of the upstream countries. The Amu Darya, the larger in water volume, is formed by the Panj River on the Tajik–Afghan border and the Vakhsh River in Tajikistan and continues into Uzbekistan and Turkmenistan before emptying into the Aral Sea. The Syr Darya, which is longer, has its source in the Tien Shan Mountains in Kyrgyzstan, flows through the Ferghana Valley into Tajikistan and Uzbekistan, and also ultimately empties into the Aral Sea (Fig. 5.3).

About 75% of the Syr Darya runoff originates in Kyrgyzstan, while 74% of the main flow of the Amu Darya originates in the territory of Tajikistan (CA Water Info 2017). In total, the upstream countries contribute 77% of the inflow to the Aral Sea basin, while Afghanistan contributes around 10% (Table 5.1).

As a result, the downstream countries are dependent on transboundary rivers that originate outside their territories. This has been the basis of many international tensions over access to water. The disputes are associated with both water apportioning and regulation of water usage (Petrov 2015). A further complication is the seasonal nature of water release and irrigational demand. Both rivers have high


**Fig. 5.3** Water resources in the Aral Sea basin. *Source* CA Water Info (2017)

**Table 5.1** Surface water resources in the Aral Sea basin (mean annual runoff, km3/y)

| Country | River basin | | Total, Aral Sea basin | |
|---|---|---|---|---|
| | Syr Darya | Amu Darya | $km^3$ | % |
| Kazakhstan | 2.516 | – | 2.516 | 2.2 |
| Kyrgyzstan | 27.542 | 1.654 | 29.196 | 25.2 |
| Tajikistan | 1.005 | 58.732 | 59.737 | 51.5 |
| Turkmenistan | – | 1.405 | 1.405 | 1.2 |
| Uzbekistan | 5.562 | 6.791 | 12.353 | 10.6 |
| Afghanistan | – | 10.814 | 10.814 | 9.3 |
| Total, Aral Sea basin | 36.625 | 79.396 | 116.021 | 100 |

*Source* CA Water Info (2017)

water levels in spring and summer due to melting snow, which is used for hydropower generation upstream and irrigation in downstream countries. In winter, the water levels are low, resulting in hydropower production levels as low as 60–70% of the spring and summer periods (World Bank 2013a). To combat this, the upstream countries have been lately engaged in the construction of large-scale water reservoirs, which has sparked fears, mainly in Uzbekistan, of disruption of the seasonal outflow of water.

### 5.3.2 Tajikistan and Kyrgyzstan: Water for Energy

Tajikistan and Kyrgyzstan have little arable land; only 6.1 and 6.6% of their total area, respectively, is suitable for agricultural production (Kocak 2015). Water-rich but land-poor Tajikistan has emerged as the most impoverished country in the region. Severe food insecurity has threatened the livelihoods of the mostly rural population of Tajikistan. Without hydrocarbon resources, Tajikistan and Kyrgyzstan have therefore resorted to strengthening their precious hydropower potential to increase economic development.

Facing energy isolation, Kyrgyzstan and Tajikistan have suffered from increasing energy shortages in winter months. But their hydropower potential is high. Tajikistan ranks top in the world in hydropower potential per unit of area (World Bank 2013b). But it currently only uses 5% of this potential; Kyrgyzstan, about 10% (Kocak 2015). Both countries have therefore further strengthened their focus on exploiting their full hydropower capacity. They have set hydropower investment and rehabilitation as a national priority. The government of Tajikistan has stated that one of its main goals is to achieve full energy independence by increasing hydropower production and making energy imports redundant (Government of Tajikistan 2011). It allocates more than USD 300 million annually (15% of the state budget) to hydropower rehabilitation (Government of Tajikistan 2014).

Tajikistan and Kyrgyzstan's energy isolation has driven them to reinvent themselves as forerunners in the hydropower sector. Tajikistan already has numerous HPPs, the largest being Nurek, Kairakkum, Baipazin, and Sangtuda I and II (Barqi Tojik 2016). Over 75% of the country's electricity supply is generated by the Nurek HPP on the Vakhsh River—currently the largest dam in CA, at a height of 300 m—with a capacity of 3000 MW and a reservoir of 10.5 $km^3$ (World Bank 2013b).

Nevertheless, Tajikistan has thus far not surpassed its 1990 hydropower production level of 18 billion kWh; current hydropower production stands at 17.2 billion kWh (Government of Tajikistan 2007). Furthermore, due to low river volumes in winter months and the high electricity demand, the country's energy system cannot adequately respond to the seasonal needs. The HPPs in Tajikistan and Kyrgyzstan cannot sustain energy supply in winter, when heating demands are highest and river flows the lowest, due to smaller releases of snow melt and glacial water. Most of the HPPs are run-of-the-river plants, without reservoirs, and vulnerable to variations in precipitation, climate change, and the whims of river flows. With worsening conditions of the ageing facilities, this shortage is predicted to further increase in the coming years. Continued deterioration of power facilities will further worsen shortages throughout the year. Most HPPs have been in operation for an average of 45–50 years without major upgrading or maintenance investments. Many are now producing well below their potential output. The ageing electricity network similarly often fails to transfer power to large parts of the country throughout the year. Insufficient energy supply nowadays has a great impact on Tajikistan's economic development, forcing the closure of around 850

small and medium-size enterprises annually, and costing an estimated 3% of GDP (Government of Tajikistan 2014). Winter shortages were estimated at 2700 MW in 2012, but if current trends continue, these deficits could increase to over 6800 MW by 2020 (World Bank 2013b).

To combat these issues, both upstream countries are trying to increase their hydropower capacity. Tajikistan has started the construction of its largest hydropower project yet. In October 2016, filling of the Roghun Reservoir was initiated in the upstream area of the Vakhsh River in eastern Tajikistan. The Roghun Dam is an ambitious, USD 3.9 billion dam which, once completed, will be the tallest dam in the world, at 335 m. It will provide another 3600 MW of generation capacity, doubling Tajikistan's electricity production.

In Kyrgyzstan, the largest HPP (capacity 1200 MW), at Toktogul on the Naryn river, a tributary of the Syr Darya (Granit et al. 2012), provides the country with over 90% of its energy. However, the large Toktogul Reservoir, which holds the door of the Syr Darya River, has been a source of disputes with Uzbekistan, Tajikistan, and Kazakhstan. In recent years, low water levels have led Kyrgyzstan to release less water into downstream countries. In the summers of 2008 and 2009, mismanagement of the Toktogul Dam led to water shortages in Uzbekistan and Kazakhstan, as well as lengthy power cuts in Kyrgyzstan.

Kyrgyzstan is planning to construct the Kambarata I HPP on the Naryn River, which, with a height of 275 m and a capacity of 2000 MW, will also be one of the largest dams in the world. Like the Roghun, the project is strongly opposed by Uzbekistan, which argues that the filling of the reservoir would reduce the flow of the Syr Darya (Rickleton 2013). In the past, Uzbekistan has made bellicose statements against Kyrgyzstan and Tajikistan over the construction of new reservoirs (Nurshayeva 2012).

Although these projects could significantly reduce energy shortages in the upstream countries, and are a matter of great national pride, they have been source of major tensions with downstream countries, mainly Uzbekistan. This is because the impacts on agricultural water supply have not yet been well defined. However, tensions in the region have abated somewhat, through an effort to mitigate the impacts downstream, as mentioned in feasibility studies (SNC-Lavalin n.d.) and strategic environmental assessments (World Bank 2014) for large dams in Kyrgyzstan and Tajikistan. More importantly, the recent (2016) change of government in Uzbekistan seems hopeful for reconciliation on water sharing and management between the upstream and downstream countries.

Their greater hydropower potential may enable Kyrgyzstan and Tajikistan to become leading regional exporters of electricity, potentially supplying growing economies in Afghanistan, Pakistan, and Iran. The inauguration of the first phase of the Central Asia–South Asia electricity network (CASA-1000) in May 2016 marks the future opportunity for Tajikistan and Kyrgyzstan to export their summer electricity surpluses at lucrative prices. The USD 1.16 billion transmission lines will connect Kyrgyzstan, Tajikistan, Afghanistan, and Pakistan, enabling large power flows from north to south (Fig. 5.4). Tajikistan and Kyrgyzstan are expected to supply up to 5 billion kWh of summer electricity annually to Afghanistan and


**Fig. 5.4** The Central Asia–South Asia power transmission project (CASA-1000). *Source* Ministry of Energy and Water Resources (2017)

Pakistan via this power transmission line (SNC-Lavalin 2011; Barqi Tojik 2016). However, difficulties in the construction phase suggest that completion of CASA-1000 may take several years (Michel 2017).

According to the recently signed agreements, Tajikistan and Kyrgyzstan will be able to sell electricity for up to USD 0.05 per kWh through CASA-1000. Large revenues can be brought in from transferring water to hydropower, which in turn can be reinvested in further HPP projects. But this prospect creates further international rivalry with Uzbekistan, which also wants to position itself as a regional exporter of electricity. Also, the lucrative pricing of electricity exports could have significant impacts on domestic electricity usage and irrigation pumping. These export prices are significantly higher than what the upstream countries are charging for irrigation water. In Tajikistan, for example, water abstraction from pumping stations cost only USD 0.0030 per kWh in 2016. Electricity subsidies to keep prices low come at a high cost to the national budget. And low energy efficiency wastes large amounts of potentially exportable electricity (World Bank 2013a).

The new incentives to allocate hydropower production to export, combined with the low efficiency, could put pressure on domestic food and energy security and thus should be contemplated cautiously. However, regional energy trade could enhance cooperation on water issues. A recent agreement between Kyrgyzstan and Uzbekistan on energy trade could be a good illustration of such cooperation (Anadolu Agency 2017).

### 5.3.3 *Uzbekistan, Kazakhstan, and Turkmenistan: Water for Food*

The downstream countries of Uzbekistan, Kazakhstan, and Turkmenistan are poor in water resources but rich in hydrocarbon reserves. Coal, oil, and natural gas make up more than 90% of energy consumption in Kazakhstan, Turkmenistan, and Uzbekistan (Granit et al. 2012). The share of agriculture in the economy of Kazakhstan is low, at only 4.7% of GDP in 2012, whereas in upstream Tajikistan and Kyrgyzstan it accounts for 26.6 and 20% of GDP, respectively. Also relatively high is the GDP contribution of agriculture in downstream Uzbekistan and Turkmenistan, at 20 and 14.5%, respectively (Kocak 2015). Agriculture in all CA countries demands vast amounts of water (Fig. 5.5). Agriculture accounts for 87.2% of all water withdrawals across the region. Uzbekistan consumes almost 45% of that, twice as much as the second-biggest consumer, Turkmenistan. The total water consumption of the upstream countries, Kyrgyzstan and Tajikistan, amounts to only 15.6%.

For the expansion of cotton monoculture, numerous dams, canals, and artificial lakes were built in Soviet times between 1950 and 1990 which are still operating today. For instance, in Uzbekistan the North and Grand Ferghana Canals transport water from the Syr Darya to the Ferghana Valley; the Amu-Bukhara Canal irrigates land in the Bukhara Region in Uzbekistan from the Amu Darya; Kirov Canal irrigates the Golodnaya ('Hungry') Steppe from the Syr Darya; and the Karshi Canal provides water to 1.2 million ha in Uzbekistan's Karshi Steppe. However, the condition of these irrigation assets is poor, with many canals ageing and

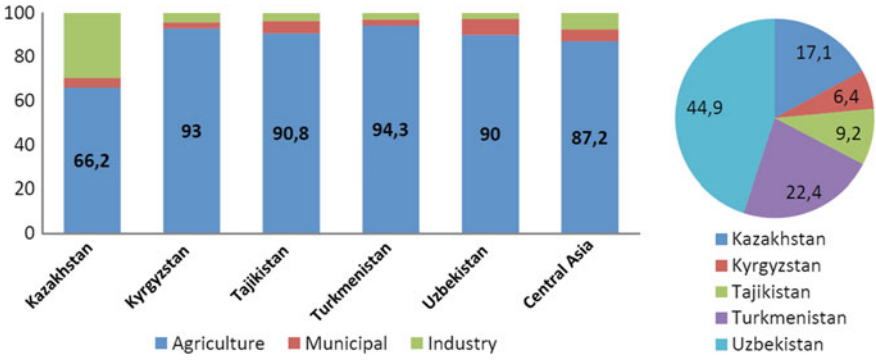


**Fig. 5.5** Sector and country shares of water consumption (in percent). *Source* Kocak (2015)

deteriorated. In Turkmenistan the huge Karakum Canal (see Fig. 5.3) was completed in 1988, transferring 12.9 $km^3$ of water—almost 15% of the flow of the Amu Darya River—to irrigate parts of the Karakum Desert (Kraak 2012). It is still the largest irrigation canal in the world and the most significant for Turkmenistan.

After the Soviet Union's dissolution, agricultural policies in the downstream countries changed to meet the new conditions. Uzbekistan enforced a reduction in cotton production and focused on wheat. Cotton's share of irrigated agriculture fell from 45 to 25% between 1990 and 1998, while the area under cereals increased from 12 to 50%. Uzbekistan accounted for 20% of globally traded cotton in the early 1990s, but only 10% nowadays (2017). Also, the irrigated area under cotton in Uzbekistan has been reduced from 2.8 million ha in the early 1990s to 1.1 million ha. But cotton still makes up more than 20% of all exports from Uzbekistan.

Kazakhstan also shifted to cereal production and currently is among the world's top eight grain-producing countries; 60% of Kazakhstan's agricultural exports are grains, and it ranks sixth in the globe in wheat exports (Granit et al. 2012; Ray et al. 2013). The main reason for this, next to assuring food security, was to reduce irrigation needs: wheat requires less than half as much water as cotton. However, producing more wheat instead of cotton did not reduce the importance of water as much as anticipated.

In Turkmenistan, which is the most sparsely populated state in CA (10.5 people per $km^2$), cotton still has the lion's share of agricultural production, as Turkmenistan is among the top ten cotton producers in the world, and its high-quality cotton is in great demand. Despite being traversed by the largest waterway in the region, the Amu Darya River, the country is very much at risk for drought and water scarcity (Collado 2015). The large quantity of water used to irrigate cotton fields certainly plays a big part in increasing the per capita water consumption, but there are other factors at stake: the inefficient household and industrial usage, the high rate of water waste, and the poor conditions of water infrastructure, including the main water infrastructure of the country, the Karakum Canal (International Crisis Group 2014; Collado 2015).

All the reasons listed above show that water security is a paramount issue for the downstream countries, and it might become a more pressing concern in the years to come, in view of the predicted effects of global warming for the region.

### 5.3.4 Climate Change and Water Security in Central Asia

A further threat to water security is the rising global temperatures and climate change. Studies strongly indicate that global warming will affect water security in CA (Gan et al. 2015). The region's glaciers have been melting more quickly in recent decades: 20% of the ice cover of the glaciers in the Aral Sea basin was lost between 1957 and 1980; it decreased 10% in the last 50 years (Eurasian Development Bank 2008, 2009). However, the exact effects of these developments for the region's water resources continue to be debated. Some studies suggest that runoff will be decreased significantly in the long term, resulting in lower river flows. Some estimates suggest that the water flow will be reduced 10–15% in the Amu Darya and 2–5% in the Syr Darya by 2050 (Eurasian Development Bank 2008). However, other studies give significantly smaller percentages, as the shrinking of glacier area seems to be counterbalanced by faster melting during the largest part of the year. Even so, they project an important seasonal shift of water resources from summer to spring, resulting in a runoff reduction of 25% in July and August, especially in the Amu Darya. This could hurt agriculture and irrigation in the lowlands, which reaches peak demand in summer. Evapotranspiration losses in the downstream regions also seem to further limit water availability in summer (Hagg et al. 2013).

The changes in seasonal precipitation patterns are also expected to impact river flows. A recent study (Hijioka et al. 2014) published by the Intergovernmental Panel on Climate Change indicates an increase in Central Asian precipitation by analyzing long-term time series and seasonal patterns. Others conclude that changes in seasonal precipitation, rather than temperature, dominated the decline in levels of the Amy Darya in 1951–2007. It is claimed that the flow of Amu Darya fell by 15.5% during this period because of lower precipitation, and increased by only 0.2% as a result of higher temperatures (Wang et al. 2016). Another study agrees that changes in the seasonality of precipitation are likely to have the most significant impact on water availability, with runoff likely to continue to decrease by 10–20% in CA (White et al. 2014). The study concludes that in periods of extended drought there is a high possibility that the available water resources will satisfy only 50% of the regional demand.

Another study considered the heterogeneous impacts of precipitation patterns in CA countries (Nelson et al. 2010). In Kazakhstan, for instance, water availability is projected to increase, while in Uzbekistan and Turkmenistan the average annual runoff of water is expected to moderately decrease. This, in turn, is argued to be a possible source of further international disputes. Together with growing populations and increasing demands for food and energy, it could result in domestic unrest and

international discord (Swinnen and Van Herck 2013). However, some policy analysts argue that there is enough time for CA's riparian countries to set up an effective international framework for water allocation and mitigate the effects of climate change, thereby making conflict over reduced water resources water unlikely (Bernauer and Siegfried 2012).

## 5.4 Discussion

### *5.4.1 Water Security and Coordination of National Policies*

There are major efforts to transform the water sector in CA after the collapse of the Soviet regime. Although strong global influences and the experiences of other regions with similar features have been 'exported' to the water sector of Central Asian countries, the water sector reforms in the region have mainly been endogenous. For example, the strongly promoted concepts of irrigation management transfer and joint management have been not taken up by Central Asian countries. The water infrastructure almost in all the countries is still in the hands of the state. Although irrigation management transfer and participatory irrigation management have been at the core of water sector reforms supported by international funding, there is still little acceptance in Central Asian countries (Abdullaev and Rakhmatullaev 2016a).

The water-energy-food nexus concept has recently appeared in CA as a paradigm to address the major challenges of water security and management in the region. But it is feared that the outdated infrastructure in all sectors (irrigation, energy, and food processing) may create greater problems rather than bringing benefits from intersectoral cooperation.

Water resources governance and management in a transboundary context are key elements of regional stability and security for CA. Over the 25 years of the post-Soviet period, water issues have been transformed from a techno-economic perspective to a socio-political approach. Institutional structures for joint allocation of common water resources were established as early as 1992, as mentioned above, including the Interstate Commission for Water Coordination, the Interstate Council for the Aral Sea Basin, and the International Fund to Save the Aral Sea, but without meeting expectations. The current state of affairs of water in the region seems to be leaning more towards the coordination of five water national policies and less towards regional cooperation over water governance and management (Fig. 5.6). Efforts to promote more regional transboundary cooperation through creating a single water policy for CA may not be that fruitful. The core idea of regional cooperation in CA should probably shift to strong efforts towards coordination of the different water policies of the five countries.

Changes at the local level should initially focus on the water and land rights systems. In the Soviet period, water rights were determined through complicated

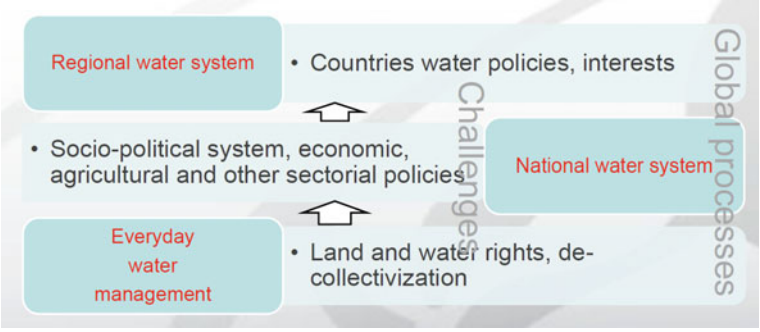


**Fig. 5.6** Interlinkages of different water systems and processes in Central Asia. *Source* Abdullaev and Rakhmatullaev (2016b)

criteria based on cropping structure, biophysical conditions of the irrigated area, and availability of water resources. In theory, the irrigated areas were classified in different categories and the water rights were determined before each irrigation season. However, in practice water rights were dependent on water availability, and priority was given to cotton cultivation. Since the breakup of the Soviet Union, the water rights systems have been changed, and de facto water distribution now depends fully on water availability in particular basins, sub-basins, and irrigation networks, but still without providing efficient distribution mechanisms.

Further, in Soviet times, planners and managers considered water an essential input for economic growth and prosperity. The nature of water institutions was technical: focused on water provision and allocation, mostly in agriculture. The water institutions were centralised in their planning, management, and financing aspects and therefore independent of local and national peculiarities. Water was perceived as a sectoral component in the entire Central Asian region. With the collapse of the Soviet system, the water sector lost both its significance and its funding sources.

The example of the Ferghana Province Irrigation Department in Uzbekistan can showcase the situations in the pre- and post-Soviet periods. Until 1985, expenditures on operation and maintenance appear to have been nearly constant; then there were distinctive increases between 1986 and 1990 (Fig. 5.7). There was initially much emphasis on water supply security and control of water supply, which was representative of the overall situation in the Soviet period. During the economic crisis which followed independence, expenditures on operation and maintenance, as well as rehabilitation, declined to insignificance. Although from 1996 onwards the Uzbek GDP started to increase again (Taube and Zettelmeyer 1998), this increase has not triggered reinvestment in the Ferghana Province Irrigation Department.

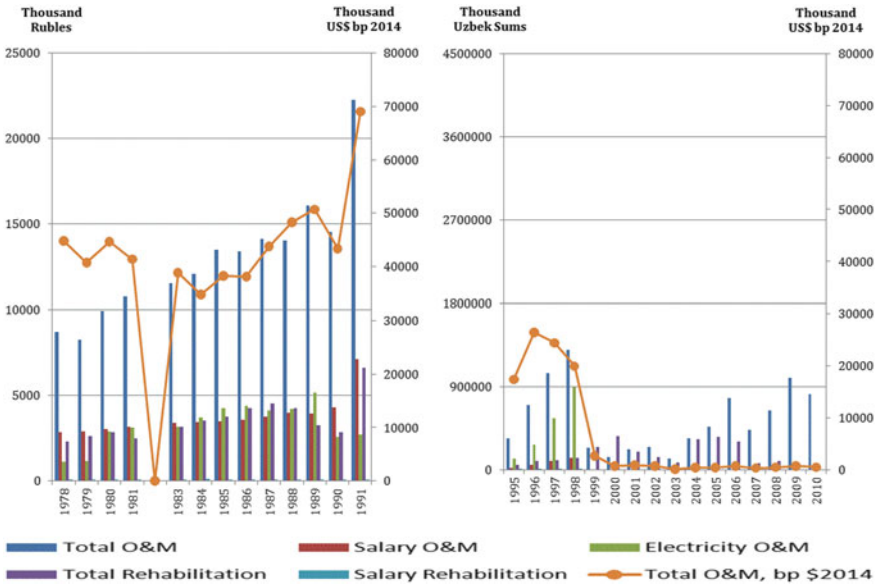


**Fig. 5.7** Operation and maintenance costs for Ferghana Province Irrigation Department, Uzbekistan, 1978–2010. The primary axis in left and right tables present the expenditure in 1000 Soviet Union Rubles for the period 1978–1991 and 1000 Uzbek Sums for the period 1995–2010, respectively. The secondary axis is in both tables presents the expenditures in 1000 USD purchasing power (bp) as of the year 2014. *Source* Wegerich et al. (2015)

### 5.4.2 *Current Status Quo and Challenges of Water Security in Central Asia*

The water sector in Central Asian countries has undergone serious transformations, and major reforms are still taking place. Many researchers have considered the water sector changes in CA through the prism of standard international processes such as irrigation management transfer and participatory irrigation management (Abdullaev et al. 2010). But most of these assumptions were short-lived, and the trajectory of water sector transformations in CA has been more about strengthening the role of the state in day-to-day water management.

In other regions, South Asia for instance, irrigation management transfer and participatory irrigation management were implemented more successfully, because the farmers had relative autonomy in operation and maintenance of irrigation infrastructure (Qureshi 2005). But in CA the governments have not transferred the actual operation and management of irrigation infrastructure to farmer organisations (e.g. water user associations). Also, declines in funding and human capacity have severely affected the performance of water institutions. And the low functioning of water institutions has resulted in alternative water governance schemes (informal, business-like, etc.), with as yet unknown results.

On a regional level, water issues became political and interstate on the collapse of Soviet Union. The newly emerged Central Asian states have started to shape their national policies and systems on all aspects of development, including security, economy, and resources. During the transition period and until now, water disputes in the Aral Sea basin have never led to military incidents but remained at the level of political tension. There have been some incidents, limited to local disputes over access to water, which, however, exacerbate inter-ethnic tensions (International Crisis Group 2014). Nevertheless, in CA, the national governments have tended to 'securitise' water-related issues, with water being 'used as a tool for intra-state posturing' (Cummings 2012). This was the case especially between Uzbekistan (under the former government) and its neighbours. The tension, especially with Kyrgyzstan and Tajikistan, increased on several occasions. In 1997, for instance, 130,000 Uzbek troops carrying out military exercises, practising for the seizure of a strategic object, were deployed near the Toktogul Reservoir (the largest in the Syr Darya basin), on the Kyrgyz border (Dinar et al. 2007).

However, it is at the sub-national level, where communities often have to rely on alternative networks to secure access to water—which is threatened by both poor infrastructure and the absence of border demarcation—that disputes over water usage often originate (International Crisis Group 2014; Horsman 2003). A number of local conflicts have taken place in the Ferghana Valley, which is shared between all CA countries except Turkmenistan. There are frequent cases of such conflicts especially in the Kyrgyz town of Batken, on the Tajik border, and the Tajik exclave of Isfhara inside Kyrgyzstan, where the Tajik population is often accused of 'creeping migration'. The Kyrgyz people maintain that the Tajiks are gradually stealing a portion of their land and water resources by taking advantage of the undefined borders (Bichsel 2009).

In 2012–13 there were 38 security incidents on the Kyrgyz–Uzbek border (with four resulting deaths) and 37 on the Kyrgyz–Tajik border (International Crisis Group 2014). Clashes in Uzbekistan's exclave of Sokh and Tajikistan's exclave of Vorukh in 2013–14 involved several thousand people, serious injuries, arson, hostage-taking, and extensive property damage. The tensions are caused by unresolved borders and disputes over access to water and land. On 11 January 2014, Tajik forces fired grenades and mortars into Kyrgyz territory. A senior Kyrgyz defence official said they were aimed at a Toktogul Reservoir pumping station (International Crisis Group 2014). In 2014, unrest broke out between Tajik and Kyrgyz villagers over access to water resources. In 2015, a crowd of nearly 500 Tajik and Kyrgyz villagers threw stones at each other, injuring several people on both sides of the border. Uzbekistan and Kyrgyzstan have also had increased tensions along their border in the Ferghana Valley, with both sides placing strategic troops to protect water assets.

Despite the local frictions, all CA states have agreed on setting up regional organisations (e.g., the Interstate Commission for Water Coordination, see above) for the adoption of water management decisions through a consensus approach. Thus, regional-level water relations have gradually became an outcome of negotiations between the five independent countries. The Soviet-period water

paradigm—hydraulic mission with centralised control system—appears inadequate for the new water security and management concept. But agreement on a paradigm for water resources management and security is still difficult to reach due to the differing water visions of the riparian states. As shown in Fig. 5.8, a technical notion of water management was maintained after the Soviet period and until early 2000 by most of the CA countries.

But after that and up to today, a shift to pursuing new regional water agreements through a political-economic perspective is noticeable. Moreover, the notion of water security emphasised by all these countries since 2015 has been one in which effective and pragmatic solutions are sought (Abdullaev and Rakhmatullaev 2016a).

### 5.4.3 *The Way Forward to Water Security Through a Hydrographic Basin Approach*

In the last decade, a river basin management approach was gradually introduced in each of the CA countries in an attempt to improve national water use and allocation plans on the principles of the EU Water Framework Directive (WFD 2000/60/EC). The EU Water Initiative was established in 2002 as a transnational, multi-actor partnership to support water governance reforms around the globe (Fritsch et al. 2017). For the region of Eastern Europe, Caucasus, and CA, one partnership was established with 10 countries (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russia, Tajikistan, Turkmenistan, Ukraine) for the improvement of legal and regulatory water-related frameworks in alignment with the Water Framework Directive, development of River Basin Management

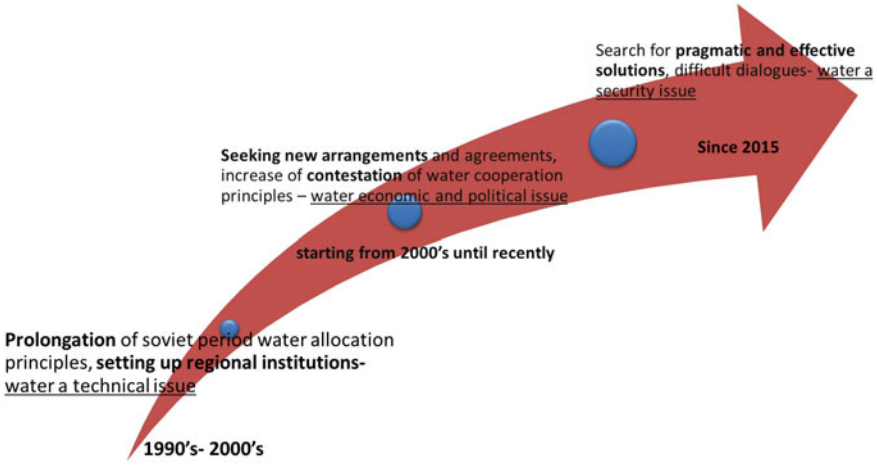


**Fig. 5.8** State of interstate water cooperation in Central Asia. *Source* Abdullaev and Rakhmatullaev (2016b)

Plans (RBMPs), and engagement of stakeholders through National Policy Dialogues and River Basin Councils.

For the implementation of the RBMPs, River Basin Organisations (RBOs) have to be established to monitor all activities related to water management on a basin level. The RBMPs have to gather information from local institutions (e.g. WUAs) and centralised institutions (e.g. ministries), and reduce the currently unregulated water withdrawals from rivers, canals, and newly built groundwater wells which are still common practice in rural areas. All CA countries have set up the legal basis for introducing the basin approach, while RBMPs have gradually been developed in Kazakhstan, Kyrgyzstan, and Uzbekistan over the last three years (2014–17). The legislative documents, mostly called 'water codes', emphasise the water-energy-food nexus of each country and the need to harmonise each national document with those of the neighbouring countries.

The RBMPs in the upstream countries will be obliged to monitor the construction of big controversial dams for hydropower production, such as the Roghun in eastern Tajikistan and Karambata I in north Kyrgyzstan. These large-scale interventions have until recently created conflicts between the upstream countries and Uzbekistan as the most vocal downstream country. But, as mentioned in Sect. 5.3.2 new feasibility studies and strategic environmental assessments are aiming to mitigate the impact downstream, while the change of government in Uzbekistan has raised hopes for reconciliation between CA countries. The current and future hydropower developments are presented in Fig. 5.9.

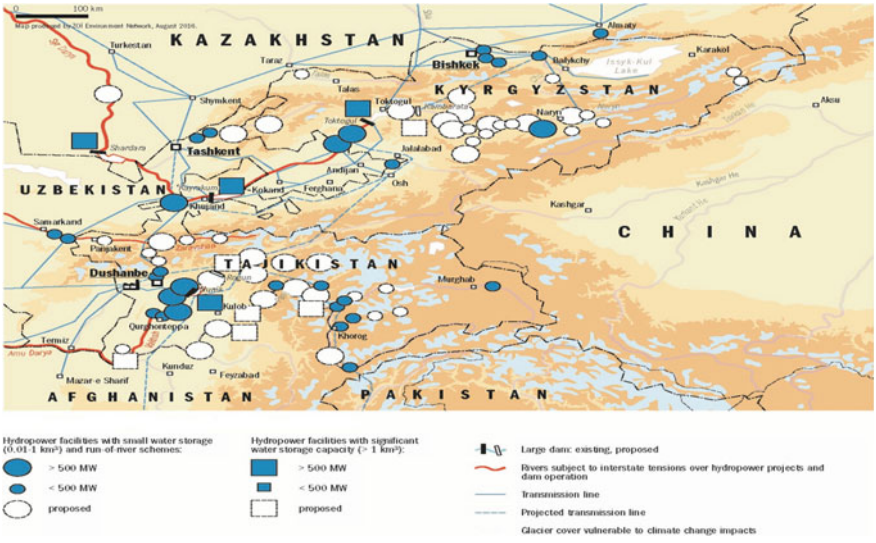


**Fig. 5.9** Hydropower developments in Central Asia, with focus on the upstream countries of Kyrgyzstan and Tajikistan, *Sources* CASA-1000 project (http://casa-1000.org); Electric power sector of Tajikistan, Barqi Tojik, 2011; Afghan Energy Information Centre (http://aeic.af/)

Most importantly, the RBMPs have to address the major challenge of extremely inefficient water supply provided through mechanised pumping. The 30–40% efficiency in many CA farming areas signals the need to restructure irrigation practices at large. Major initiatives have been taken towards shifting to less water-demanding crops in Tajikistan and Uzbekistan, rehabilitation and modernisation of pumping systems all over CA, redesign of tariff policies, and provision of more authority to local agencies like water user associations (UNECE 2017).

Also, in the drinking water supply sector there are major efforts to improve the technical efficiency of the network and carry out economic and institutional reforms (e.g. European Bank for Reconstruction and Development 2015, 2016). International organisations and donors are investing in the rehabilitation of irrigation networks and drinking water supply, mainly in rural areas of Tajikistan, Kyrgyzstan, and Uzbekistan. Moreover, investments in technological interventions in oil, gas, coal, and uranium mining in the region are slowly increasing in volume (Kazakhstan Green Energy 2017). These interventions are anticipated to reduce water input and also to mitigate the water pollution induced by these activities.

However, there is a notable lack of coordination, monitoring, and assessment of these interventions, which is mainly due to overlaps between too many governmental authorities and the differences between governments in prioritising water resources management. For instance, Kazakhstan sets a high priority on water management for food production and holds the Ministry of Agriculture responsible for the development and implementation of agricultural policy and water management. Groundwater use remains under the supervision of the Ministry for Investment and Development and the Committee of Geology and Subsoil Use (UNECE 2017). A similar situation presents itself in Uzbekistan, where the Ministry of Agriculture and Water Resources is responsible for surface water resources and the State Committee on Geology and Mineral Resources for groundwater. Agriculture also plays a dominant role in downstream Turkmenistan, where the Ministry of Agriculture and Water Resources is mainly accountable for efficient agricultural water management.

Kyrgyzstan in 2005 tried to assign greater importance to the water sector by establishing the National Water Council to coordinate all the state and private agencies involved with water resources management. But the council has been inactive for many years, and the newly introduced basin approach is in substance being implemented by the Department of Water Economy and Melioration under the Ministry of Agriculture and Melioration. The clear priority of water for energy use in Tajikistan found expression in the creation of the Ministry of Energy and Water Resources in 2013. While hydropower development is the primary mandate of the ministry, water for agricultural use is supervised by the Agency of Land Reclamation and Irrigation, which is of inferior importance to the ministry.

Coordination of the activities of these authorities by the national RBOs and communication of these RBOs within the framework of a river basin (e.g. the Syr Darya) remains a major challenge to be confronted in the CA region.

## 5.5 Concluding Remarks

The transition to state sovereignty in CA has involved a shift from regional to national policy on natural resources, with major effects for water security. The five countries were initially bound together 'by history, by culture and geography, but also because of decisions made during the Soviet period' (Olcott 2001). The change of the regime signalled the need to securitise water sources on the national level, mainly in connection with the need to securitise the economy of the new states.

National concerns have echoed the need to securitise water resources since the last days of the Soviet area (the *glasnost* period—Weinthal 2002). For instance, on multiple occasions the governments of Central Asian countries have blamed the Soviets for the deterioration of natural resources (Wegerich 2001, cited in MacKay 2009). Yet, the solutions proposed for such environmental problems sometimes resemble the Soviet mega-projects in being based on the engineering of water sources. For instance, representatives of Central Asian states have revived a Soviet-era plan to divert Siberian rivers to refill the Aral Sea (EurasiaNet 2002; The Telegraph 2010).

The latest reforms in water management through a hydrographic approach are expected to bring a new era in water planning and administration by slowly decentralising authorisation from the ministries to RBOs. The River Basin Councils, although they may initially have a limited role, are expected to eventually engage major actors in each region by also informally auditing the activities in each basin. There are major challenges to be met in the communication between RBOs, both within each country and between neighbouring countries. It is questionable for instance whether RBOs will effectively become the main coordinating agency on a basin level or become another intermediary actor in the governmental structure.

Regional organisations and commissions like the Interstate Commission for Water Coordination of Central Asia and the International Fund for Saving the Aral Sea are currently the main outlets of regional cooperation on water resources management and planning in CA. But small steps have been taken in the post-Soviet period to promote a common understanding of water security.

International organisations and donors like the Swiss Development Agency, World Bank, Asian Development Bank, and German Federal Foreign Ministry have attempted to securitise water resources by heavily investing in 'hard' (rehabilitations of HPPs, pumping systems, dredging, etc.) and 'soft' (institutions, legislation, etc.) water management components (Mogilevskii et al. 2017). Improved water services and planning is considered by many donors and agencies a major element of regional stability in CA. But more vigilance is needed with respect to engagement of local communities, as well as endorsement by the central government in each country. More than a few initiatives in the water sector in CA have been gradually abandoned due to lack of attention by local stakeholders and national authorities (Varis 2014).

In CA water security is undeniably a multidimensional concept—perceived differently by each country. Diverse priorities and objectives for water use

management at the national level may torpedo water security in CA through excessive demands and unilateral initiatives. The current (2017) new government in Uzbekistan has brought a new policy dialogue with all its neighbours on water resources management, offering hope for a compromise between upstream energy needs and downstream agricultural and food demands.

There have also been attempts to enhance the regionalisation of infrastructure, trade, and services among the five countries and promote cohesive economic development. For example, interstate train itineraries between the major cities of Uzbekistan and Kazakhstan have been launched (Trend News Agency 2017), while the inclusion of Kazakhstan and Kyrgyzstan in the Eurasian Economic Union (RT 2015) has brought closer economic ties between the two countries.[1]

The political-economic approach that is currently being followed for water management and security in CA as described in this study is greatly affected by the surrounding economic developments in the region. It is anticipated that the common desire of all five countries to promote economic welfare and growth on the national level will also benefit water security and planning on the regional level.

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