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REGIONAL WATER INTELLIGENCE REPORT CENTRAL ASIA

Baseline Report

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Regional Water Intelligence

Regional Water Intelligence Reports (RWIR)

The purpose of the Regional Water Intelligence Reports (RWIR) is to provide regular updates on the political economy of transboundary water resources issues, management and development in support of sustainable investments. The RWIR focus on the socio-economic aspects of water management and highlight the links between water, energy, food and human security from a regional perspective. Each RWIR is designed to provide the client with Key Messages related to their specific needs.

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Note to the Reader

Water is an increasingly strategic resource in the Central Asian region for economic and social development. Water cuts across critical issues such as food and fibre production, energy generation, environmental sustainability and human security. The report highlights these issues and their inter-linkages. The report targets the Aral Sea Basin and focuses on Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. Afghanistan (also a part of the basin) and influential neighboring countries like China and Russia are part of the regional analysis.

The Report was commissioned by the UNDP Water Governance Facility (WGF) as an independent study to inform UNDP strategic decision making on current and future regional and national water programming and sustainable investments.

The Report is a summary of a baseline study prepared in July 2009 for the United Nations Development Programme (UNDP) to support the identification of opportunities for sustainable investments and to inform implementation of ongoing regional initiatives. It is believed that other actors will also find the report useful as a basis for their strategic decision-making in the Aral Sea Basin region.

The WGF would like to thank the authors of the Report and UNDP colleagues for their inputs and comments.

For the Water Governance Facility,
Håkan Tropp and Alastair Morrison

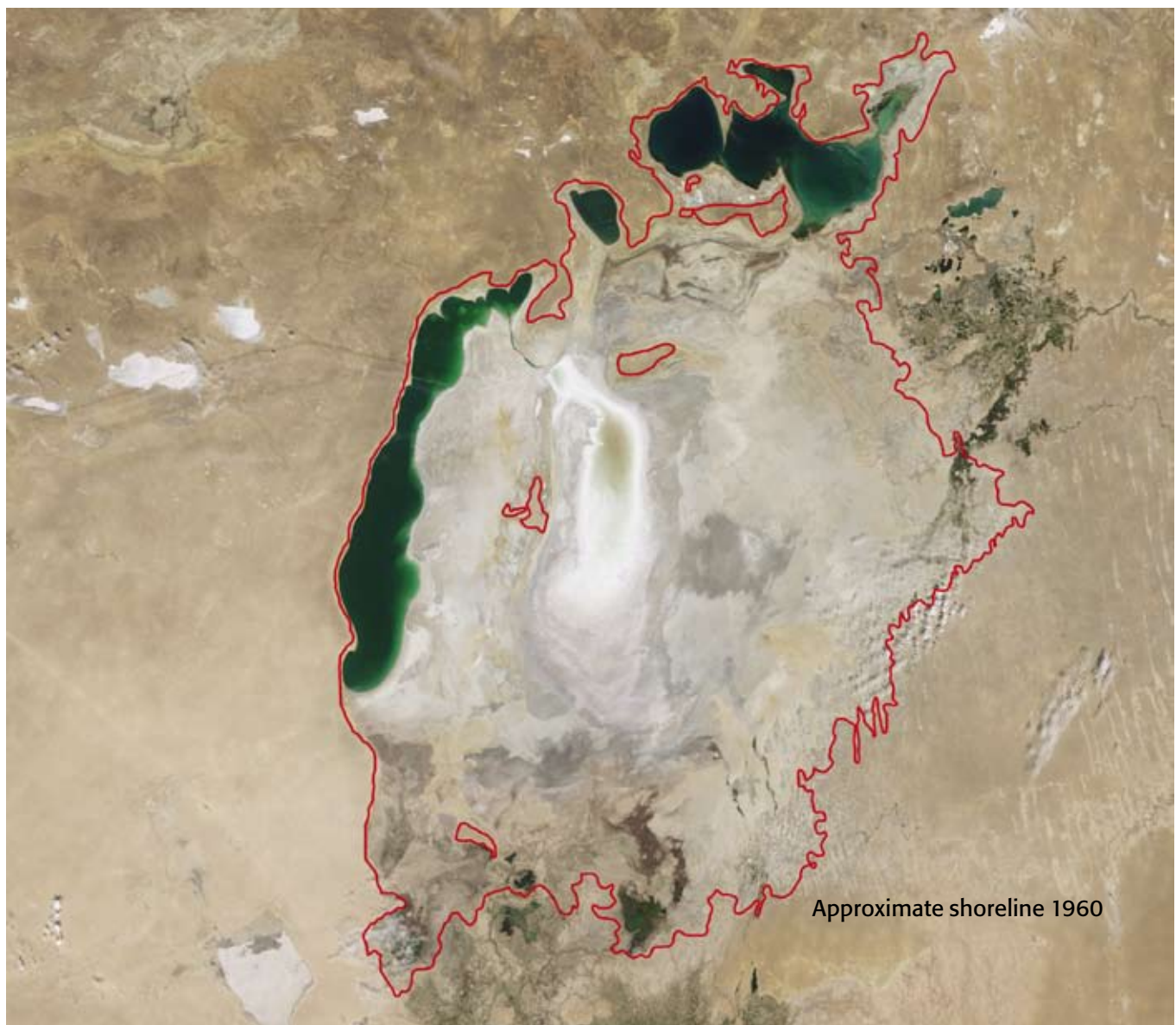


Illustration of the shrinking Aral Sea between 1960-2009.



The Central Asian region and the Aral Sea basin.

List of Abbreviations

CACENA	Caucasus, Central Regional Water Partnership	IMF	International Monetary Fund
CAREC	Central Asia Regional Economic Cooperation	ICWC	Interstate Commission for Water Coordination
CAWSC	Central Asia Water Sector Coordination Initiative	IPCC	Intergovernmental Panel on Climate Change
EAEC	Eurasian Economic Community	NATO	North Atlantic Treaty Organization
EBRD	European Bank for Reconstruction & Development	OECD	Organisation for Economic Cooperation and Development
ECCA	Eastern Europe, Caucasus and Central Asia, EU program	SIC	Scientific Information Centre
EU	European Union	SWF	Sovereign Wealth Funds
EC	European Commission	TI	Transparency International
ECO	Economic Cooperation Organization	UN SPECA	United Nations Special Programme or the Economies of Central Asia
FAO	Food and Agriculture Organisation	UNECE	United Nations Commission for Europe
IAEA	International Atomic Energy Agency	UNDP	United Nations Development Programme
IFAS	International Fund for Saving the Aral Sea	USDA	United States Department of Agriculture
IFI	International financing Institutions	WEC	World Energy Council
IDB	Islamic Development Bank	WIN	Water Integrity Network
IEA	International Energy Agency		
IFPRI	International Food Policy Research Institute		

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1 Conclusions and Key Messages

1.1 The regional context

- 1. Water and economic growth.** The Central Asian states and Afghanistan, except Kazakhstan, are poor. Water for economic growth is therefore at the core of their interests. There is a significant hydropower potential in the Aral Sea Basin¹ and there exist major hydrocarbon assets. The region as a whole is relatively well endowed in water resources but lacks good national and regional management frameworks². There are significant “upstream-downstream” issues with wealthier countries downstream and poorer countries upstream; hydropower potential upstream and irrigation demands downstream; and different governance structures, for example, Kazakhstan pursuing a market-oriented approach while Turkmenistan is based on full state property of water resources. Kazakhstan is taking steps towards commercialisation and cooperation in some water-related sectors such as hydro energy. Water had not been a limiting factor for growth under past arrangements for regional benefit sharing under the Soviet Union. However, water use is now being developed within a different regional framework with independent states promoting significant water development tracks unilaterally putting more stress on the shared water resource. There have already been strong signals in the declining Aral Sea, and with drought and low levels of reservoir storage creating shocks and set-back to the economies in the region. With growing water developments to meet economic growth, opportunities for exports of the benefits of water use into new regional markets are wider than before. Economic growth and regional reform in the water sector is likely to be most effective when grounded in one or more of the regional economic cooperation arrangements. This requires open dialogue on the need for reform that recognises the energy-food-environment nexus of water resources.
- 2. Water governance.** Serious challenges to economic development and water resource reform are posed by lack of transparency and democratic freedoms. Various monitoring institutions³ continue to rank several of the Central Asian nations among the worst performers with regard to issues of corruption and human rights. Corruption can seriously affect the effectiveness of projects undertaken by governmental institutions or initiatives funded by international aid and development agencies. Central Asian nations are also at risk of political instability⁴. All of these indicators have consequences on the long term development of the respective societies as a whole, not least regarding the management of water resources. Regime change might occur swiftly and violently⁵.
- 3. The Aral Sea Basin.** The Aral Sea Basin is a closed drainage system, with the Amu Darya and Syr Darya rivers discharging into the Aral Sea. As both rivers have their sources in the high mountains with snow and ice melt, annual run-off shows strong natural variations. Winter rainfall and spring snowmelt dominate volume and timing of the hydrological regime. The peak natural water discharge into the Aral Sea is in July–August and the minimal during December – March, when the water supply is almost entirely groundwater. In an average year, glacial melt water in Tajikistan contributes 10–20 percent of the runoff of large rivers in the region. In dry and hot years the contributions from glacier melt water to certain rivers can reach up to 70 percent in the summer period. Annual flow variability is especially dependent on the snowpack in the Pamir Mountains. The Aral Sea Basin aquifer consists of at least four different primary aquifers and renewable resources of groundwater are located in about 339 differentiated local aquifers. The region is not water stressed but has restricted per capita amounts of renewable water resources with only Kazakhstan reaching values above 5,000 m³ each year (7,405 m³)⁶. The Aral Sea itself is an example of water-management gone terribly wrong. The major interventions during the Soviet period to stimulate cotton production have led to significant reduction in inflow to the sea. In 2007 the surface of the lake decreased to 10 percent of its original, and the salinity of the remaining southern part is now three times that of normal seawater.⁷ Large amounts of persistent pesticides from agriculture production have ended up in the Aral Sea floor. With the drying of the lake, the floor became land, and this has resulted in poisonous dust coming from the old sea bed.
- 4. Hydropower potential.** Tajikistan, Kyrgyzstan and Afghanistan constitute the water tower of the Aral Sea Basin countries. All countries are striving to develop their hydropower potential, given that about 8 percent of the hydropower potential of the region has been developed. Tajikistan and Kyrgyzstan are the major producers of hydropower in the region, having an installed capacity of 7,009 MW. Total installed capacity in the region is 10,719 MW. The hydro power situation in Afghanistan is difficult to assess as years of conflict has left the power grids severely damaged. Continued instability frequently hampers any attempts to develop the sector. There are five large hydropower plant projects at different stages of progress in the region, all located in Tajikistan and the Kyrgyz Republic⁸. The two largest of these are storage schemes (Kambarata I in the Kyrgyz republic and Rogun I & II in Tajikistan). Kambarata I will have an estimated capacity of 1,900 MW at a cost of approximately 1.9 billion USD, while Rogun I & II will have an estimated capacity of 3,600 MW at a cost of approximately 2.5 billion USD. The biggest run-of-river dam project, Sangtuda I in Tajikistan, is being commissioned in 2009, with a capacity of 670 MW. A run-of-river power station has been constructed on the Amu Darya in Khorog with support from the Aga Khan Foundation, the Asian Development Bank, and the International Finance Corporation. Some of the projects are expected to generate enough energy for export. Downstream countries have expressed fears that the considerable storage capacities of the largest projects will impact water supply to potentially millions of citizens⁹.
- 5. Agriculture and cotton.** Agriculture in the Aral Sea Basin is dominated by cotton, but with an increasing shift towards cereal production. A 2005 report by the International Crisis Group states: “The economics of Central Asian cotton are simple and exploitative. Millions of the rural poor work for little or no reward growing and harvesting the crop. The considerable profits go either to the state or small elites with powerful political ties. Forced and child labor... are common”. However, cotton is central to the regions agricultural production, and will remain so. There is a need for structural reform to allow improved efficiency of resource use, marketing and food security. Production is characterised by low agricultural water use efficiency, with 37 percent losses on supply to farm contours.

6. **Irrigation.** Over 90 percent of the Aral Sea Basin surface water flow is used for irrigation, primarily in Uzbekistan and Turkmenistan. A total area of about 10,679,000 ha (1993-1997) is equipped for full control irrigation¹⁰. Uzbekistan has the largest area at 4,223,000 ha. All countries aim to maximise their respective irrigation capabilities. In Afghanistan the area equipped for full control irrigation is 3,199,000 ha but it is unclear how effectively this potential can be exploited under the current situation. In irrigated areas with high rates of evaporation, groundwater levels have risen resulting in salinisation. Between 10 percent and 50 percent¹¹ of all irrigated agricultural land was affected by salinisation between the years 1993-1997.
7. **Water storage for hydropower generation and irrigation.** Increasing winter storage and ensuring release regimes for summer irrigation in the downstream riparian countries will benefit all parties if energy during the winter can be guaranteed for the upstream countries. A basin-wide management system was operated during the Soviet Union period when downstream states traded energy generated from hydrocarbons during the winter period for water for irrigation during the summer period. When the Soviet Union broke down, the Independent States took a unilateral approach and were unable to negotiate a new cooperative water regime. Optimising the use of water and energy basin-wide remains fundamental. Run-of-river hydropower technologies can avoid the worst of the “electricity versus food” trade-offs now facing Central Asia’s water managers. Many potential sites have been identified.
8. **Water-food-energy nexus.** Central Asia’s poorest countries find themselves particularly vulnerable to water, energy, and food insecurities (water-food-energy nexus). A series of factors such as drought, in combination with higher food and fuel prices culminated in what can be considered a (food) crisis in broad parts of Central Asia in 2007-2008. In the spring of 2008 WFP estimated that roughly 2 million Tajikistanis experienced food insecurity. Tajikistan experienced a “compound crisis” during the winter of 2008, when exceptionally cold weather caused breakdowns in the country’s energy infrastructure, damaged winter crops and reduced livestock herds. Drought conditions led the USDA to forecast declines for the 2008-2009 wheat harvest ranging from 3 percent in Uzbekistan to 25 percent in Tajikistan and Turkmenistan. Water levels in hydropower stations and reservoirs across the Aral Sea Basin reached unprecedented low levels, and posed the real risk of Toktogul and Nurek reservoirs falling below “dead levels”, extending energy cutbacks. The situation was subsequently exacerbated by higher global food prices and by the onset of drought conditions in the spring and summer, which particularly affected Central Asia’s southern and eastern regions, parts of the Fergana Valley and the Aral Sea Delta. Despite a relatively quick response by the international community the crisis revealed the need for new perspectives and strategies in the region regarding similar situations. Such strategies entail linking food, energy and water supply chains within and beyond the Central Asian region.
9. **Food insecurity.** With water and agriculture policy reform slow, food insecurity and malnutrition remain at high levels. Central Asian countries may face increased poverty, food insecurity, and malnutrition with associated increasing the social and political costs. Water use is an important part of the food security agenda. Food self-sufficiency in Central Asia is not curing the region’s problem of food insecurity. Central Asia needs to develop bilateral and multilateral trade agreements within the region and outside of the region, with returns from value chains directed into modernising the region’s dilapidated irrigation systems.
10. **Land reform.** Land reform is a crucial factor for agricultural development, greater efficiency in resource management and better utilisation of water resources. Steps in this direction have been taken by more or less all of the countries in the region but with varied intensity. Kyrgyzstan is leading in this regard with reform strategies in place shortly after the fall of the Soviet Union. The reforms included privatisation of state and collective farms, creation of institutions to facilitate and safeguard the process and the introduction of a market oriented land distribution. Impacts of land reform vary from country to country. In Tajikistan it has meant a rapid recovery of agricultural production with significantly higher output levels than 1991 for several branches within the sector (Lerman and Sedik, 2008).
11. **Water supply and sanitation.** Apart from Uzbekistan, sanitation in the region is reported to be between 90 percent and 100 percent¹² coverage, both in urban and in rural areas. However, service provision has declined dramatically outside the capital cities. The ability to mobilise resources for the sector is severely limited as government budgets are constrained and average household income is low. The declining coverage is characteristic of the overall economic decline and disruption of many service institutions in the former Soviet Union countries during the early years of independence. Not one of the Central Asian Countries is projected to meet the sanitation target of the Millennium Development Goals. Differences between countries in the region are great and official data should be considered with caution. The World Bank¹³ states that the reliability and quality of the services have deteriorated during the last decade and are related to the pre-transitional state of the sector as a whole. The World Bank states further that poorly maintained water distribution networks have resulted in unsafe drinking water in some urban areas.
12. **Toxic waste.** According to the ENS¹⁴ more than one million people in Central Asia are at risk of being affected by toxic waste from poorly managed waste sites. The Aral Sea Basin contains an estimated two million cubic meters of uranium tailings, located in the upper reaches of the Syr Darya basin. The radioactive threat stems from 92 toxic waste sites in Kyrgyzstan that contain tailings from uranium mining during the Soviet era. The construction of the dumps does not meet standards for safe storage of uranium waste. As a result, the area is assessed as being among the world’s ten most polluted areas, with local, regional and transboundary implications. In addition to the risks of mobilising radioactive materials into river systems, groundwater contamination and crop safety in the Fergana Valley are at risk. The problem might be aggravated further by natural disasters such as mud and landslides as well as earthquakes that potentially enable radioactive material to penetrate river and groundwater systems. A proper inventory

of the sites has not been conducted in over 30 years. In 2004 the World Bank approved funding of a six-year project to mitigate effects of potential contamination and exposure by stabilising areas considered to be at risk. This would include creation of warning systems as well as monitoring programmes. In April 2009 the Bishkek Conference was held in Kyrgyzstan, with the aim to discuss joint plans and strategies as well as strengthening regional partnerships with regard to the present situation. The outcome should be considered of key importance to any potential partner of future action regarding the status of regional water resources and environment.

13. **Climate change.** There are strong indications that global warming is accelerating the melting of Central Asia's glaciers. During the period 1957-1980 the glaciers in the Aral Sea Basin lost 20 percent of their ice cover. During the 20th century the glaciers of Tajikistan were reduced in mass volume by 20-30 percent on average. In Afghanistan the decrease is as much as 50-70 percent. The long-term impact of the decreasing glaciers will be a permanently reduced runoff. Projections of the overall long-term flow reduction by 2050 are 10-15 percent in the Amu Darya and 2-5 percent in the Syr Darya. According to UNESCO¹⁵ there are, however, uncertainties about exactly how current glacier melting affects the basin. Snow melt in mountain ranges above 3,000 m, which provides most of Central Asia's run-off, is more or less unmonitored. Despite fears that the Central Asian glaciers will be completely gone by mid-century, Kazakhstan's National Committee within UNESCO'S International Hydrological Program paints a somewhat less grim picture, pointing to glacial upsurge in some parts of the region (however not comparable to the considerable glacial decrease). Recent science carried out by the same institution estimates that water resources in the region may fall by 20-40 percent by mid century (according to their most pessimistic climate model). There is also risk in the shorter term that glacial lakes overflow or burst their banks.
14. **Regional cooperation.** Trust is low between Central Asia countries and between groups within the countries. This partly explains why there are multiple regional organisations with overlapping mandates. Despite the existence of regional cooperation organisations, there are many difficulties in promoting dialogue on shared water resources. According to the International Crisis Group¹⁶ there are several key reasons for this including: 1) regional water systems were designed during the Soviet Union period and now they are managed by five different states; 2) Central Asian economies are dominated by irrigated agriculture practices, the output of which maintains the ruling elites grip on power; 3) Central Asian states have increasingly adopted "zero-sum" positions on water resources and at the same time increased consumption to unsustainable levels; 4) downstream countries are militarily and economically stronger than upstream countries which have produced a power asymmetrical relationship that becomes evident in water conflicts.
15. **Geopolitical situation.** Both Russia and China have key geopolitical interests in the region. The influence of China as an investor in hydropower and as an upstream competitor for water also appears to be having serious implications for the other large

and shrinking lake, Lake Balkhash in Kazakhstan¹⁷. The EU, in contrast, is not seen by the Central Asian countries as a key player even though the EU could potentially be an important partner in promoting good governance and environmental issues. The United States has a strategic security interest in the region that will not be reduced in the coming years. A fourth "axis" to consider is Turkey, Iran and Pakistan that all have strategic energy and longer term trade interests. There are signs that conflicting strategic interests of different regional players might get more complicated as different groups strengthen their positions. For example, the Shanghai Cooperation Organization (SCO) including China, Russia and some Central Asian states have shown their readiness to be a counterweight to US interests in the region. The US applied for observer status in the SCO in 2005 but was denied. Turkey with its considerable historical and cultural ties to large parts of Central Asia has also raised its profile as a regional key player. Ankara has expressed its potential as a gateway to push forward EU agenda in the region, thus benefiting ambitions to forge closer ties to the European Union. Turkey also enjoys a special relationship to Turkmenistan¹⁸, the regional supplier of natural gas and a country that is of interest to the EU in terms of energy security.

16. **External Financing Institutions.** IFIs activities in the region relating to the water sector span various fields of interest. According to the Asian Development Bank there are several efforts involving many major actors in Central Asia to tackle the energy and water resource management sectors. UN SPECA established a 'project working group' on energy and water in 1998. The group has created lists of investment projects for funding by donor agencies as well as creating a regional diagnostic study on water and energy in Central Asia. The World Bank has foremost assisted on a country level basis, mainly focused on activities towards projects in the energy sector and reforms based on market principles. Initiatives involving donor organisations in the water management sector are several. EBRD has focused, among other things, on municipal projects to improve water distribution systems. The EU is involved in various water resource management projects, mainly developing regional water and land information systems and interstate water agreements. USAID has been active in regional water management activities since 1993 and among its achievements is contributing to the 1998 framework agreement on Syr Darya River. USAID has switched its focus in later years from policy reforms to more practical, short term strategies on local scales. Germany supports rehabilitation of small-scale hydro electric plants in the Kyrgyz Republic. Growing donor coordination is increasingly evident in Central Asia. For example, United Nations Commission for Europe (UNECE), Organisation for Economic Cooperation and Development (OECD) and the European Commission (EC) have agreed to align their water activities under a new partnership umbrella. Another new partnership umbrella is the Central Asia Water Sector Coordination Initiative (CAWSCI) which is an effort to get several donor agencies to align their water activities and increase effectiveness of donor interventions. However, clear leadership and strength to coordinate and convene all parties appear lacking. The issue of country participation in these regional donor coordination processes also needs to be carefully assessed and ensured.

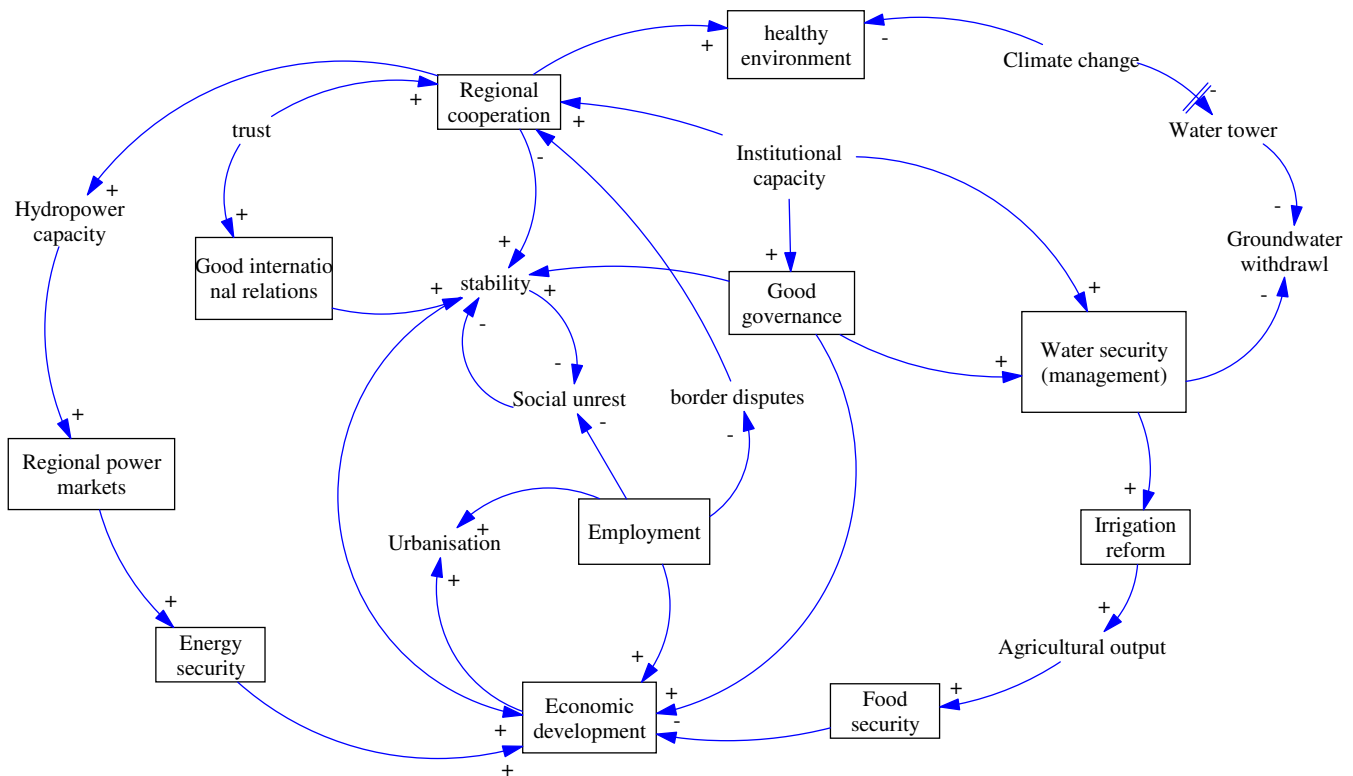
1.2 System analysis and drivers for change

Our analysis indicates that attempts to tackle regional cooperation on water resources have not been very successful. One of the latest attempts by the International Fund for Saving the Aral Sea (IFAS) Heads of State in Almaty, Kazakhstan, April 2009, to discuss a common agenda for the Aral Sea Basin ended with no tangible results and "...if anything stoking acrimony among participants on the water-use issues".¹⁹ Key issues include disagreement on how to cooperate because of the upstream countries' interests in developing water resources primarily to meet energy needs and the downstream riparians' interests in safeguarding irrigation needs. All countries agree that cooperation to address the Aral Sea is critical but the tools and instruments to do this are not currently available.

Economic development is the primary interest of all the Central Asian states. Hence, support towards that objective is critical. In relation to regional water issues we conclude that what all the

central Asian states have in common are the needs to undertake irrigation reforms to increase food security, strengthen power generation through good hydropower development coupled with a focus on regional power markets to ensure energy security, and manage water collectively to tackle climate change and achieve water security. These measures would in turn contribute towards improvement of the Aral Sea ecosystem.

Positive drivers to move towards the economic development objective are the available human capital, the good water and energy resources, steps towards regional economic cooperation and market economies, and emerging reforms in the agriculture sector. Negative drivers are political instability, a colonial legacy from the Soviet period, weak management and institutional structures, distrust and boundary disputes, climate change, crime and violence, poverty, and external forces seeking access to the region's natural resources.



The diagram shows the underlying factors and key drivers in the region, and how they are linked. A positive sign next to a link illustrates a reinforcing relation, whereas a negative sign illustrates a balancing relation.

2 Regional Political and Economic Outlook

2.1 Water politics

2.1.1 During the Soviet period

During the Soviet era the states of Central Asia were engaged in advanced cooperation over shared waters. Water supplied from upstream states was compensated through energy provision in the other direction. Water resources were an exclusive state property and therefore provided as a 'free good'. The Union determined quotas between its different republics. Charges were only for the development and maintenance of water supply schemes and not for the amount of water consumed. This considerably reduced water use efficiency (Klötzli, 1994) and contributed to the demise of the Aral Sea. Water policies were largely supply-driven as opposed to demand-driven (Björklund, 1999). Countries outside of the Soviet Union but inside the Aral Sea Basin, including Afghanistan and Iran, were influenced by the Soviet water management approach as they were to some degree within the sphere of economic dependence on the Soviet Union.

2.1.2 Post independence water politics

The collapse of the Soviet Union brought the emergence of 15 new states, among them the five central Asian countries. Water apart, there were a range of other serious challenges for the newly formed states. First the overall political challenges of forming a nation state and second, the decision to open up their economies and move from a centralised to a market-based economy. Borders between states were drawn along 'artificial lines' and border disputes still persist.

Competition for regional influence and domination in the central Asian region continues. Russian interests in the region are long standing but also Iran, Turkey, China and the US have all increased influence. Predominantly Shia Iran has sought to influence parts of the Muslim communities living in the region despite the Sunni dominance. China has increased its influence through economic activity and trade. The US has strategic interests, and in order to secure supplies to its Afghanistan operation has sought to use military as well as civil airbases in the Central Asian countries. Kyrgyzstan decided in February 2009 to evict US forces from one of its airbases and currently it is reported that the US instead are negotiating a return to Uzbek air bases. The US interest has in turn been seen by Russia and China as an effort to alter the strategic balance in the region and thus prompted Russian action to get more involved.

Since the break-up of the Soviet Union, the competing demands upon the Amu Darya and Syr Darya water resources by the newly-independent states have become increasingly evident. Even though the states decided in 1990 to keep quotas from the Soviet era, they also affirmed their rights to control land, water and other natural resources within their territories for agriculture and energy purposes.

During the Soviet period downstream states would pay upstream states for the summer release of water stored during winter time with free gas and coal to generate electricity in the cold winter months. Shortly after independence the countries in the region

agreed to maintain the pre-independence system. But after some time this was deemed unworkable, primarily because of the civil war in Tajikistan that ended a decade ago and the decline of the economy of Kyrgyzstan which meant that water monitoring stations fell into disrepair. In essence the water issue has increasingly been seen by all countries as a zero-sum game. This, in turn, has led the countries to adopt steps to increase the national control over water. The upstream countries have argued that water should be treated as a commodity and paid for by the downstream countries. The downstream countries have, in turn, adopted the international legal foundation that water in an international river is a common good to be shared by all riparians (Linn, 2008).

2.2 Democracy and corruption

According to the Economist annual survey, the countries of Central Asia (including Afghanistan) are among the least democratic in the world. Kyrgyzstan qualifies as a "hybrid regime" while all other nations in the region are considered to be authoritarian. Turkmenistan and Uzbekistan rank among the five least democratic countries in the world. All countries in the region are severely affected by corruption. According to Transparency International's annual index, they are among the most corrupt in the world. These results have been consistent over several years of survey.

Substantial transformations towards democratic reform have not been realised in the region in the years since the collapse of the Soviet Union (Olcott, 2002). In particular Tajikistan, Turkmenistan and Uzbekistan as well as in regions of Kazakhstan and Kyrgyzstan, secular and civic values have increasingly been set aside for traditional values (national, cultural or religious) in some cases with fundamentalist expressions.

Kyrgyzstan and Kazakhstan have progressed further in economic reform and are also more open societies. To sustain economic growth and development it can be expected that these countries will face strong internal pressure for democratic reform despite previous setbacks. Other countries in the region that have developed slower, like resource rich Turkmenistan, will face even more difficult transitions with growing and probably increasingly frustrated populations.

Afghanistan held free elections in 2004 which ensured the installation of a western-oriented president. Continued fighting between NATO forces and insurgents and the ensuing lack of security has crippled the democratic process in the country (Peters, 2009). The elections in August 2009 have done little to resolve the democratic process, with a turnout of only 38 percent of voters and both the Independent Electoral Commission and EU observers considering the results to be compromised²⁰.

2.3 Religion

Most of the countries have a clear majority of Sunni Muslims, with Shia comprising between 3-6 percent of the Muslim population. Kazakhstan is the exception in terms of religious composition where around half of the population is Muslim and half is Christian. Islamic fundamentalism in the five Central Asian countries appears not to be a major issue except for concerns regarding the growing strength of the Taliban in Afghanistan and Pakistan.

2.4 Economic cooperation and regional institutions

There exist a number of organisations and institutions for economic and political cooperation in the Central Asian region and beyond. There are overlapping mandates between these organisations and it is unclear how they relate to each other. There are currently four key regional economic institutions plus the proposed Central Asian Union:

The Shanghai Cooperation Organization is an intergovernmental mutual security organisation founded in 2001 by China, Kazakhstan, Kyrgyzstan, Russia, Tajikistan and Uzbekistan. Formerly all countries with the exception of Uzbekistan were parts of the Shanghai Five formed in 1996. Besides the work on security related issues, the organisation works also to address socio-economic development issues. A framework on economic cooperation was agreed in 2003. The organisation promotes bilateral cooperation where multilateral cooperation is not politically feasible.

The Eurasian Economic Community (EAEC) originated from the CIS customs union between Belarus, Russia and Kazakhstan from 1996. Kyrgyzstan joined in 2000 and Tajikistan and Uzbekistan in 2005. EAEC aims to provide the countries with a single economic space for coordinating approaches to the international trading system.

The Central Asia Regional Economic Cooperation (CAREC) Program was initiated in 1997. CAREC's goal is to improve living standards and to reduce poverty in CAREC countries through more efficient and effective regional economic cooperation. To date, the programme has focused on financing infrastructure projects and improving the region's policy environment. The members of CAREC are Afghanistan, Azerbaijan, China, Tajikistan, Mongolia, Kyrgyzstan, Uzbekistan and Kazakhstan. Turkmenistan and Russia have also been invited to join. CAREC also co-operates with the Shanghai Cooperation Organization and the EAEC.

The Economic Cooperation Organization (ECO) is an intergovernmental regional organisation established in 1985 by Iran, Pakistan and Turkey for the purpose of promoting economic, technical and cultural cooperation. ECO is the successor organisation of the Regional Cooperation for Development (RCD) that existed between 1964 and 1979. Member countries are Afghanistan, Azerbaijan, Iran, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkey, Turkmenistan and Uzbekistan. The organisation aims to promote economic development in its member countries and the removal of trade barriers to further the integration of its members in the international trading system.

A recent attempt to revitalise regional cooperation is the Central Asian Union proposed by Kazakhstan President Nursultan Nazarbaev on April 26, 2007 and to consist of the five Central Asian republics of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. The proposed Union would primarily deal with interstate border issues, trade, visa regimes, tourism, and security. If realised, the Central Asian Union would represent a counter-balance to the existing Russian-dominated Collective Security Organization (CSO) and the Chinese-Russian led Shanghai Cooperation Organization²¹. Though the proposed Central

Asia Union has the support of the presidents of Kyrgyzstan and Tajikistan, it was outright rejected by Uzbekistan president Islam Karimov²².

2.5 Regional water cooperation

After independence the five states in the Aral Sea basin established several institutions to address regional water issues. The International Fund for saving the Aral Sea (IFAS) was established with its executive committee and national branch offices. The Interstate Commission for Water Coordination (ICWC) was established within IFAS. The Aral Sea Basin Programme (ASBP-1) was established along with the Interstate Commission on Sustainable Development (ICSD) in 1992 and the Regional Hydro-Meteorological Centre²³. This institutional development has been described as visionary, but the reasons may have been more pragmatic: after independence the cotton harvest had to be secured, and the way to do this was quickly signing an agreement that basically confirmed the old management regime during the Soviet time²⁴.

The International Fund for the Aral Sea (IFAS) is under the authority of the deputy prime ministers of the Central Asian states, but excludes Afghanistan. The organisation's task is to administer the *Aral Sea Basin Program, ASBP*, or more specifically, to prepare a general strategy of water distribution, rational water use, and protection of water resources in the Aral Sea Basin. On the basis of the strategy, draft intergovernmental legal and normative acts to regulate issues related to the consumption and protection of water from pollution, and the social and economic development of the region (Björklund 2005). Long-term water and energy issues have also been addressed by ICWC. Kazakhstan, Kyrgyzstan and Uzbekistan signed an agreement concerning dams in the upper Syr Darya River Basin in March, 1998 which includes provisions for Kazakhstan and Uzbekistan to share equally in the purchasing of summer hydropower from Kyrgyzstan, while the payments can be made in cash or by means of delivery of coal or gas.

The EU Water Initiative and its Eastern Europe, Caucasus and Central Asia (EECCA) program is a partnership that seeks to improve the management of water resources in the EECCA region. The partnership was established between EU and the EECCA countries at the World Summit for Sustainable Development in 2002. One important component in this is the "Integrated water resources management, including transboundary river basin management and regional seas issues". Several organisations and partners of the Kyrgyz EUWI National Policy Dialogue process agreed in 2008, in Bishkek to work closer together and coordinate actions regarding complementary water sector programmes in Central Asia. These strategies aim foremost at creating synergies and avoid duplicative actions in the region. This would also strengthen potential for future cooperation²⁵.

In 2002, Central Asian countries together with Caucasian countries, formed the *CACENA Regional Water Partnership* under the Global Water Partnership (GWP). Within this framework, state departments, local and regional organisations, professional organisations, scientific and research institutes as well as the private sector and NGOs cooperate to establish a common understanding of the critical issues threatening water security of the region.

In 2004, experts from Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan produced a regional water and energy strategy (UNECE, UNESCAP, 2004) within the framework of the *United Nations Special Programme on the Economies of Central Asia, SPECA*. In collaboration with the European Union Water Initiative and the European Commission, UNECE is engaged in developing integrated water resources management in the Central Asian States. In cooperation with Germany and other EU countries, UNECE might also play a role in the implementation of the EU Strategy for Central Asia in the water and energy sectors (Libert, 2008).

In spite of the promising steps to organise water management at the regional level, cooperation organisations that exist in the Central Asian region do not appear to be working effectively and cooperation is not taking off. The World Bank (World Bank, 2006) has argued that linkages among sectors represent an opportunity for increased cooperation such as border management, security, labor movements, trade, irrigation investments and water allocation along the major river basins and between electricity trade, hydropower generation and water. A concrete proposal that can generate benefits to the region is to *progress towards a regional power market*, with major electricity flows and benefits in the region. This would also help to ease the surging energy demands during winter time in parts of the region.

2.6 Financial crisis

The economic situation in the Central Asian countries was already problematic before the financial crisis of mid-2008. Central Asia is facing severe problems as a result of the global financial crisis with decrease in growth, increased unemployment, return of migrant workers (mainly from Russia) with resulting decrease in remittances, and falling exchange rates. The falling currencies of the region have made external debt much more expensive and

inflation rates are soaring. Measures to strengthen the currencies against the dollar have been taken but are not sustainable in the long-term as currency reserves have shrunk drastically since autumn 2008²⁶.

2.7 Labor, employment and migration

Unemployment is a major problem that could potentially feed fundamentalism and destabilise countries as well as the region as a whole. In some countries the official figures are very low (Uzbekistan 0.9 percent, Tajikistan 2.3 percent, Kazakhstan 6.9 percent) but are much higher in reality. In Kyrgyzstan the official figure is 18 percent and as high as 60 percent in Turkmenistan²⁷. With the financial crisis still ongoing the situation is likely to get worse as migrant workers from Central Asian countries are forced to return from Russia. Growing unemployment rates can create more fertile ground for extremism.

Net migration rates for Afghanistan in 2008 are the second highest in the world, second only to the United Arab Emirates, according to the Central Intelligence Agency. After decades of civil war and conflict, millions of Afghans have lived outside the country since 1979²⁸ – at times, as much as one fifth of the population. Afghans have long been the world's single largest refugee group.

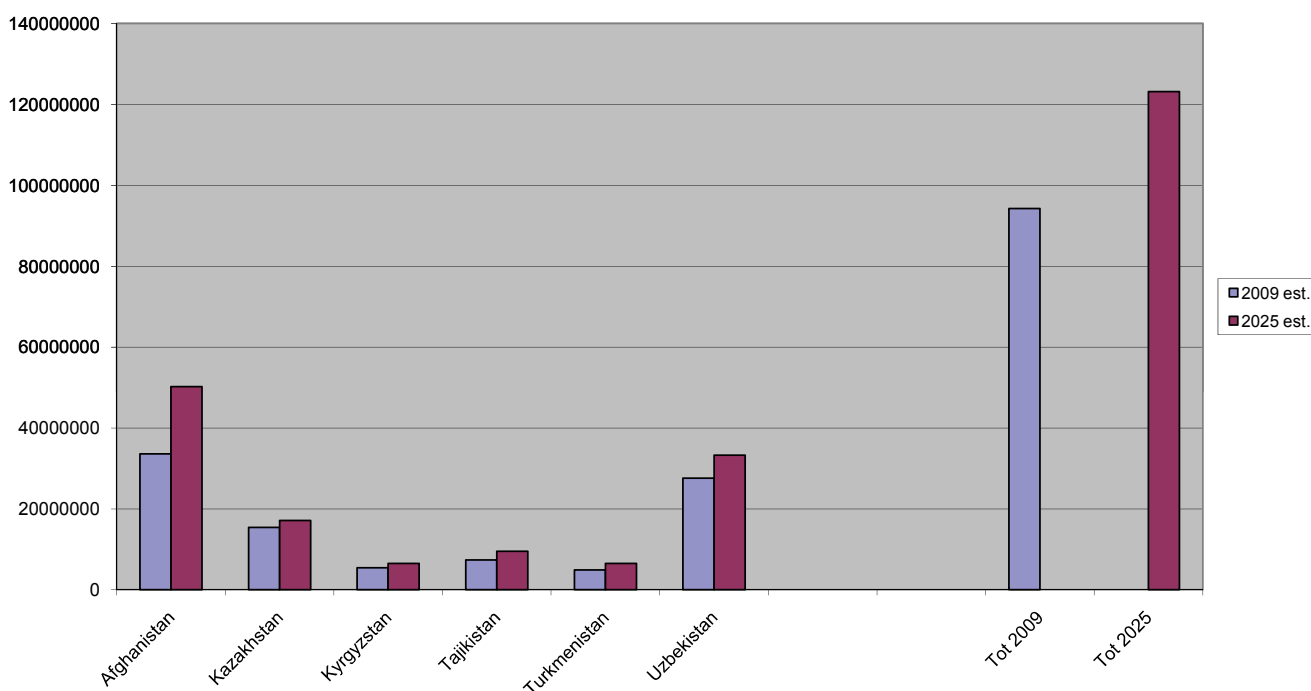
2.8 National political and macro-economic information

2.8.1 Kazakhstan

Political development

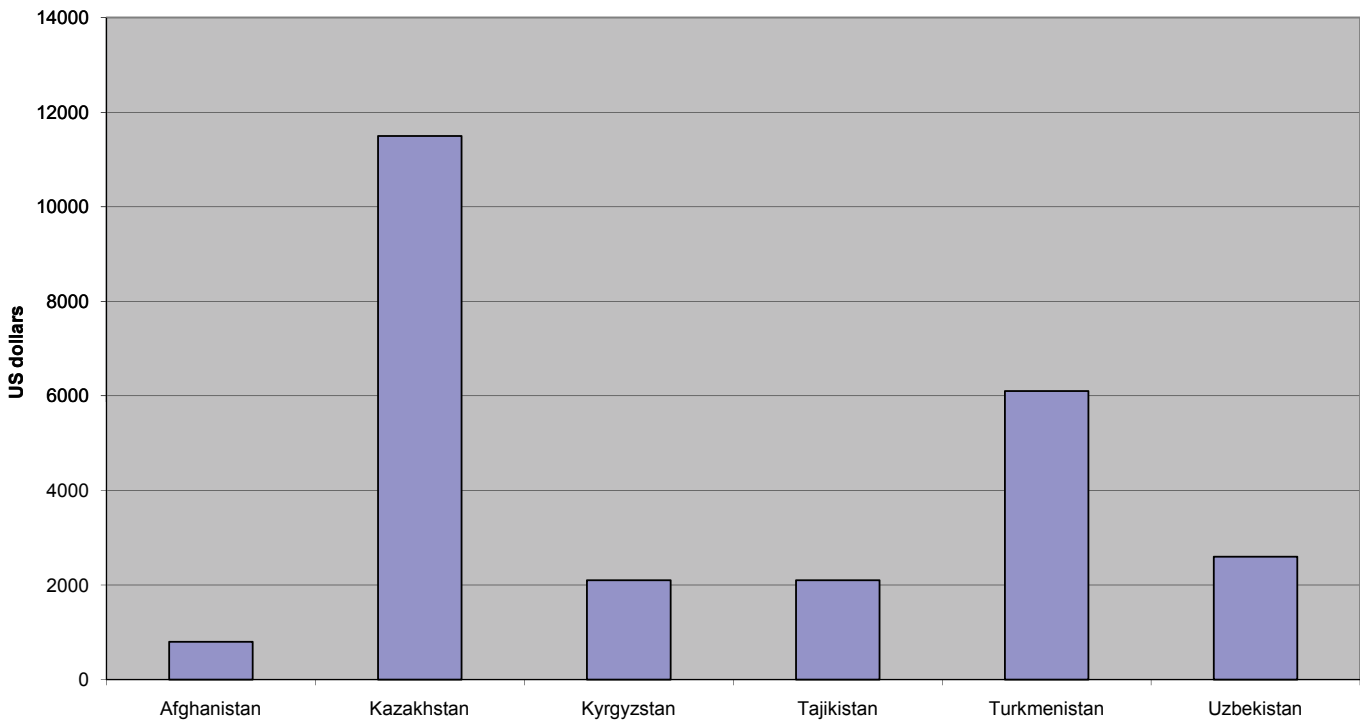
Kazakhstan is ruled by President Nursultan Nazarbaev (since 1991). His party Nur Otan won all the parliamentary seats in the parliament in the last elections, and no other party reached the

Population
Source: CIA- world factbook, PRB



GDP per capita

Source: CIA- world fact book



threshold of 7 percent to get into parliament. Nazarbayev seeks to retain the role as president, and in June 2007 the constitution was amended so that he could be president for life. Corruption and human rights violations are reported. While the country enjoys relative stability, it has problems of income inequality and poverty – between 10-15 percent of the population are considered to be poor.²⁹

Macro-economic development

In a regional comparison the economy of Kazakhstan is strong and developed. The GDP per capita in 2008 was around 11,500 USD. Since its economy is dependent on commodity exports the slump in the worldwide economic activity has had serious negative impacts in the country. As a consequence, economic growth in the country has significantly slowed down. The IMF forecasts an economic growth for Kazakhstan at -2 percent during 2009. To address the significant economic slowdown the country has, after initially drawing down foreign exchange reserves, opted for a devaluation of some 18 percent. Still, there is a trust on the part of the international system that the country will be able to address and handle the economic crisis in a sound manner^{30,31}.

2.8.2 Kyrgyzstan

Political Development

Kyrgyzstan is a poor country with over half of its people living below the poverty level. Its first president, Askar Akayev, ruled the country from 1991 to 2005 when he was ousted from power after public protests against his rule largely on matters of corruption and authoritarianism. New elections were held in which Kumanbek Bakiev came to power, on a promise to decrease corruption and reduction of presidential power. However, he has since come under fire from some quarters for failing to live up to the promises made during his campaign. By regional comparison, the democratic level

in the country is relatively high but political and social unrest has marked much of Bakiev's reign.³²

Macro-economic development

The Kyrgyz economy is expected to be badly hit by the financial crisis with a slowdown in growth from 7.5 percent in 2008 to a predicted 1 percent growth for 2009³³. The GDP per capita was around 2,100 USD in 2008. The global and regional economic slowdown will negatively affect the Kyrgyz economy via trade and remittances, also spilling over to domestic demand.

2.8.3 Tajikistan

Political Development

Tajikistan is still recovering from the devastating civil war that followed the disintegration of the Soviet Union. Two warring factions, one supported by Russia and led by Emomali Rakhmon and one by Pakistan, the United Tajik Opposition (UTO), engaged in a civil war between 1992 and 1997 when a peace agreement was brokered by the UN. The agreement left Rakhmon as president with the bulk of power but with UTO receiving a 30 percent representation within government. Tajikistan is furthermore plagued by poverty, with over 80 percent living below the poverty line.³⁴

Macro-economic development

Tajikistan inherited economic structures that were heavily dependent on Soviet supply and trade networks. After the break-up of the Soviet Union the Tajik economy suffered a severe blow arising from the interruption of trade and transfers. However, the Tajik economy experienced a growth at 8.5 percent in 2008 and the forecast for 2009 is a growth of about 2-3 percent³⁵. This growth is from a low level, with a GDP per capita at 2,100 USD for 2008. Loss of remittances from returning migrant workers will affect the economy negatively.

2.8.4 Turkmenistan

Political Development

Turkmenistan is, in essence, a one party state with a foreign policy founded on isolation and neutrality. The country is isolated from many of its neighbors and participates as a member of just one of the regional organisations in the region (The Economic Cooperation Organization). The president, Gurbanguly Berdimukhammedov, has virtual absolute power in the country. His predecessor, Saparmurat Niyasov, had increasingly isolated the country. Small reform steps have been taken, and the president has entered into discussions on joining other regional and international organisations.³⁶

Macro-economic development

The GDP in Turkmenistan grew by 10.7 percent in 2008. The IMF forecasts GDP growth to be just above 10 percent in 2009³⁷. The GDP per capita in the country is around 6,100 USD. The relative isolation of the Turkmen economy has left the country less exposed to impacts of the recent financial crisis and economic slowdown compared with its neighbors.

2.8.5 Uzbekistan

Political Development

Since 1991 the country has been ruled by former communist Islam Karimov. Repression of opposition movements and a poor human rights record are reported. Although Karimov had already served two terms – the maximum according to the constitution- he won a landslide victory in 2007 elections. Islam is a strong force in Uzbekistan and the country has experienced terrorist attacks during the last decade. Poverty is a huge problem in Uzbekistan estimates in 2004 placed one third of the population below the poverty line³⁸.

Macro-economic development

The Uzbek economy enjoyed a growth rate at about 9 percent during 2008, and the IMF is predicting the growth to only decline to around 7 percent during 2009³⁹. GDP per capita was around 2,600 USD in 2008. The loss of remittances from migrant workers returning home from Russia is expected to affect the economy negatively. Government control over the economy, absence of economic reforms and protectionist policies has contributed to the poor state of the economy in spite of high growth rates during the last few years⁴⁰.

2.9 International assistance and aid

According to the World Bank, Overseas Development Assistance (ODA) reached the equivalent of 83 USD per person in Afghanistan in 2008. The US pledged 10.4 billion USD worth of development aid to Afghanistan between 2002 and 2008 of which roughly 5 billion USD have actually been dispersed⁴¹. The Afghan government has requested 50 billion USD from international donors for the next five years of development (ibid). Kyrgyzstan was the second largest recipient of aid with a per capita value of 60 USD.

USAID has been active in Central Asia since the collapse of the Soviet Union. Aid money aims to improve several sectors in the region, including health, governance (including budget and tax systems, law etc) and environment and agriculture.

The European Union has adopted a somewhat similar approach as USAID, targeting broad sectors of Central Asian societies. The 2007 EU strategy for a new partnership with Central Asia lists five key areas: establish a regular political dialogue at the level of Foreign Ministers, an EU education initiative, EU rule of law initiative, a human rights dialogue, and conduct a regular energy dialogue. The EU, hence, sees the need to work with the Central Asian countries to develop their energy sectors as large parts of Europe are depending on safe and effective energy supply from the region. There is also an expressed wish to assist the Central Asian countries in their potential aspirations to forge closer ties with the EU as the union expands further eastwards. The EU Water Initiative is also contributing towards improved water management in the region.

UNDP⁴² has started a multi-million dollar project with the European Commission and the Government of Norway in support of national integrated water resource management and water policy dialogues in Tajikistan and the Kyrgyz Republic. Through its cooperation with GEF, UNDP is supporting sustainable land management projects under the multi-donor Central Asian Countries' Initiative for Land Management. Together with UNECE, OSCE, UNEP, and NATO's Science for Peace programme, UNDP is supporting the Environment and Security initiative's mapping of cross-border environmental risks in the Amu Darya and Eastern Caspian basins. The Environment and Security initiative (ENVSEC) is a cooperative arrangement between UNEP, UNDP, OSCE and NATO, identifying and mapping situations in which environmental problems threaten to generate tensions and where environmental cooperation may help build a common understanding of other more general issues. For example joint collection of data or management of a transboundary nature reserve is not seen to immediately reduce insecurity per se, but to help to build trust and strengthen cooperation^{43,44}.

UNDP has been appealing for regular assessments, monitoring and medium-term prevention of "compound energy-water-food crises" in Central Asia⁴⁵ based on an approach focusing on:

- making national water management frameworks more sustainable;
- helping Central Asia respond to climate change threats by capturing the benefits of renewable energy and carbon finance; and
- helping Central Asia respond to human security risks posed by uranium tailings and other water-related environmental hot spots.

Several donor agencies have recently agreed to align their water activities within a new partnership umbrella – the Central Asia Water Sector Coordination Initiative (CAWSCSI), a process that maps projects and interventions, and supports the identification of innovative and commonly agreed-upon strategic approaches and implementation mechanisms. CAWSCSI is meant to provide a tool that allows partners to define synergies and opportunities, to link programmes and initiatives in the region in order to increase effectiveness of donor interventions.

3 Water Resources and Hydrology

3.1 Data availability

Hydrometric monitoring reached its most advanced level in the mid-1980s⁴⁶. However, in the 1990s, because of widespread economic destabilisation, this system declined; there are now 384 climatic stations and 273 hydrometric posts⁴⁷, whereas in 1985 there were more than 800 posts. Water quality is registered at 154 points.

The ICWC is the best-equipped regional centre, with an IWRM information system supported by UNECE and UNEP/GRID Årendal and with financing from the Swiss Development Cooperation. This system, CAREWIB, currently serves stakeholders in the Aral Sea Basin at the interstate level. The Information System on water and land resources in the Aral Sea basin is designed to support decision-making processes in the water sector in Central Asia. The Information System is a practical tool for comprehensive assessment of the water situation, and a means for dissemination of required data checked and adjusted by the states. It is intended to enable regional and national organisations to transfer to a common “informational language” that will help raise the validity of data being used, and therefore raise the effectiveness of water resources management. There is an operational data system on the Syr Darya River basin that allows users to access information from the previous month⁴⁸, with a similar system for the Fergana IWRM project.

3.2 Aral Sea Basin

Eight countries share the 1,549,000 km² Aral Sea Basin. The Syr Darya drains five countries – China, Kazakhstan, Kyrgyz Republic, Tajikistan and Uzbekistan. The Amu Darya drains six countries – Afghanistan, Iran, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan.

Based on long-term time series adjusted for withdrawals⁴⁹, average annual renewable surface water resources in the Aral Sea Basin are estimated at 116 km³. At 78 km³, flows in the Amu Darya would naturally be twice those of the Syr Darya Basin at 37 km³. More than 70 percent of the flow of the larger Amu Darya rises in Tajikistan and of the Syr Darya in the Kyrgyz Republic.

The climate is sharply continental, with high evaporations rate (up to 1,700 mm p.a.) and high summer temperatures (up to 49° C).

Winter rainfall and spring snowmelt dominate volume and timing of the hydrological regime. The annual flow variability is especially dependent on the snowpack in the Pamir Mountains. The headwaters drain a glacial environment with a characteristic large number of natural lakes⁵⁰, together storing 51 km³.

3.3 Massive decline in annual decadal inflows into Aral Sea

The climate makes agriculture difficult without irrigation. In the 1960s, the development of irrigation in the Soviet part of the Aral Sea Basin increased the irrigated area from about 4.5 million ha in 1960 to almost 8 million ha in 2000⁵¹. The livelihoods of nearly half the region’s population depend directly or indirectly on irrigated agriculture. With the expansion of irrigation, total water withdrawal increased from 64.7 km³ in 1960 to 120 km³ in 1980, of which more than 90 percent was used for agricultural purposes. By 2000, withdrawals had fallen back to 105 km³, and the inflow to the Aral Sea estimated at 1-2 km³/year from the Syr Darya and 5-10 km³/year from the Amu Darya. Uzbekistan and Turkmenistan account for 54 percent and 22 percent of irrigation withdrawals respectively.

Primarily as a consequence of irrigation withdrawals, inflows into the Aral Sea dropped dramatically:

- Prior to 1960 56 km³
- 1961-1970 43 km³
- 1971-1980 17 km³
- 1981-1990 4 km³

Losses of 50 percent or more of the diverted water occur throughout the system, and there is obviously scope for substantial increases in water use efficiency, particularly at the farm level⁵². Not all the volume shown as ‘losses’ is wasted. Of the estimated return flows of 40-50 km³, 51 percent returns to rivers, 33 percent to natural depressions, and 16 percent is re-used in irrigation⁵³. Re-use in irrigation is low because high mineralisation from salinised soils represents a source of pollution incompatible with agriculture. New lakes have been formed purely from return flows, for example at Sarykamys and Arnasai.

In 2007 the surface of the lake decreased to 10 percent of its original, and the salinity of the remaining southern part is now

	Syr Darya		Amu Darya		Aral Sea Basin	
	km ³ /yr	% of basin flow	km ³ /yr	% of basin flow	km ³ /yr	% of basin flow
Afghanistan	-		14.50	18.3	14.5	12.4
China	0.75	2.0	-	-	0.75	0.7
Iran			0.86	1.1	0.86	0.9
Kazakhstan	2.43	6.5	-	-	2.43	2.1
Kyrgyz Republic	26.85	72.2	1.60	2.0	28.45	24.4
Tajikistan	1.01	2.7	55.73	70.3	56.74	48.6
Turkmenistan	-		1.53	1.9	1.53	1.3
Uzbekistan	6.17	16.6	5.06	6.4	11.22	9.6
Total	37.20	100.0	79.28	100.0	116.48	100.0

three times that of normal seawater. Large amounts of persistent pesticides from agriculture production have ended up in the Aral Sea floor. With the drying of the lake, the floor became land, and this has resulted in poisonous dust coming from the old sea bed. Over recent years interventions have been made to save at least part of the Aral Sea. The construction of Kokaral dike that separates the northern part (Small Aral Sea) from what used to be the southern part of the sea has resulted in filling up at least the northern section. The current dike seems to hold. Two earlier attempts to construct the dike failed, because it was washed away once the water level rose. The current increased level has led to a reported return of fish and a milder micro-climate. Nevertheless, due to the high salt levels in the water of the southern Aral Sea, the evaporation is speeding up, leading to a rapid disappearance of at least the eastern part.⁵⁴

3.4 Substantial but complex groundwater resources

The Aral Sea Basin aquifer system is complex and consists of at least four primary aquifers. Renewable resources of groundwater are located in 339 differentiated local aquifers with total reserves of 43,5 km³, of which 25,1 km³ are in the Amu Darya basin and 18,4 km³ in the Syr Darya basin⁴⁸. In 2000, actual water abstraction from aquifers is 11 km³/year, although in 1990 it exceeded 14 km³.

As a result of irrigation, large parts of the basin are affected by rising groundwater and salinisation. Salinised areas as percent of area equipped for full control irrigation (1993-1997)⁵⁵ were estimated as: Turkmenistan 37 percent, Kazakhstan 11 percent, Uzbekistan 51 percent, Kyrgyzstan 6 percent and Tajikistan 16 percent.

3.5 Water infrastructure

Water storage reservoirs were constructed during the Soviet era to modify the natural river flow patterns to those needed for irrigation and to generate hydropower primarily. More than 80 water reservoirs of capacity of over 10 million m³ have been constructed, many 30-40 years ago⁵⁶. The aggregate capacity of these water reservoirs exceeds 60 km³, of which approximately 44 km³ is useable, including 17 km³ in the Amu Darya basin and 27 km³ in the Syr Darya basin.

Kyrgyzstan controls 58 percent of total storage capacity of the Syr Darya and Tajikistan controls 9 percent of the Syr Darya storage capacity and 60 percent of storage capacity of the Amu Darya.

Forty-five hydropower plants have been installed with total capacity of 34,500 MW⁵⁷. Dams for hydroelectricity generation also supply irrigation schemes, linked to rivers and storage by major conveyance canals. The Niyazov Canal, the world's largest irrigation canal, is the most significant, conveying 15-20 km³ from the Amu Darya to south-west Turkmenistan. Other canals include: the North and Grand Fergana Canals transporting water from the Syr Darya to the Fergana Valley; the Karshi Canal providing water to 1.2 million hectares in Uzbekistan's Karshi Steppe; the Amu-Bukhara Canal irrigating land in the Bukhara Region in Uzbekistan from the Amu Darya; and the South Hungry Steppe and Kirov Canals irrigating the Golodnaya Steppe from the Syr

Darya. The total length of canals⁵⁸ is over 500,000 km, composed of an irrigation network (47,750 km inter-farm and 268,600 km on-farm) plus 191,900 km of collector drains. More discussion on current and planned power generation is included in Section 4 of this report.

The asset condition is poor⁵¹, and an annual bill of 1.6 billion USD per annum has been projected for rehabilitation. Operation and maintenance (O&M) costs have fallen upon the individual states inheriting the assets, with no evidence of cost sharing for regional assets. The Asian Development Bank has proposed a proportional cost sharing for operation and maintenance of the hydraulic facilities. Kyrgyzstan recently introduced by law the possibility of charging other countries an economic price for water originating from within its borders.

3.6 Sanitation

Apart from Uzbekistan, sanitation in the region is reported to be between 92 percent and 100 percent coverage, both in urban and in rural areas. The data from the Joint Monitoring Programme (JMP) are based on national census information and sometimes extrapolations of information. The data tell various stories. They make clear that the rural areas have much more simple facilities, but also that urban areas have often only half of their sanitation through piped facilities. In theory that is not a major problem, provided proper techniques are used, and provided the population density does not exceed certain levels (ref. JMP, Latest country data from the joint monitoring programme.)⁵⁹

% of population with access to improved sanitation	Urban	Rural
Uzbekistan (est.2004)*	97%	95%
Tajikistan (2005)*	95%	91%
Kyrgyzstan (2006)*	94%	93%
Turkmenistan (2006)*	100%	98%
Kazakhstan (2006)*	97%	98%

*JMP 2006; UN Data 2006

In its global report on water and health the WHO shows a more clear link between water, sanitation and hygiene (WSH) and death/disabling disease, with the richer Kazakhstan closer to developed countries, Uzbekistan in between, and the rest more towards developing countries.⁶⁰

	% WSH related death	% WSH related DALYs*
Kyrgyzstan	3	4,5
Kazakhstan	0,9	1,5
Tajikistan	4	6,1
Turkmenistan	4	5,5
Uzbekistan	1,3	2,2
World	6,3	9,1
Developed countries	0,5	0,9
Developing countries	8	10

*: DALY: disability-adjusted life year

The World Bank warns that countries in Central Asia face a particularly challenging battle. Service provision has declined dramatically outside the capital cities; in many smaller cities and rural areas it has all but collapsed. The ability to mobilise resources for the sector is severely limited as government budgets are constrained and the household income is low. Continued IFI involvement is essential to keep the system from collapse⁶¹. However, in rural areas the World Bank is limiting the intervention to demonstration projects (a 15 million USD rural water investment is complemented with 680,000 USD for sanitation in Kyrgyzstan⁶²). These observations are confirmed by the Asian Development Bank: The declining coverage is characteristic of the overall economic decline and disruption of many service institutions in the former Soviet Union countries during the early years of independence. Not one country is projected to meet the MDG sanitation targets^{63,64}.

3.7 Regional water issues

The Soviet era water management represented a form of regional ‘benefit sharing’ in which regional economic interests dominated the interests of individual ‘states’, with water allocation arrangements being primarily for the purposes of operating an intensive infrastructure system. Clearly, the environmental and social demands of the Aral Sea Basin did not figure with any prominence in this arrangement. With the collapse of the overarching economic interests, the region is reverting to national water allocation negotiations, but in an economic setting that is isolated from the wide framework of Soviet interests that was previously in place.

There are significant upstream-downstream issues, including, in general terms,

- A configuration of wealthier countries downstream and poorer countries upstream
- Hydropower potential upstream and irrigation and environmental demand downstream
- Different water governance structures⁶⁵.

Important milestones in water allocation have been:

- Analysis of water shortages in 1974–1975, and especially in 1982, led in 1987 to two Basin Water Organizations: BWO “Amu Darya” with headquarters in Urgench, and BWO “Syr Darya” in Tashkent.
- 1992 allocation of Amu Darya waters (Resolution 566 of the Science and Technological Council of the Soviet Union’s Water Management Ministry in 1987).
- An interstate agreement between Kyrgyzstan, Uzbekistan and Kazakhstan signed in 1996, stipulating compensation for Kyrgyzstan for not fully utilising its hydro-power potential during winter and allowing increased water releases during summer⁶⁶.
- Turkmenistan and Uzbekistan Heads of State bilateral agreement of 1996, based on equal shares of the ‘adjusted run-off’ at Kerky, including diversion to the Karakum Canal.
- Management since 1998 of Syr Darya waters on the basis of mutual obligations of the riparians in fuel and energy exchange, and irrigation water. “Actual implementation has revealed that conflicting power and irrigation needs of the four states have hindered the fulfillment of agreed water allocation terms and necessitate further talks”.

- In 2000 Kyrgyzstan and Kazakhstan signed an agreement regarding shared water resources of the Chu and Talas Rivers (Wegerich K, 2008). In it the parties agreed to share operational and maintenance costs regarding transboundary infrastructure and in proportion to received water amounts. The agreement has commonly been regarded a success and by some described as the “way forward” in Central Asian water politics.

No interstate agreement for the Aral Sea Basin is in place that addresses the cost sharing of operations and maintenance, rehabilitation and modernisation of infrastructure, nor regulation of information exchange. A draft agreement was prepared in 1999, but countries have not approved it for operational use. Regular annual disputes now occur over seasonal water delivery scheduling, as water releases for hydropower in winter by the upper riparians have reduced water available for summer irrigation. The existing draft agreement has been deemed to be inconsistent with principles of equitable rights and sustainable development.

There are some cooperative agreements regarding the shared water resources of the Aral Sea. A strong feature regarding these is their multilateral character. Existing agreements as documented by the Institute of Waters and Watersheds of the Oregon State University shows that some of them include all five Central Asian countries connected to the Aral Sea basin (not counting Afghanistan as one of those). Key agreements are summarised in the table below.

There are a number of bilateral interactions, also involving neighbors from outside Central Asia (notably China, Iran).

Kazakhstan and China: Kazakhstan and China share some 20 transboundary rivers. Two of Kazakhstan's main rivers, the Ili and the Irtysh, originate in China. China is extracting increasing amounts of water from both rivers upstream of the border. Such extractions have adversely affected Kazakhstan's agricultural and industrial development. During a visit of president Nazarbaev to China on April 16 2009 he discussed with President Hu Jintao in Beijing the issues of reasonable and mutually acceptable use and protection of the resources of trans-border rivers. The Chinese President confirmed readiness of the Chinese side to engage in official discussion of the issue of water apportioning of the cross-border rivers.⁶⁷

Tajikistan and Kyrgyzstan: the two countries have been investigating the option for creating a new power-grid that does not involve transmission through Uzbekistan. Tajikistan plans to build new hydropower dams, and assumes it will need alternative routes to the current main corridor through the territory of its downstream neighbors.⁶⁸

Iran and Turkmenistan: Iran and Turkmenistan are planning to set up a joint water consortium. Presidents of the two countries held talks on water cooperation on the sidelines of the ECO Summit.⁶⁹

Tajikistan and China: The Tajik government is heavily in debt and must find heavy foreign investment to build planned dams. China agreed to build a USD 300 million hydroelectric power plant, Nurobad-2, with a capacity of 160 to 220 megawatts in August 2008⁷⁰.

Name	Parties	Principal Issue area	Treaty Basin	Date	Signatories
Agreement on joint activities in addressing the Aral Sea and the zone around the Sea crisis, improving the environment, and ensuring the social and economic development of the Aral Sea region	Multilateral	Water Quality	Aral Sea Amu Darya Syr Darya	March 26, 1993	Kazakhstan Kyrgyzstan Tajikistan Turkmenistan Uzbekistan
Resolution of the heads of states of Central Asia on work of the EC of ICAS on implementation of action plan on improvement of ecological situation in the Aral Sea Basin for the 3-5 years to come with consideration for social and economic development of t	Multilateral	Water Quality	Aral Sea Amu Darya Syr Darya	March 3, 1995	Kazakhstan Kyrgyz Republic Tajikistan Turkmenistan Uzbekistan
Agreement between the governments of the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan on joint and complex use water and energy resources of the Naryn Syr Darya cascade reservoirs	Multilateral	Irrigation	Syr Darya	March 17, 1998	Kazakhstan Kyrgyz Republic Uzbekistan
Agreement between the government of the Republic of Kazakhstan, the government of the Kyrgyz Republic and the government of the Republic of Uzbekistan on cooperation in the area of environment and rational nature use	Multilateral	Water Quality	Not specified	March 17, 1998	Kazakhstan Kyrgyz Republic Uzbekistan
Agreement between the government of the Republic of Kazakhstan, the government of the Kyrgyz Republic and the government of the Republic of Uzbekistan on the use of water and energy resources of the Syr Darya Basin	Multilateral	Joint Management	Syr Darya	March 17, 1998	Kazakhstan Kyrgyz Republic Uzbekistan
Protocol on inserting amendments and addenda in the agreement between the governments of the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan on the use of water and energy resources of the Syr Darya Basin	Multilateral	Hydro-power/ Hydro-electricity	Syr Darya	May 7, 1999	Kazakhstan Kyrgyz Republic Tajikistan Uzbekistan
Agreement between the Government of the Republic of Kazakhstan and the Government of the Kyrgyz Republic on the utilisation of the water facilities of interstate use on the Chu and Talas Rivers	Bilateral	Joint Management	Talas	January 21, 2000	Kazakhstan Republic of Kyrgyz Republic

Uzbekistan, Kazakhstan & Russian Federation: Uzbekistan is exploring with Kazakhstan and the Russian Federation the possibility of diversion of the Ob and Irtysh rivers. The proposed project consists of building a canal from Siberia, across Kazakhstan, to Uzbekistan. This reflects a previous Soviet plan, and backers include Moscow's mayor, Yuri Luzhkov, as well as many Central Asian leaders and a growing number of Russian scientists. In theory, the project would solve the problem of the limited extra water resources available to Uzbekistan. The project would also enable the Russian Federation to play a greater role in the region and especially in Uzbekistan. There are fears about the salinisation of water during transfer, important technical issues (a breach could flood large territories between Siberia and Central Asia) and the financial and geopolitical costs to Central Asia would be very high⁷¹. Other obstacles to the project might be Chinese plans to divert water from the Irtysh River, then using 25 percent rather than the present 10⁷².

Uzbekistan and Kyrgyzstan: Beyond inter-state tensions over water allocation, land conflicts in border zones involve water rights. Tensions persist between Kyrgyz and Uzbeks in the Fergana Valley. The Andijan reservoir, lying in a border area and currently leased to Uzbekistan, increases tensions. Kyrgyzstan claims that it does not receive any compensation for the lease while Uzbekistan has been reluctant to enter into negotiations (ibid).

Uzbekistan and Turkmenistan: A very tense relationship exists over water use, with both countries heavily dependent on irrigated agriculture, and both reliant to a significant degree on the Amu Darya as the source for their irrigation water. At independence, rumors circulated of a small-scale secret war between the two states over the river's resources. Over the years, there have been persistent reports of Uzbek troops taking control of water installations on the Turkmen bank of the river by force, as well as military tensions along the Buxoro (Bukhara)–Lebap border. Both countries have routinely engaged in accusations of overuse and misuse of water supplies. Other tensions between the two states have arisen over shared irrigation systems around the Tuyamuyun reservoir. The reservoir belongs to Uzbekistan, but is located in Turkmenistan. A Russian newspaper reported that in the early 1990s Uzbekistan established contingency plans for the occupation of north-eastern Turkmenistan (including the reservoir).

3.8 National water sector institutional, legal and policy context

The first steps towards water reforms took place directly after the collapse of the Soviet Union and the independence of the five states. Subsequently the states have tried to maintain a level of cooperation on water. IWRM planning processes have begun in

all five countries. At the national level, a number of institutions may be found, but it is difficult to find accessible information. Exchange of available information is not happening easily^{73,74}. Each country has a National Hydro-Meteorological service (NHMS), supported by the Swiss Development Cooperation. In 1992 all regional countries agreed to keep the Soviet-era water allocation quotas at a meeting in Almaty.

The Interstate Council for the Aral Sea Basin (ICAB) and the International Fund to Save the Aral Sea (IFAS) were set up in 1993 and then merged in 1997. The structure includes the ICWC and the Scientific Information Centre (SIC). The Interstate Coordinating Water Commission (ICWC) was established to facilitate the implementation of the above mentioned water quotas. Connected to and operated by ICWC is the SIC. This institution is foremost responsible for training of water officials. It also maintains an information database accessible to its member states. Executive branches of the ICWC are called Amu Darya BWA and Sur Darya BWA (Basin Water Management Association). They monitor implementation phases and also have the right to adjust them. All these institutions are situated in Uzbekistan.

IFAS was created to address Aral Sea issues and to raise funds and social assistance to people in the affected area. Each country has two representatives on IFAS executive committee charged with implementing Board decisions. A major task of IFAS is to implement an action programme decided on by regional leaders in 1994. Both organisations work in close conjuncture and coordination with the respective national branches in charge of water management in each country (the Water Resources Committee of the Ministry of Natural Resources and Environmental Protection in Kazakhstan, the Ministry of Reclamation and Water Management in Tajikistan, the Ministry of Water Management and Agriculture in Kyrgyzstan, the Ministry of Water Management and Agriculture in Uzbekistan and in Turkmenistan the Ministry of Reclamation and Water Management⁷⁵).

Kazakhstan

Kazakhstan has developed an IWRM plan (with assistance of NORAD, DFID, UNDP and the GWP). As part of this plan it has adopted basin councils in all river basins in the country⁷⁶ as the managing structure. This is also the intended structure for stakeholder agreements on the use of the resource. A number of provisions were made regarding metering of water use and subsidising water saving technology⁷⁷. Relevant institutions are the Kazakhstan Water Partnership (part of the GWP structure) and the Ministry of Environment Protection⁷⁸. Its website contains the main environmental reports (in Russian). The country has several commissions with its neighbors to deal with transboundary water. There are joint commissions with Russia, Kyrgyzstan and China for this purpose.

Kyrgyzstan

Kyrgyzstan has started a road-mapping exercise as part of developing an IWRM policy⁷⁹. The Institute of Public Policy in Bishkek organises debates on water policy, and publishes the transcripts of the meeting on its website⁸⁰. The Institute for Public Policy is a Bishkek-based independent organisation that was founded in April 2005. It aims at promoting public policy and development of mechanisms for constructive interaction between state

institutions, civil society, mass media and businesses. According to Deutsches Institut für Entwicklungspolitik (DIE) the Kyrgyz IWRM implementation is making some progress but is still far from satisfactory. The country is making some headway in creating legislation but is lagging when it comes to implementation. Most achievements can be found in issues regarding regulatory integration and in particular decentralisation of management structures regarding irrigation. DIE further states that health and gender issues are widely ignored. Parts of the IWRM process that need more attention are foremost⁸¹: sustainable institution and capacity building, strengthening organisations at the local level and a general improvement in information distribution among stakeholders.

Tajikistan

Tajikistan has also started a road-mapping exercise as part of developing an IWRM policy⁸². Together with Kyrgyzstan the country is the primary source of regional water resources. The Tajik government has objectives to expand irrigated land over its territory, possibly by intakes from the Zeravshan River. After independence, Tajikistan increased its irrigated area by 200,000 ha, and it intends to increase this area further.

However, most countries downstream are more concerned by Tajikistan's objective to increase its hydropower capacity. At the opening of the second Central Asia/South Asia Electricity Trade Conference in 2006, the Tajik president recalled that the total capacity of functioning hydroelectric power plants in Tajikistan amounts to only 3.2 percent of its hydro-energy resources and stated that this share should be increased.

Turkmenistan

Turkmenistan is the only country that is not active in developing a policy towards IWRM, although the need to do so is acknowledged⁸³. A law from 2007, allowing for larger groups of farmers to organise themselves, paves the way for setting up water users associations. Funding from oil has resulted in major increases in investments over the last 15 years.⁸⁴

Turkmenistan is constructing an artificial lake in the Kara Kum desert, the Golden Century Lake (or Lake Turkmen) to be filled up with used irrigated waters. Risks are that this is likely to aggravate tensions with the riparians^{85,86}. The scheme is intended to guarantee Turkmenistan's water security and create some 4,000 km² of farmland. It will also prevent flooding in Turkmenistan by drainage water from Xorazm in Uzbekistan (another source of discord between the states). According to the International Crisis Group, "there is also an ethnic dimension to the project – an estimated one million ethnic Uzbeks living in the Dashkhozv Province of Turkmenistan may have to be resettled to the Karakum Desert once the lake has been completed". In addition to concerns about population movements, this project has inevitably raised concerns in Uzbekistan that water will be drained from the Amu Darya to maintain the lake's water level.

Uzbekistan

Uzbekistan is currently the second largest exporter of cotton in the world, selling over 800,000 metric tons every year. Cotton is therefore a key source of hard currency for the Uzbek government and an important component of state control over its population,

as land tenure and cotton sales are tightly managed by state or quasi-state bodies. The country acknowledges threats from climate change, but also expresses its concern on the upstream developments in hydropower development.

Uzbekistan's key water management objective is to maintain the position that it established during the Soviet era, that of being awarded increasing allocations. Uzbekistan has achieved food security, and now it would like to develop additional irrigated areas in order to produce a food surplus to export to neighboring countries.

4 Energy Situation

4.1 Water and energy nexus

Hydropower constitutes about 27.3 percent of average energy consumption in the Aral Sea Basin. The largest hydropower plants are the Nurek on the Vakhsh River in Tajikistan and Toktogul on the Naryn River in Kyrgyzstan. Nurek Dam was constructed by the Soviet Union between 1961 and 1980, originally having a generating capacity of 2,700 MW but has since been redesigned to produce 3,000 MW. As of 1994, this formed the majority of Tajikistan's 4,000 MW hydroelectric generating capacity, which was adequate to meet 98 percent of the nation's electricity needs.

Afghanistan, Tajikistan, and Kyrgyzstan are striving to develop their untapped hydropower potential. In February 2007, Russia announced a partnership with Tajikistan to complete the Rogun Dam on the Vakhsh River in southern Tajikistan. The World Bank has issued a press release about their intention to support the project with a comprehensive feasibility study⁸⁷. Rogun has a capacity to produce 3,600 MW of electricity, with possible energy markets in Pakistan and Afghanistan⁸⁸.

Talks between Russia and Tajikistan on completing the construction of the Sangtuda-1 plant began in 2003 and in 2004 the parties signed an inter-governmental agreement. Open joint-stock company Sangtuda HPP-1 has recently been constructing the hydroelectric power plant with support of Russia. According to the agreement, completion was scheduled for late March 2009. Russia retains a 75 percent share in the power plant, which will have an estimated capacity of 670 MW.

Iranian companies have started building the Sangtuda Hydroelectric Plant-2 in Tajikistan⁸⁹. The Iranian government has taken on the obligation to finance 81.8 percent of the cost of construction (180 million Euro), with the Tajik government providing the remainder.

About 8 percent of the hydropower potential is developed in the region as a whole. During the Soviet era downstream states traded energy generated from hydrocarbons during the winter period for water for irrigation during the summer period. Such a basin wide benefit sharing management system worked and delivered benefits but with significant environmental tradeoffs. When the Soviet Union broke down the independent states took a unilateral approach and were not capable of negotiating a new cooperative water regime in which water and energy were closely related.

Kyrgyzstan, the most upstream country of the Syr Darya River, is now heavily dependent on neighboring countries for its energy

supply, and demands the possibility to explore the hydropower potential within its borders. Uzbekistan, lying downstream of Kyrgyzstan and then of Tajikistan, has access to cheaper energy production with its own fossil fuel but depends on Kyrgyzstan to release water at the right time for the country to be able to use it for irrigation of its cotton fields. Kazakhstan, the most downstream country, now receiving a reduced quantity of water of lowered quality, has claims on the upper riparian states to increase quantity and improve quality. Uzbekistan also makes territorial claims on parts of Tajikistan, where a majority of the inhabitants are Uzbeks. And even if there are legal agreements in place for the sharing of waters between the states these agreements are not fully kept (Björklund, 2005). In mid-2008 Kyrgyzstan refused the downstream countries their agreed share as there had been too little water to satisfy Kyrgyz energy demands (Libert, 2008).

The perceived power asymmetry regarding energy supply might be one reason for nations like Kyrgyzstan and Tajikistan to explore and develop their hydro energy potential. Both countries are considered to have the greatest potential for hydro energy, and even though only a small portion of the potential is installed at present, they generate more hydro electricity than any other Central Asian state (World Bank, 2004). Kyrgyzstan has seen a four-fold increase in hydro energy over the last two decades while Tajikistan has almost doubled its capacity over the same time span. In 2007, Tajikistan announced⁹⁰ a USD 1bn plan to become one of the world's leading hydropower producers. President Emomali Rakhmon said the former Soviet republic hoped to attract foreign investment over the next three years to help build 80 power plants.

4.2 Energy balance

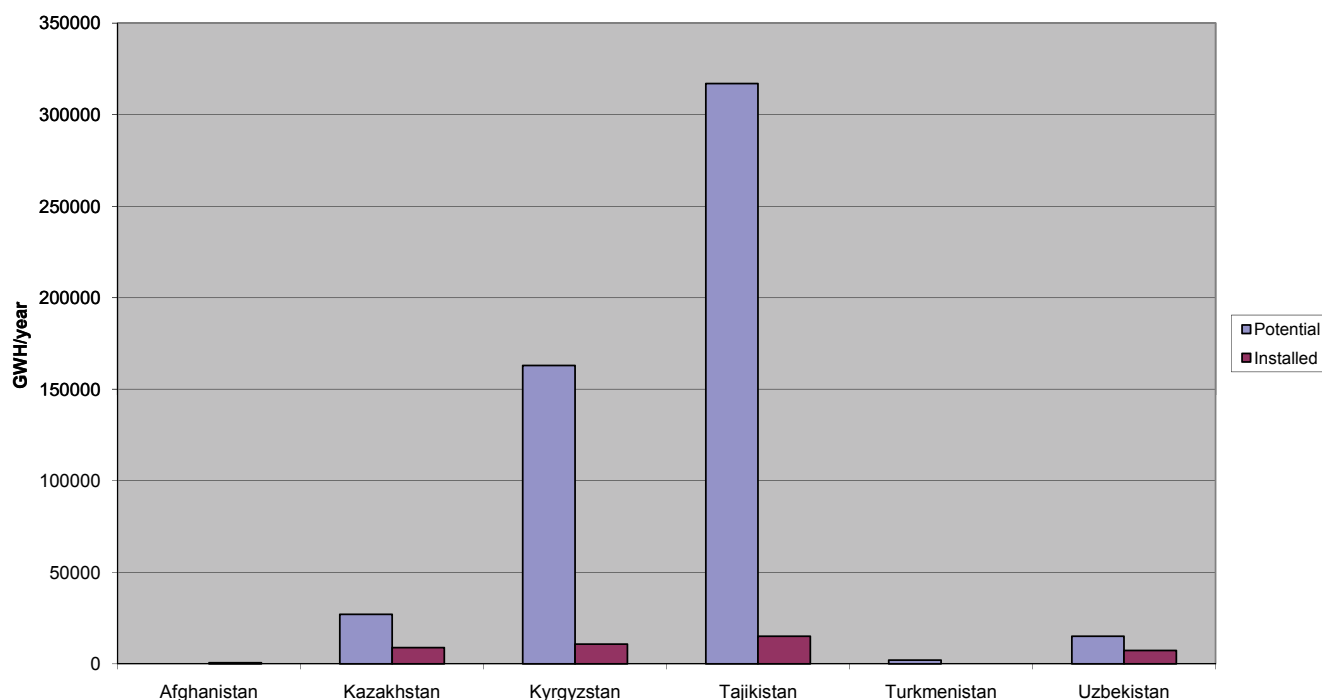
The contribution of hydropower to general energy consumption is highest in Tajikistan (about 98 percent) and in Kyrgyzstan (about 75 percent), and lowest in Turkmenistan (about 1 percent). Potentially, the region can meet more than 71 percent of its energy requirements from hydropower which could equal an output of about 150 GW h.

Coal, oil and natural gas make up more than 90 percent of energy consumption in Kazakhstan, Turkmenistan and Uzbekistan, where coal is the major source in Kazakhstan and natural gas dominates Turkmen and Uzbek energy supplies. Both Turkmenistan and Uzbekistan serve as regional suppliers of natural gas (Central Intelligence Agency, 2009), which gives them leverage in the region as they are in control of pricing the export resource and surrounding nations have few alternatives. However, to date, this strategic position has failed to translate to domestic development.

Levels of greenhouse gas emissions and water use per dollar of GDP produced are among the world's highest in Uzbekistan, Turkmenistan and Kazakhstan. Hence, the payoffs to investments that modernise the region's water and energy infrastructures and practices could similarly be among the world's highest. There is a great and very real opportunity for Central Asia to attract carbon finance into sustainable energy and water use projects. UNDP's Carbon Facility is helping Central Asian countries to capture the benefits of carbon finance. A recent carbon finance agreement between Uztransgas in Uzbekistan and Fortis Bank show that "green investment" can be attracted successfully into Central Asia⁹¹.

Hydro electricity potential/installed

Source: World Bank, UN data



	Hydro Electric Potential (MW)	Installed Capacity (MW)
Afghanistan	400	595
Kazakhstan	27000	8861
Kyrgyzstan	163000	10778
Tajikistan	317000	15086
Turkmenistan	2000	
Uzbekistan	15000	7278
Total	524400	42598

Reference. Hydropower potential: IEA and Potential Water Resource Development in Northern Afghanistan and its implications for Amu Darya Basin, Working paper 36, 2004

There are few reliable information sources that explore the Afghan energy situation. Hydro electrical power stations and their extended networks are sensitive and frequently targeted by insurgent activity.

Reference. Hydropower potential: IEA and Potential Water Resource Development in Northern Afghanistan and its implications for Amu Darya Basin, Working paper 36, 2004

UNDP is supportive of developing a portfolio of projects that scale up the use of run of river and micro-hydropower plants in the upstream countries of the region. Such investments can play an important role in improving food and energy security in remote communities. Individually, national economies lack the economies of scale for investing, and national power utilities acting individually lack the capacity, on the large power schemes. Small community investments to replace depreciated pumping systems can help bring damaged water infrastructure back on line with low capital outlays. However, the technical and management capacity for small-scale schemes is weak.

No country in the region area has nuclear capacity (IEA, 2005) and as a consequence this energy source does not play any part in any of the respective countries' energy consumption. Renewable energy alternatives besides hydro energy seem to be more or less non-existent at present and despite potentials (particularly of solar power) do not contribute to any discernible extent to energy supply.

4.3 Regional power markets

The development of a regional power market is viewed as a promising approach to increase cooperation and to ensure that benefits generated from the implementation of water and energy cooperation are distributed amongst the riparian states. ADB has supported regional power transmission projects to promote regional energy trade and cooperation among the Central Asian republics as a first step towards the long-term goal of establishing a wholesale regional power market. USAID in cooperation with USEA has initiated a multi-year Regional Energy Markets Assistance Program (REMAP) to support a power market through profes-

sional partnerships and exchange programmes between Central Asia and Europe, and development of policies, and regulations. President Nazarbaev in Kazakhstan has expressed an interest to develop hydroelectric resources of Tajikistan, such as the Rogun hydroelectric power station, and constructing transmission lines to carry hydroelectricity through Kyrgyzstan to Kazakhstan.⁹² Tajikistan and Uzbekistan together account for 65 percent of the generation capacity in the Central Asian grid. Enhancing the bilateral power trading relationship between the two countries is expected to encourage broader economic cooperation in this area within Central Asia (ADB 2002).

Measures are being undertaken to create the relevant infrastructure for hydropower transmission within Tajikistan and for its exports to the region's states. Construction of the "South-North" transmission line has been initiated, and investment projects for the construction of the transmission lines of Rogun-Kabul-Ghirat – Meshkhed and Rogun – Kabul – Islamabad are being currently developed.⁹³

5 Agriculture and Food Security

5.1 Importance of agriculture (employment and GDP)⁹⁴

Agriculture in the Aral Sea Basin is dominated by cotton and characterised by a need for structural reform to allow improved efficiency of resource use, marketing and food security.

Whilst each country has a range of crops, the major story of the region is cotton. In the table below, the area of irrigated agriculture is given, and the area of cotton. Uzbekistan and Kazakhstan also have extensive areas of irrigated grains, in particular wheat. If the opium poppy economy is included for Afghanistan, the share of GDP of agriculture increases to more than 70 percent.

5.2 Exports and imports

Uzbekistan accounts for almost 10 percent of globally traded cotton, down from more than 20 percent in the early 1990s, due to a combination of reduced area, poorer yields, and also the rise of other producers, including the 'francophone' countries of Africa, as well as China, India and Pakistan. Other producers of the Central Asian regions account for a further 5 percent of global trade⁹⁸. Cotton makes up more than 20 percent of all exports from Uzbekistan and 10 percent for Tajikistan. Although both Turkmenistan and Kazakhstan are large producers of cotton, their large oil and gas industries result in cotton being a smaller percentage of exports. There is virtually no trade within the Central Asian countries, with the majority of exported cotton going to either China or the EU.

Cotton is not the only significant agricultural export from the region. Kazakhstan is already among the world's top-eight grain producing countries, production of wheat in 2008 reaching 15 million tonnes, and it is the number-one exporter of flour. Currently 60 percent of Kazakhstan's agricultural exports are grains, but investment into Kazakhstan to increase production and productivity of grains looks set to increase its share as a global trader. Area under grain production has increased by 2 million hectares in the last 5 years. Kazakhstan exports to a total of 39 countries; the high gluten content in its wheat compensates for its relatively high transport expenses⁹⁹.

Uzbekistan has also seen some shift from cotton dominance to production of grains, with more than 500,000 tonnes of exports in recent years. Uzbekistan also exports large quantities of horticultural products, including fruits.

Turkmenistan relies less on agriculture for export earnings due to relatively large oil and gas reserves, but does produce some livestock and horticultural crops. Kyrgyzstan and Tajikistan

	Employment in Agriculture	Agriculture as % of GDP	Major Exports (agriculture)
Afghanistan ⁹⁵	67%	53%	Wheat
Kazakhstan	<10%	<10%	Grains
Kyrgyzstan	55% ⁹⁶	35%	Cotton, Horticulture
Tajikistan	n/a	25%	Cotton
Turkmenistan	n/a	30%	Cotton
Uzbekistan	40%	20%	Cotton, grain ⁹⁷

Country	Area ('000 hectares)		Production ('000 tonnes)	
	Irrigation*	Cotton**	Cotton	Horticulture***
Afghanistan	1,5	<20 (1%)	<15	n/a
Kazakhstan	3450 (16%)	200 (6%)	180	5,3
Kyrgyzstan	1050 (77%)	<30 (3%)	48	2,45
Tajikistan	630 (68%)	220 (35%)	172	1,6
Turkmenistan	1750 (94%)	540 (31%)	219	1,2
Uzbekistan	3990 (89%)	1450 (36%)	1,17	5,75

* Brackets = percentage of arable land irrigated

** Brackets = percentage of irrigated land dedicated to cotton (2003 figures)

*** Fruits, vegetables, roots and tubers

have diverse agricultural sectors, but limited export of livestock and horticultural crops. Kyrgyzstan and Tajikistan are net food importers, as is Afghanistan.

5.3 The story of cotton

“White Gold” was the name given to cotton by the Soviet regimes. A different view is provided in a report by the International Crisis Group in 2005¹⁰⁰, which states the following:

“The cotton industry in Uzbekistan, Tajikistan and Turkmenistan contributes to political repression, economic stagnation, widespread poverty and environmental degradation. Without structural reform in the industry, it will be extremely difficult to improve economic development, tackle poverty and social deprivation. The economics of Central Asian cotton are simple and exploitative. Millions of the rural poor work for little or no reward growing and harvesting the crop. The considerable profits go either to the state or small elites with powerful political ties. Forced and child labor and other abuses are common.”

A further report by the Environmental Justice Foundation in 2005 titled “White Gold – The True Cost of Cotton: Uzbekistan, Cotton and the Crushing of a Nation” also explores the social and environmental cost of cotton production in this region.

All countries of the Aral basin produce cotton, although Afghanistan and Kyrgyzstan are very small producers. Uzbekistan is the largest producer of cotton in the central Asian region, and 5th largest producer both by volume and area in the world. Although production has reduced since the early 1990s, Uzbekistan still produces over 1 million tonnes of lint cotton per year, at an average of around 700 kilograms per hectare. Whilst this is above the world average of 620 kilograms per hectare, when compared to other countries that rely solely on irrigated cotton, the production is low. For example, Turkey produced 1,330 kilograms per hectare and Australia 1,560¹⁰¹.

The USDA in 2002 assessed the potential for yield increases in Uzbekistan as almost double current productivity. This assessment was based on a comparison to Australia, a country with a similar growing climate as Uzbekistan. In fact, Uzbekistan may even be more competitive due to the reliable water source from snow melt and glacier melt, although the sustainability of these water sources are under threat from glacial retreat. Examples of modernisation of cotton farming methods in Kyrgyzstan¹⁰² with support from SECO include moves towards organic farming practices and trade promotion that are showing encouraging initial results. In Uzbekistan development measures taken in the water sector, such

as the Kashkadyra and Navoi Rural Water Supply Project (among others) in cooperation with the Asian Development Bank seem to show some signs of achieving improvements regarding more effective water use among other benefits.

5.3.1 Structure of the cotton industry in Uzbekistan

The cotton industry in Uzbekistan is characterised by a highly centralised control system utilising a large population of laborers and farmers. Centralised input supply, farmer quotas and controlled buying and marketing make this a challenging industry to reform.

The government maintains significant control of the cotton industry through central planning, including the farmer quota system that requires a certain level of production from farmers, but also a required area to be planted, providing little incentive to improve productivity and shift additional land to other crops.¹⁰³ Seed cotton is hand harvested, and delivered by farmers to local gins where it is sold to Uzkhlomprom which controls 127 gins and is 51 percent state owned. From here, Uzkhlomprom sells more than 70 percent of the lint cotton to 3 state controlled trading groups: Uzprommashimpeks (with a turnover of some USD 330 million in 2005), Uzmarkazimpeks, and Uzinterimpeks¹⁰⁴.

Cotton not exported is transferred to Uzbeklegprom: the government-controlled Association of State Cotton Enterprises. This bureau is charged with overseeing Uzbekistan’s domestic textiles industry; a sector mostly composed of joint ventures established between the Uzbek state and foreign investors.

Uzprommashimpeks’ website lists major partners, of which at least 5 are major European trading houses, including Louis Dreyfus, International Cotton Trading, Noble Resources, Dunavant and Paul Reinhart¹⁰⁵. These sales are supported by European banking groups (including Credit Suisse, Societe Generale and ABN-AMRO) who provide credit for buyers¹⁰⁶.

5.4 Food security¹⁰⁷

Food security in most of the central Asian region is low, with the exception of Kazakhstan and to a lesser extent Uzbekistan and Turkmenistan due to higher export potential for both countries of cotton and oil/gas respectively. However, distribution of the income from these exports is not shared equitably, resulting in ongoing food insecurity for particularly the rural workers.

One measure of food insecurity is the number of undernourished people within the overall population. The following table summarises this:

Country	Population (million)	Rural Population (%)	Population* Under-nourished (%)	External Ag. Assistance ('000)	% arable land under cotton
Afghanistan	32	-	-	-	1%
Kazakhstan	15	45%	6%	46	6%
Kyrgyzstan	5.2	65%	4%	19	3%
Tajikistan	6.3	75%	56%	47	35%
Turkmenistan	4.9	55%	7%	37	31%
Uzbekistan	26	65%	25%	62	36%

* 2007-2008 Human Development Report

Inefficient farming systems, trade policies and structural deficiencies all contribute to poor outcomes for the rural poor in particular. However, a convergence of events in 2008 has exacerbated food security problems in central Asia, including locust plagues, drought and cold winters.

The Central Asian region has also suffered from high global food prices, as food imports are critical from most countries. Food prices rose by as much as 30 percent across all basic foods in 2008¹⁰⁸. Kazakhstan is a strong exporter of grains and may have even benefited from higher grain prices, but Uzbekistan with almost 4 million hectares of irrigated land still relies on imports for some basic grains as well as for 50 percent of potato consumption.

Turkmenistan, with 1.75 million hectares and 97 percent of total water use allocated to agriculture is also a net importer of basic foods. The dry winter of 2008 combined with a hot summer left water supplies low and field crops not supplying sufficient grain to feed farmers and livestock. With a significant proportion of the available water being used for cotton in these lower catchment countries, food insecurity increased accordingly.

Uzbekistan has increased land under wheat production since the mid 1990s from 620,000 hectares to 1.2 million by 2005. Under the Soviet regime, grain was traded from Kazakhstan to Uzbekistan in return for cotton, but after the collapse of the Soviet Union, Uzbekistan has converted some cotton producing land to wheat production, and is now a net exporter of grains¹⁰⁹.

5.5 Slow structural reform at the national level

A 2002 report entitled 'Agrarian Reform in Uzbekistan and other Central Asian Countries'¹¹⁰ summarises the regional situation as: "Kyrgyzstan has been the most aggressive in restructuring agricultural enterprises, privatising land, and promoting individual farming. Kazakhstan and Turkmenistan have had similar legal and policy reforms, but implementation has lagged. Tajikistan's efforts at reform have been hampered by civil strife and continued weakness of government. Uzbekistan, in contrast to the others, has attempted to control its progress towards market-oriented agriculture very closely, with the result that the agrarian sector looks on the surface very similar today to what it looked like in 1991".

The strength of local government in all of the ex-Soviet countries needs to be taken into account when discussing structural reform. Although the regional governors are appointed by the President, they often manage local affairs closely.

Afghanistan:

Land ownership exists in much the same way as it has for hundreds of years. Farms are generally small, particularly horticultural farms at less than 1 hectare. There is little doubt though that with 30 years of war, the main impediments to improved productivity is lack of investment capability, infrastructure and government institutions to provide support to farming communities. Basic services, such as input supplies are virtually non-existent. Quality of planting materials, either for annual or perennial crops, is poor.

Kazakhstan:

A more open political and economic system, coupled with exten-

sive arable land resources, has encouraged investment in Kazakh agriculture, with countries including Saudi Arabia, United Arab Emirates, Iran, Japan and South Korea investing in grain production, which has seen an increase in land under cultivation of 2 million hectares in the last 5 years.

Kyrgyzstan:

Kyrgyzstan instituted a land reform programme to transfer use rights to land from the Soviet-era large state farm cooperatives to individual farmers as early as 1994. By 1999 over 90 percent of Kyrgyz farms were held in private hands with long term (99 years) use rights. Farm land may be bought and sold and transferred through inheritance. However, the small size of farms is resulting in low profitability, and therefore restrictions on investment and ability for diversification¹¹¹.

Tajikistan:

A period of civil unrest post-1991 slowed the capacity for agrarian reform in Tajikistan, and continues to contribute to high levels of poverty and food insecurity. Government reform called Freedom to Farm recently implemented in Tajikistan aims to give farmers the right to choose which crops they wish to produce, without government interference and quotas. This is seen as an attempt to allow free market principles to dictate what crops are grown. Allowing farmers to choose what they plant has the potential to make farms more efficient and profitable. It is of high importance to see that these principles are followed through, as many reports from the country suggests that local strong men¹¹² control regional farming activities by use of local law enforcement.

However, there is still considerable pressure to grow cotton which can be more profitable to local traders and officials. But diversification of the Tajik economy and eliminating the system of debts owed by families working cotton fields is considered crucial to reducing poverty¹¹³. When collective farms of the Soviet era were broken up, farmers received part of the land, but also part of any debts owed by the collective farmers. This means many farmers spend much of their income servicing old debts, making profitability very difficult¹¹⁴.

Turkmenistan:

A 1996 reform put an end to Soviet-style collective farms, but the system was partly replicated in the new farmers' associations, with farmers leasing land in a broader structure with limited privatisation. The state continues to exert control over crop production, directing what is planted and buying it at fixed prices, particularly grain and cotton. Rural households generally have their own small plot of land on which they grow crops for subsistence or for sale. Current legislation allows ownership of land only if it is used for housing and small household plots. At the same time as these announcements in March 2009, the Turkmen leader indicated that market mechanisms would soon be introduced into the agriculture sector^{115,116}.

Uzbekistan:

Despite comments by the political leadership of Uzbekistan regarding the removal of politics from agriculture, and commentary on the need to reform all parts of the economy, the country has not significantly participated in the global shift to open trade and capital flows. Centralised economic planning and policies that control cotton production are still the norm. To encourage diversification, farmers should be given greater control over what

crops to plant, and how much to charge for their produce. Input supplies, credit access and marketing channels are all still tightly controlled by government controlled agencies.

Some decrease in area of cotton production has occurred since the early 1990s and increase in food producing crops has occurred, with the area under grain production increasing by more than three-fold. However, the state still has considerable control over the crops to be produced, and centralised marketing is still very much dominant. Whilst a change in land and water management has slowly occurred, at the same time the government still controls cotton production and marketing very closely. Wheat is still centrally planned also, but does allow farmers greater flexibility than in the cotton industry. Interestingly, most farm products are not centrally controlled, although with high control over cotton production, this limits farmers' ability to move significant areas into diversified cropping¹¹⁷.

Donor Activity and Support to the Agriculture Sector

Based on FAO Country Profiles, all countries of the Central Asian region receive significant support to the agriculture sector by way of project funding, direct aid and programme investments. The World Food Program is active across the region.

Of agricultural donor support, Turkmenistan received the least both in absolute numbers and per capita, whilst Uzbekistan received the most (excluding Afghanistan). All major donor groups, including Asia Development Bank, World Bank, European Commission, and multiple UN programmes are all active and highly visible in the agriculture and food sector.

An example of specific investments has been the European Bank for Reconstruction and Development, which has actively supported a number of textile ventures in Uzbekistan and Kyrgyzstan to improve use of raw cotton at a local level¹¹⁸. Little information is provided on any commitments these donors may require for governments to improve social and structural reforms linked to this project support. But reports by both the International Crisis Group and the Environmental Justice Foundation call for stronger demands to be placed on recipients of international donor support.

5.6 Opportunities for improvement

Cotton is regularly held responsible for the destruction of the Aral Sea, for continued resistance to critical agricultural and political reform and the continued poor economic performance of the Central Asian region. However, this report contends that cotton may in fact provide an opportunity for pushing through reforms. Cotton is central to the politics and economy, and the success of the region will only occur with the support of the powerful political figures of the region. There are four clear areas of reform that require further investment and focus:

- Structural reform in the agricultural sector to allow for free flow of investment and ownership by rural families, including the freedom to farm without state intervention in agricultural decisions
- Labor reform, in particular regarding child labor. The International Labor Organisation (ILO) as well as UNICEF has roles to play in such activities
- Productivity improvements through market mechanisms, innovations and skill development

- Reduced water and resource consumption through regulation and market mechanisms

Commercial Pressures

The industry can look to the textile sector where consumer and political forces have combined to promote reform. These often cover clothing made from cotton yarn and material, but are starting to extend to the entire 'supply chain'¹¹⁹.

Programmes aimed at highlighting issues surrounding child labor in textile and clothing manufacturing can be extended to include cotton production. An example of this in action is the multi-national clothing retailer Hennes & Mauritz. They have active programmes in Uzbekistan to tackle child labor (in conjunction with UNICEF), as well as promoting organic and sustainable cotton production¹²⁰.

The European Union is one of the largest traders of cotton from the Central Asian region, despite increased purchases from major Chinese and Asian buyers. Cotton is traded from the Central Asian region through major European trading houses (see earlier section on Uzbekistan) and supported by major European banks. These groups should be included in any overall solution, by engaging with them on socially responsible investment programmes. Development changes also need to be linked to aid and development funding – increasing the internal pressure in producing countries.

GM Cotton

One area that has yet to be fully explored in the Central Asian region is the use of genetically modified cotton varieties. With pesticide residues an environmental problem, the use of these crops needs to be considered. Numerous studies have indicated that when used in conjunction with well structured integrated pest management programmes, genetically modified cotton reduces pesticide use significantly.

Water Use Efficiency & Resource Management

- Independent analysis of the Uzbekistan cotton industry indicated a doubling of productivity can be achieved. It is inferred from this that improvements across all agriculture sectors can be achieved.
- The structure of quotas and set payments has not encouraged water use efficiency (price set for yield requires a minimum amount to be produced, even if not water efficient)
- Water use is not widely metered in most regions, although Uzbekistan began implementing metered water use in 2003
- Structuring water as a 'tradable asset' and allowing markets to set water prices has been successful in the Murray Darling basin of Australia^{121,122}. This has also allowed the environment to be treated as a 'water user'. Such a system may provide lessons for use in other similarly 'stressed' river basins such as the Aral Sea basin.

6 Environment and Climate Change

6.1 Water quality and pollution

Salinity, fertilisers, agro-chemicals and uranium tailings are major regional water quality issues. Water generated in the mountain areas is of high quality, with salinity levels generally in the range 0.15 to 0.25 g/l¹²³. Salinity levels increase with progression downstream, as a result mainly of the salt load in the return flows from irrigated areas

discharged via the collector drains. Thus, in the lower reaches of the two main rivers, there have been significant increases in salinity over time with the expansion of irrigation. Salinity levels have now stabilised, and over the decade 1991-2000 there was a drop in mean annual values of salinity in the middle and lower reaches of both the Amu Darya and Syr Darya rivers. This is attributed to decreased drainage flows related to changed water management.

Land salinisation is a growing problem due predominantly to poor irrigation practices. World Bank figures quoted in the Environmental Justice Report¹²⁴ from 2005 indicate that as much as 69.4 percent of agricultural land in Central Asia is salt affected, with 96.9 percent in Turkmenistan.

A statement in March 2009, and widely reported in the media, by Professor Malik Burlibayev from the Kazakh Agency of Applied Ecology, warned that the Syr Darya River's water is polluted with sulfate chloride contaminants, heavy metals, organic pollutants, and bio-genes, and is not fit even for irrigation on food crops¹²⁵. Orazgul Zhunusova, head of the Kazakhstan department for expertise and control of the Aral-Syr Darya ecology, further added to the view of Syr Darya's polluted state. Zhunusova said that according to data from the latest monthly samples her office takes, "the level of biological contamination of the water for March was 1.3 times higher than accepted norms."¹²⁶

A World Bank report from 2003¹²⁷ highlighted the high use of fertilisers, pesticides and herbicides that find their way into drainage water and back into the river systems. This point was also taken up by Olga Speranskaya, recent winner of the Goldman Environment Award and ecologist from the Moscow based ECO-Accord, an independent environmental organisation, who said up to 80 percent of Kyrgyzstan agricultural land is contaminated with fertilisers, despite recent reductions in actual fertiliser use¹²⁸. Data taken from FAO Country Profiles indicates fertiliser use in Uzbekistan is around 160 kilograms per hectare of arable land compared with 40 kilograms in Australia.

6.2 Environmental risks

The region has a number of environmental legacies from the Soviet era in the form of old industrial complexes and mining facilities that are still working, sites that have stopped producing, waste dumps that are poorly constructed and not maintained and the consequences of very unsustainable agricultural practices. These environmental risks are acknowledged by the governments as well as by the international community.

Major disaster-related risks include uranium tailings, earthquakes, floods, landslides and other hazardous substances. Many of the uranium tailings are located in the upper reaches of the Syr Darya basin, for example at Mailuu-Suu, Taboshar, and Minkush. According to a report in OOSKA News of April 2009¹²⁹, there are a total of 23 uranium mine tailings and 13 waste rock dumps in the area of one former uranium plant in a tributary of the Naryn River feeding the Syr Darya. The total tailings volume is about 1.96 million cubic meters, and there are some 0.8 million cubic meters of waste-rock dump in the area of the former uranium plant located in the west of Kyrgyzstan¹³⁰. The construction of the dumps does not meet standards for safe storage of uranium

waste. "Some 1,000 tons of soil containing radioactive material migrates from the Mailuu-Suu area towards Uzbekistan (upstream of Kazakhstan) by land and by water every year," according to the President of Ecosan International Organization, Yusufjan Shadimetov. The Kyrgyzstan Government has also recently indicated its concern for these radioactive tailing dumps, and the UNDP has targeted this as an issue also

In 2003, Germany's Deutsche Welle reported that 28,000 new patients were diagnosed with cancers in Kazakhstan every year. At the same time, 169 cases of cancer per 100,000 people were registered in the country in 2002, according to WHO.¹³¹ In May 2009, following a response to the 63rd Session of the United Nations General Assembly, an international conference was hosted in Bishkek on the theme of 'Uranium tailings: local problems, regional consequences, global solutions', organised with the assistance of UNDP. In 2004, the World Bank approved a seven-year, USD 6.9 million project to minimise the exposure of people and livestock to radiation from abandoned uranium mine tailings and waste rock dumps in the area around Mailuu-Suu. UNDP has estimated that USD 42 million is needed to rehabilitate the radioactive waste sites and minimise the regional environmental threats.

Large areas in the foothill areas of the region risk being subjected to an increase frequency of mudflows (IPCC, 2008). For example 15 percent of Kazakhstan lay within these risk areas. If the predicted increase in heavy precipitation events becomes reality and the rapid melting of glaciers continue 156 human settlements, including the largest city Almaty, will be threatened by mudflows in Kazakhstan (EDB and EB IFAS, 2009). The melting of glaciers, increase in glacial runoff and increase in frequency of glacial lake outbursts has caused an increase in mudflows and avalanches in the whole of Asia (IPCC, 2008).

Increases in events with heavy precipitation will increase mudflows, mudslides and also siltation loads in the rivers and irrigation systems of the region. This will create serious problems with silting in irrigation canals and dams, as well as decreasing the quality of the water for irrigation purposes (EDB and EB IFAS, 2009). For large parts of the population, 48 percent in Tajikistan, who use rivers, channels and small irrigation networks as their main water source this will pose a serious threat to their health status (2nd Nat. Com. Tajikistan, 2008).

6.3 Climate change

6.3.1 Evidence of climate change

The countries of Central Asia are heavily interconnected by the transboundary water systems. The observed changes in climate over the 20th Century show an increase in mean annual air temperature of 1-2°C while the changes in precipitation show no clear trends (IRCC, 2008). For the two main water courses of the region, the Amu Darya and Syr Darya, no significant change during the last century can be found that can be attributed to climatic factors. The changes that have occurred are caused by anthropogenic activities (EDB and EB IFAS, 2009).

The water availability of the region is expected to decrease in the long term due to melting of the glaciers that feed the region's main water courses. This will be aggravated by a rise in water consump-

tion due to population growth and intensive development of the countries' economies (EDB and EB IFAS, 2009). Analysis undertaken on the annual flows in Kazakhstan, including the Syr Darya Basin, shows no significant change from 1950. The exception is the rivers feeding Lake Balkhash where the runoff has increased as a result of degradation of mountain glaciers (EDB and EB IFAS, 2009). In the Amu Darya Basin, the glacier-snow fed tributaries show no significant change of the hydrological regime over the last 50 years (EDB and EB IFAS, 2009).

Observations from the last century show that the Central Asian countries have had an increase in surface air temperature, and particularly during the winter months. The highest rates of increase have been recorded in the lowland areas, while the warming has been slower in the mountainous regions, or even slight cooling has been observed at certain locations (EDB and EB IFAS, 2009). With diminishing snow and glacial cover this might change, as this alters the climatic regime of a region.

No clear trends in the observations from the last century can be seen in the region when it comes to precipitation. It varies throughout the region as well as through the seasons. What can be stated is that many parts of Central Asia have seen an increase in variability and intensity of precipitation during the last century (EDB and EB IFAS, 2009).

The melt water from glaciers in Tajikistan contributes on an average year 10-20 percent of the runoff of large rivers in the region. In dry and hot years the contributions to certain rivers can reach up to 70 percent in the summer period (EDB and EB IFAS, 2009). In the 20th century the glaciers of Tajikistan have decreased by 20-30 percent on average (2nd Nat. Com. Tajikistan, 2008). In Afghanistan the decrease is as much as 50-70 percent. This glacial melting may increase the runoff to the rivers in the region in the short term. The long term effect of the depleted glaciers will however be a reduced runoff (EDB and EB IFAS, 2009). During the period 1957-1980 the glaciers in the Aral Sea Basin lost 20 percent of their ice cover (EDB and EB IFAS, 2009).

6.3.2 Climate change scenarios

Scenarios indicate that the region will generally become warmer and receive more precipitation. The runoff to rivers and lakes will not necessarily be larger because of the increased precipitation. More water will infiltrate to soil and groundwater layers due to increase in evaporation and fewer days of frost in the ground as a result of the increased temperature. The most certain prediction for the region is an increase in extreme weather events, with high intensity precipitation events and prolonged droughts being more common than today.

The region as a whole is predicted to be subjected to an increase in annual air temperature of 1-7°C compared to the 1960-1990 average. All countries are also expected to receive an increase in mean annual precipitation varying between approximately 7 percent in Uzbekistan, 18 percent in Tajikistan, 27 percent in Kazakhstan and 46 percent in Kyrgyzstan. The precipitation is expected to show a higher degree of variability than the present situation, which can lead to increased frequencies of droughts and floods.^{132,133} (IPCC, 2008, EDB and EB IFAS, 2009). The increase in temperature over the last century has increased the suitable land for agriculture production in Central Asia (IPCC, 2008).

The runoff of the Syr Darya River is not expected to exceed the natural variations in any of the scenarios for the period up to 2030. The calculated models for Amu Darya show a reduction of water by 5-8 percent until 2030. When looking at the period until 2050 a reduction in both rivers is expected (these scenarios have excluded the precipitation variable, which adds to the uncertainty of the predictions).¹³⁴ The 2nd National Communication from Tajikistan states that the long term effect on the country's rivers' runoff is expected to decrease by 5-15 percent.

Climate change will alter the pre-conditions for much of the region's most important sectors. The agriculture sector will be facing changed hydrological regimes, with probably more runoff in the winter months and drier summer periods. The soil texture and moisture will be altered and crop yields will be more difficult to sustain. The impacts on food production in Central Asia are expected to be substantial with 30 percent decrease in crop yields by the end of this century¹³⁵. The changes of runoff in rivers also have great effects on the hydropower sector in the region, with Tajikistan having one of the world's highest potential for hydropower.¹³⁶

6.3.3 Adaptation to variability and climate change

The countries in the region need to set up strategies for coping with short term variability and long term climate change impacts. A possible solution is to increase the storage capacity to cope with the inter-annual variations as well as the predicted increase of floods and droughts. The upstream countries have a high dependency on hydropower for electricity production and still a large potential to develop this further. When doing so the future effects of climate change must be considered early in the planning process.

Because large areas are at risk to mudflows due to increasing precipitation, glacial melting and bursts of glacial lakes, inhabited areas in these risk zones need to consider climate change in long term planning and establish disaster contingency plans. A drastic suggestion has even been to move the city of Almaty away from its current location to the Kapshagayskoye reservoir to avoid the risk of a huge mudflow.¹³ Early warning systems are one way of mitigating the effects of mudflows or floods (IPCC, 2008).

Modernising the irrigation system and increasing the effectiveness of each water drop in agriculture is needed to cope with the warmer climate. The agricultural production system should be prepared to incorporate new crops that are more suitable to new conditions of a warmer climate, and different soil composition and moisture^{138,139}. One effect of a failing agricultural sector is the increasing difficulty of rural survival, driving a migration to urban centres. In Kazakhstan urban and peri-urban slums have developed rapidly. This not only creates new problems in urban areas, but also removes labor from the agriculture sector.¹⁴⁰

The international agreements on water use between the Central Asian countries need to be revisited in the light of possible future changes in water quantity and quality. To mitigate regional tension and conflict over a diminishing resource, it is important to look into how the agreements deal with changes in the common resource and how conflict can be prevented by revisiting agreements that may become irrelevant due to climatic changes.

7 References

- Aladin, N., Plotnikov, I S & Filipov AA (1999): Hydrology and Ecology of the Aral Sea". In Lindahl-Kiessling (ed) *Alleviating the Consequences of an Ecological Catastrophe*. Save the Children, Sweden, Swedish UNIFEM-committee and Royal Swedish Academy of Science.
- Björklund, G, 1999: "The Aral Sea – Water Resources, Use and Misuse". In: Lindahl-Kiessling (ed) *Alleviating the Consequences of an Ecological Catastrophe*. Save the Children, Sweden, Swedish UNIFEM-committee and The Royal Swedish Academy of Science.
- Björklund, G, 2005: "People, environment and Water Security in the Aral Sea Area." In: Schlyter (ed) *Prospects for Democracy in Central Asia*. Swedish Research Institute in Istanbul.
- Dukhovny, V. and Sokolov, V. 2003. *Lessons on Cooperation Building to Manage Water Conflicts in the Aral Sea Basin*, UNESCO-IHP, WWAP, PCCP papers, 50 pp.
- Dukhovny, V., Mirzaev, N. and V. Sokolov, 2008: *IWRM Implementation: Experiences with water sector reforms in Central Asia*. In: Rahaman, M. M. & Varis, O. (Eds.): *Central Asian Waters – Social, Economic, Environmental and Governance Puzzle*: xx-xx. Water and Development Publications, Helsinki University of Technology, Finland.
- European Aid,. 2009: *European Community Regional Strategy Paper for Assistance to Central Asia for the period 2007-2013*
- Eurasian Development Bank 2008: *EDB Eurasian Integration Yearbook 2008*.
- FAO, 1997: *Irrigation in the countries of the former Soviet union in figures*. FAO Water Reports.
- Fummagali M., 2008 *The 'Food-Energy-Water' Nexus in Central Asia: Regional Implications of and the International Response to the Crises in Tajikistan*. EUCAM. 2008
- Global Environment Facility, GEF, 1997: *Aral Sea Basin (Kazakstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan): Water and Environmental Management in The Aral Sea Basin*. GEF-project document.
- Glazovsky, N, 1995: "The Aral Sea Basin". In: Kasperson, J., Kasperson, R and B.I. Turner (eds) *Regions at Risk. Comparisons of Threatened Environments*. United Nation University Press.
- Horsman, S. 2008: *Afghanistan and Transboundary Water Management on the Amu Darya: A Political History*. In: Rahaman, M. M. & Varis, O. (Eds.): *Central Asian Waters – Social, Economic, Environmental and Governance Puzzle*: xx-xx. Water and Development Publications, Helsinki University of Technology, Finland.
- Jarsjö, J and G. Destouni, 2004: *Groundwater discharge into the Aral Sea after 1960*. *Journal of Marine Systems*. Volume 47. Issues 1-4.
- Jonsson A, 2005: *Public Participation in Water Resources Management: Stakeholder Voices on Degree, Scale, Potential, and Methods in Future Water Management*. Royal Swedish Academy of Sciences 2005
- Klötzli, S., 1994: *The Water and Soil Crisis in Central Asia – a Source for Future Conflicts?* ENCOP Occasional Paper No.11. Center for Security Policy and Conflict Research Zürich/Swiss Peace Foundation. Berne
- Kotlyakov, V.M., 1991: *The Aral Sea basin. A critical environmental zone*. *Environment*. January/February 1991.
- Lerman Z and Sedik D., 2008 Hebrew University 2008.
- Libert, B, 2008: *Water management in Central Asia and the activities of UNECE*. In: Rahaman, M. M. & Varis, O. (Eds.): *Central Asian Waters – Social, Economic, Environmental and Governance Puzzle*: xx-xx. Water and Development Publications, Helsinki University of Technology, Finland.
- Micklin, P and N.V. Aladin, 2008: *Reclaiming the Aral Sea*. *Scientific American*, Inc. April 2008:64-71.
- Rahaman, Muhammad, M., Varis, Olli (eds). 2008: *Central Asian Waters – Social, economic, environmental and governance puzzle*. Helsinki University of Technology.
- Olcott Brill M. 2002: *Democracy, Human Rights, and the War on Terrorism in Central Asia*. Carnegie Endowment for International Peace,
- Olcott Brill M. 2007: *Democracy Promotion in Central Asia: From High expectations to Disillusionment*. Carnegie Endowment for International Peace,.
- Peters G. 2009: *Afghanistan Democracy Fatigue*. Harvard Kennedy School,.
- Raskin, P., Hansen, E., Zhu, Z., and Stavisky, D., 1992: *Simulation of Water Supply and Demand in the Aral Sea Region*. *Water International*, 17(1992). IWRA.
- Roll, G., Atexeeva, N., Aladin, N., Plotnikov, I., Sokolov, V., Sarsembekov, T. and P.P. Micklin, 2004: *Aral Sea. Lake Basin Management Initiative. Experience and Lessons Learned Brief*. (http://www.worldlakes.org/uploads/aralsea_30sep04.pdf)
- UNDP, 1995: *The Aral in Crisis*. UNDP, Tashkent
- UNEP, 1992; *Diagnostic Study for the Development of an Action Plan for the Conservation of the Aral Sea*. UN
- World Bank, 2006: *Economic Co-operation in the wider Central Asia region*, World Bank Working Paper 75
- UNESCO, 2000 (ed.), *Water Related Vision for the Aral Sea Basin for the year 2025*. Prepared with the Co-operation of the Scientific Advisory Board for the Aral Sea Basin (SABAS) for the 2nd World Water Forum. 2nd World Water Forum publication, The Hague. 100 p.
- Wegerich K, 2008: *Passing Over the Conflict. The Chu Talas Basin Agreement as a Model for Central Asia?* Irrigation and Water Engineering Group, Wageningen University 2008

Endnotes

- ¹ Central Asia Regional Electricity Potential Study. World Bank, 2004
- ² Central Asia Regional Electricity Potential Study. World Bank, 2004
- ³ Transparency International (2008), Economist Intelligence Unit (2008)
- ⁴ Economist Intelligence Unit, 2008
- ⁵ Economist Intelligence Unit, 2008 (Political Instability Index Methodology)
- ⁶ FAO, 2007
- ⁷ Aral Sea continues to shrink, August 2009, earthobservatory.nasa.gov
- ⁸ Central Asia Regional Electricity Export Potential Study. World Bank, 2004
- ⁹ www.waterpowermagazine.com/story.asp?sc=2052456
- ¹⁰ Aquastat, (1993-1997)
- ¹¹ Aquastat, (1993-1997)
- ¹² Undata, 2006, JMP, (2005-2006), UNICEF, 2006
- ¹³ www.worldbank.org/eca/water
- ¹⁴ Environment News Service, May 2009
- ¹⁵ UNESCO Almaty Cluster Office for Kazakhstan, Kyrgyzstan, Tajikistan & Uzbekistan, March 2007
- ¹⁶ ICG Asia Report No 4, May 2002
- ¹⁷ <http://news.bbc.co.uk/2/hi/asia-pacific/3397077.stm>
- ¹⁸ Asia Times, May 2007
- ¹⁹ <http://www.eurasianet.org/departments/insightb/articles/eav042909.shtml>
- ²⁰ Crisis Watch No.74, October 1st 2009. International Crisis Group
- ²¹ Wikipedia
- ²² Radio Free Europe.5/14/08
- ²³ Towards to 5th World Water Forum, ICWC 2009 (<http://www.cawater-info.net>)
- ²⁴ The governance of Central Asian waters: national interests versus regional cooperation, Jeremy Allouche, four, 2007 (www.unidir.org/pdf/articles/pdf-art2687.pdf)
- ²⁵ <http://waterwiki.net/index.php/CAWSCI>
- ²⁶ EurasiaNet, January 21, 2009 and Hürriyet News, April 15, 2009
- ²⁷ CIA World Fact book
- ²⁸ Amnesty International, 2008
- ²⁹ <http://www.europeanforum.net/country/kazakhstan>
- ³⁰ www.reuters.com/article/asiaCompanyAndMarkets/idINLG700520090?pageNumber=2&virtualBrandChannel
- ³¹ IMF, World Economic Outlook – Crisis and Recovery, April, 2009
- ³² <http://www.europeanforum.net/country/kyrgyzstan>
- ³³ <http://in.reuters.com/article/asiaCompanyAndMarkets/idINN1838542220090318>
- ³⁴ <http://www.europeanforum.net/country/tajikistan>
- ³⁵ [http://www.ef.europa.eu/pubmgmt.nsf/\(getAttachment\)/F77DD069A8341946C12575390037F965/\\$File/NOTE7N5DY5.pdf](http://www.ef.europa.eu/pubmgmt.nsf/(getAttachment)/F77DD069A8341946C12575390037F965/$File/NOTE7N5DY5.pdf)
- ³⁶ <http://www.europeanforum.net/country/turkmenistan>
- ³⁷ <http://www.eurasianet.org/departments/news/articles/eav040709c.shtml>
- ³⁸ <http://www.europeanforum.net/country/uzbekistan>
- ³⁹ <http://www.eurasianet.org/departments/briefs/eav012909a.shtml>
- ⁴⁰ <http://www.europeanforum.net/country/uzbekistan>
- ⁴¹ Center for American Progress, 2008
- ⁴² <http://waterwiki.net/index.php>
- ⁴³ Environment and Security: Transforming risks into cooperation – The case of the Eastern Caspian Region. UNEP, UNDP, UNECE, OSCE, REC, NATO, 2008 (http://www.envsec.org/centasia/pub/caspian2eng_scr.pdf)
- ⁴⁴ Environment and Security: Transforming risks into cooperation – Central Asia – Ferghana / Osh / Khujand area. UNEP, 2005 (<http://www.envsec.org/centasia/pub/ferghana-report-engb.pdf>)
- ⁴⁵ UNDP Central Asia regional risk assessment: Responding to water, energy, food insecurity, January, 2009
- ⁴⁶ Lessons on Cooperation Building to Manage Water Conflicts in the Aral Sea Basin: PCCP, UNESCO (2003)
- ⁴⁷ PCCP, 2003
- ⁴⁸ CAWATERinfo, Syrdarya River basin (http://www.cawater-info.net/syrdarya/index_e.htm)
- ⁴⁹ Lessons on Cooperation Building to Manage Water Conflicts in the Aral Sea Basin: PCCP, UNESCO (2003)
- ⁵⁰ Aral Sea Dam Safety Project, 1999
- ⁵¹ FAO Water Report 15
- ⁵² GEF Agency of the IFAS Aral Sea Basin Program: Water and Environmental Management Project: Sub-Component A1: National and Regional Water and Salt Management Plans
- ⁵³ CAWATERinfo – Waste and Drainage Water
- ⁵⁴ Aral Sea continues to shrink, August 2009, earthobservatory.nasa.gov
Aral Sea recovery, NASA May 4 2007, earthobservatory.nasa.gov
The return of the sea, TIMESONLINE, June 23 2007
The Northern Aral Sea makes a comeback, CAWATERinfo / Eurasianet, J.Lillis 25 April 2009
- ⁵⁵ Aquastat, (1993-1997)
- ⁵⁶ CAWATERinfo: Dams and Hydropower

- ⁵⁷ CAWATERinfo: Dams and Hydropower
- ⁵⁸ CAWATERinfo: Irrigated lands
- ⁵⁹ <http://documents.wssinfo.org/resources/documents.html>.
- ⁶⁰ (SAFER WATER, BETTER HEALTH, Costs, benefits and sustainability of interventions to protect and promote health, WHO, 2008
- ⁶¹ <http://go.worldbank.org/8DWA7P22LO>
- ⁶² <http://go.worldbank.org/BW14BUXD60>
- ⁶³ <http://www.adb.org/Water/Topics/MDGs/north-central.asp#Kazakhstan>
- ⁶⁴ Asia Water Watch 2015, ADB, UNDP, UNESCAP, WHO, 2005
- ⁶⁵ World Lakes: Lake Basin Management Initiative: Experience and Lessons Learned Brief: Aral Sea (2004)
- ⁶⁶ Aral Sea Catastrophe: Case for National, Regional and International Cooperation. B. Islamov 1998
- ⁶⁷ Peyrouse, 2007 and Kazakhstan, China presidents discussed trans-border rivers usage, CAWater, 16 April 2009 (http://www.cawater-info.net/news/04-2009/16_e.htm)
- ⁶⁸ The governance of Central Asian waters: national interests versus regional cooperation, Jeremy Allouche, four, 2007 (www.unidir.org/pdf/articles/pdf-art2687.pdf)
- ⁶⁹ www.zawya.com/Story.cfm/sidZAWYA20090412061155/Iran-Turkmenistan%20water%20consortium%20
- ⁷⁰ Tajikistan Hopes Water Will Power Its Ambitions, <http://www.nytimes.com/2008/09/01/world/asia/01tajikistan.html>, September 1, 2008
- ⁷¹ The governance of Central Asian waters: national interests versus regional cooperation, Jeremy Allouche, four, 2007 (www.unidir.org/pdf/articles/pdf-art2687.pdf)
- ⁷² The Jamestown Foundation, September 2006
- ⁷³ Towards to 5th World Water Forum, ICWC 2009 (<http://www.cawater-info.net>)
- ⁷⁴ Vadim Sokolov, GWP CACENA / ICWC, April 2009, personal communication
- ⁷⁵ International Crisis Group, May 2002
- ⁷⁶ http://waterwiki.net/index.php/National_IWRM_and_Water_Efficiency_Plan_for_Kazakhstan
- ⁷⁷ Towards to 5th World Water Forum, ICWC 2009 (<http://www.cawater-info.net>)
- ⁷⁸ <http://www.nature.kz/eng/ekolog/ekolog.php>.
- ⁷⁹ Vadim Sokolov, GWP CACENA / ICWC, April 2009, personal communication
- ⁸⁰ <http://www.ipp.kg/en/events/617>
- ⁸¹ Deutsches Institut für Entwicklungspolitik (DIE), 2006
- ⁸² Vadim Sokolov, GWP CACENA / ICWC, April 2009, personal communication
- ⁸³ Towards to 5th World Water Forum, ICWC 2009 (<http://www.cawater-info.net>); Vadim Sokolov, GWP CACENA / ICWC, April 2009, personal communication
- ⁸⁴ Towards to 5th World Water Forum, ICWC 2009 (<http://www.cawater-info.net>)
- ⁸⁵ Giant Turkmen Lake Sets Off Environmental Alarms, Marina Kozlova (<http://www.asiawaterwire.net/node/329>)
- ⁸⁶ (Water management in Central Asia: state and impact, UNEP GRID Arendal, 2003, (http://maps.grida.no/go/graphic/water_management_in_central_asia_state_and_impact1)).
- ⁸⁷ Central Asia Online
- ⁸⁸ Rogunskaya Hydro Power Station – Performance Characteristics
- ⁸⁹ New Europe 12th January, 2009
- ⁹⁰ BBC News, April 2007
- ⁹¹ Ms. Kori Udovi ki, United Nations Assistant Secretary General, UNDP Assistant Administrator, Director, UNDP Regional Bureau for Europe and the CIS. Remarks delivered at: “Strengthening Regional Cooperation on Water Management in Central Asia” Conference, Almaty, 17 Nov. 2008
- ⁹² <http://www.eurasianet.org/departments/insight/articles/pp051408.shtml>
- ⁹³ Ministerial Dialogue "Making a Difference" in the High-Level Segment of CSD
- ⁹⁴ FAO Statistics Yearbook 2004 and FAOSTAT data, 2005, <http://faostat.fao.org/faostat>
- ⁹⁵ World Bank, 2005 (documentation for Afghanistan Emergency Horticulture and Livestock Project)
- ⁹⁶ CIA World Fact Book 1999
- ⁹⁷ FAOSTAT data, 2005, <http://faostat.fao.org/faostat>
- ⁹⁸ USDA: <http://www.ers.usda.gov/Briefing/Cotton/trade.htm>
- ⁹⁹ <http://businessneweurope.eu/story1489>
- ¹⁰⁰ ‘The Curse of Cotton: Central Asia’s Destructive Monoculture’ Asia Report No.93, February 2005, International Crisis Group
- ¹⁰¹ International Cotton Advisory Committee 2002 ‘Cotton World Statistics’
- ¹⁰² <http://www.irinnews.org/Report.aspx?ReportId=33724>
- ¹⁰³ Abdullaev I, Giordano M, Rasulov A. 2007. Cotton in Uzbekistan: Water and Welfare. In: Kodyati D et al (eds.): Cotton Sector in Central Asia. SOAS, 112-128. (Downloaded from <http://www.zef.de/staff/784.html>)
- ¹⁰⁴ ‘White Gold: The True Cost of Cotton’ 2005, Environmental Justice Foundation, UK
- ¹⁰⁵ Uzprommashimpeks official website www.upm.uz/eng
- ¹⁰⁶ ‘The Curse of Cotton: Central Asia’s Destructive Monoculture’ Asia Report No.93, February 2005, International Crisis Group
- ¹⁰⁷ Multiple Sources including: FAO Country Profiles and CIA World Fact Book
- ¹⁰⁸ ‘Central Asia Regional Risk Assessment: Responding to Water Energy and Food Insecurity’ UNDP, New York 2009.
- ¹⁰⁹ Abdullaev I, Giordano M, Rasulov A. 2007. Cotton in Uzbekistan: Water and Welfare. In: Kodyati D et al (eds.): Cotton Sector in Central Asia. SOAS, 112-128. (Downloaded from <http://www.zef.de/staff/784.html>)
- ¹¹⁰ Bloch, P 2002, ‘Agrarian Reform in Uzbekistan and Other Central Asian Countries’, Land Tenure Centre, University of Wisconsin
- ¹¹¹ <http://www.nationsencyclopedia.com/economies/Asia-and-the-Pacific/Kyrgyzstan-AGRICULTURE.html>
- ¹¹² US Department of State. Bureau of Democracy, Human rights and, Labor. 2008 Human rights Report: Tajikistan, 2008
- ¹¹³ http://pulitzercenter.typepad.com/untold_stories/2009/03/freedom-to-farm.html

- ¹¹⁴ http://www.nytimes.com/2008/10/15/world/asia/15tajik.html?_r=1
- ¹¹⁵ <http://www.eurasianet.org>
- ¹¹⁶ <http://www.gundogar.org/?02200475290000000000000011000000>
- ¹¹⁷ Abdullaev I, Giordano M, Rasulov A. 2007. Cotton in Uzbekistan: Water and Welfare. In: Kodyati D et al (eds.): Cotton Sector in Central Asia. SOAS, 112-128. (Downloaded from <http://www.zef.de/staff/784.html>)
- ¹¹⁸ EBRD official website www.ebrd.com
- ¹¹⁹ For example see www.fibre2fashion.com/news/apparel-news/newsdetails.aspx?news_id=61662
- ¹²⁰ Hennes & Mauritz official website www.hm.com/gb/ (Corporate Responsibility)
- ¹²¹ See official website of the Murray Darling Basin Authority www.mdba.gov.au
- ¹²² 'Awash in Waste', Economist April 11th 2009, Page 17
- ¹²³ GEF Agency of the IFAS Aral Sea Basin Program: Water and Environmental Management Project: Sub-Component A1: National and Regional Water and Salt Management Plans
- ¹²⁴ 'White Gold: The True Cost of Cotton' 2005, Environmental Justice Foundation, UK
- ¹²⁵ For example: Water & Sanitation Weekly, OOSKA News, April 15 2009 Volume 1, Issue 4
- ¹²⁶ www.rferl.org/content/Water_In_Kazakhstan_Too_Filthy_To_Even_Use_For_Agriculture/1616923.html
- ¹²⁷ Water Resources in Europe and Central Asia, 2003. Volume 2 'Country Water Notes and Selected Transboundary Basins' (World Bank, New York)
- ¹²⁸ www.forexpros.com/news/commodities-futures-news/interview-soviet-toxic-legacy-still-poisoning-russia
- ¹²⁹ Water & Sanitation Weekly, OOSKA News, April 29 2009 Volume 1, Issue 6
- ¹³⁰ OOSKA News, April, 2009
- ¹³¹ WHO Global Info Base, 2002
- ¹³² Climate Change and Water, Technical Paper prepared by Working group II, IPCC, June 2008
- ¹³³ Impact of Climate Change to Water Resource in Central Asia, EDB and EB IFAS, 2009
- ¹³⁴ Impact of Climate Change to Water Resource in Central Asia, EDB and EB IFAS, 2009
- ¹³⁵ Climate Change and Water, Technical Paper prepared by Working group II, IPCC, June 2008
- ¹³⁶ The second national Communication of the Republic of Tajikistan under the United Nations Framework Convention on Climate Change, the Government of the Republic of Tajikistan, 2008
- ¹³⁷ Impact of Climate Change to Water Resource in Central Asia, EDB and EB IFAS, 2009
- ¹³⁸ The second national Communication of the Republic of Tajikistan under the United Nations Framework Convention on Climate Change, the Government of the Republic of Tajikistan, 2008
- ¹³⁹ National Human Development Report Kazakhstan, 2008
- ¹⁴⁰ National Human Development Report Kazakhstan, 2008

Selected Data Sources

- Amnesty International. State of the Worlds Human Rights. Report 2008.
- Center for American Progress. www.americanprogress.org
- CIA. The World Fact Book, 2009.
- Economist Intelligence Unit. Political Instability Index 2008.
- FAOSTAT
- Institute of Waters and Watersheds. Oregon State University, 2009.
- International Energy Agency. IEA statistics. www.iea.org, 2005
- Transparency International. Corruption Index 2008
- US aid. <http://www.usaid.gov/>, 2009
- World Bank, Datasets Human Development and Public Services Research
- World Bank 2004. Central Asia Regional Export Potential Study.



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