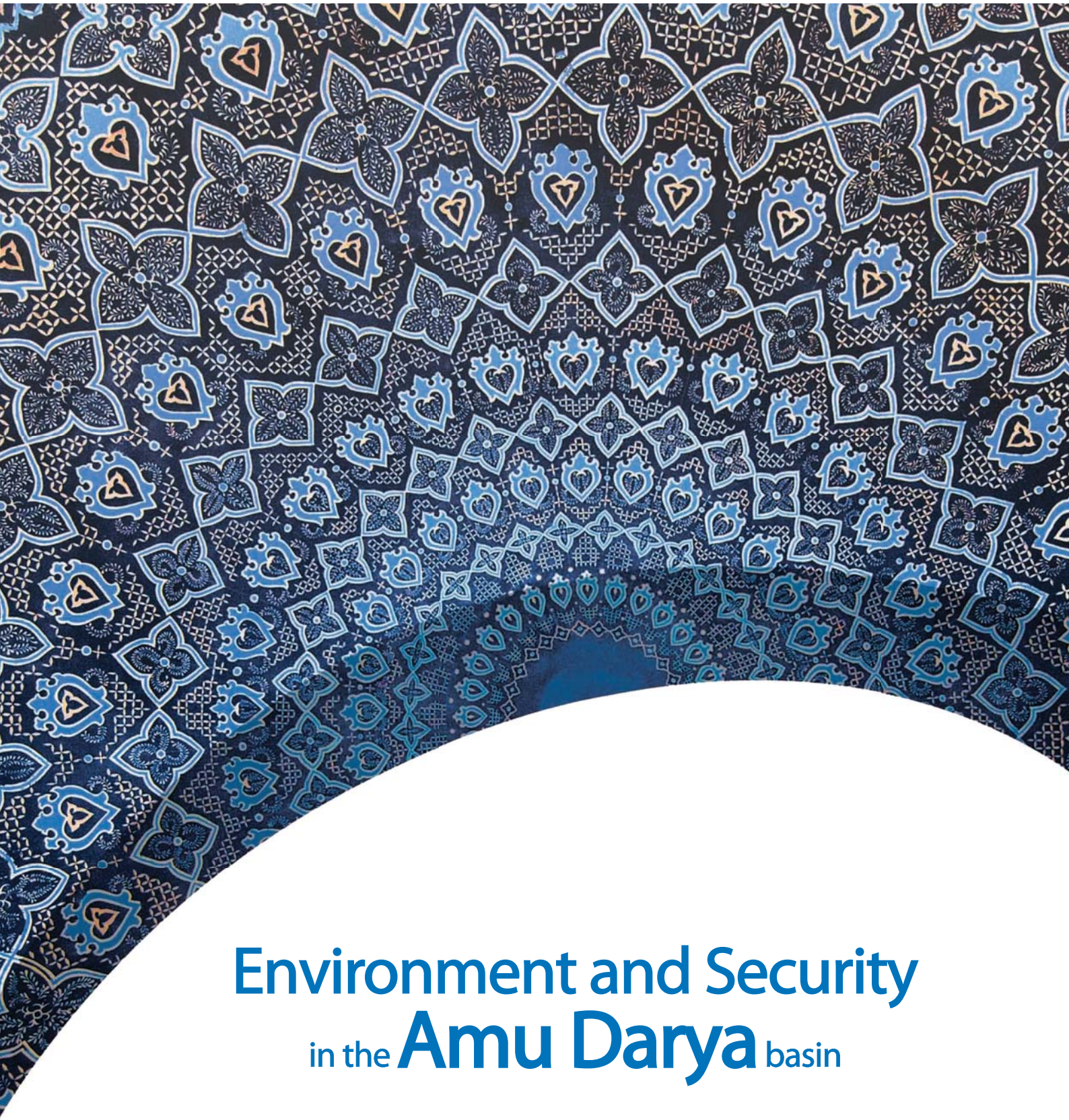


Environment and Security in the Amu Darya basin

UNEP

ENVSEC
Environment & Security

ENVIRONMENT AND SECURITY IN THE AMU DARYA BASIN

This report was prepared on behalf of the partner organisations of the Environment and Security Initiative by UNEP, GRID Arendal and Zoi Environment Network with assistance and advice from:

M. Akmuradov, M. Anstey, D.M. Baheer, B. Baliev, M. Baltes, M. Beilstein, T. Berkeliev, H. Boboev, L. Bogdetskaya, E. Bournay, B. Bowling, E. Buttanri, C. Daniel, R. Daussa, S. Davidov, K. Davis, L. De Martino, K. De Wispelaere, N. Denisov, S. Dustov, M. Farhad, B. Frattini, Z. Hamdard, H. Hopko, U. Islamov, I. Kadyrzhanova, Y. Kamalov, A. Karimov, A. Kayumov, M. Khakdodov, A. Khomidov, S. Khoshmuhamedov, G.N. Khurami, V. Kim, J. Krähenbühl, B. Libert, S. Mahmood, A. Mäkelä, S. Michaelis, C. Milow, M. Moseneder, A. Nasretdinov, L. Nazarova, S. Nordström, V. Novikov, R. Nurmuhamedov, M. Palosaari, A. Reimov, L. Reznikova, L. Rio, N. Safarov, F. Safi, S. Samoylov, B.A. Sarwari, A. Stralchenia, O. Simonett, B. Slay, S. Smalys, B. Snoy, D. Stucker, A. Stukalo, G. Thapan-Raina, S. Vuola, A.W. Modaqiq, K. Wegerich, H.E. M. Zaher, A. Zaidi

Language editing: Harry Forster

The Ministry of Foreign Affairs of Finland has provided generous support for the process of identifying environment and security issues in the Amu Darya river basin, regional and local consultation, field missions and publication of the assessment report. The Government of Norway has supported the project by providing additional resources to GRID-Arendal. UNDP contributed to the cost of activities related to Afghanistan.

Cover artwork based on photo from: shutterstock image

Printed on 100% recycled paper at GRAPHI 4, France

UNEP promotes environmentally sound practices globally and in its own activities. This report is printed on 100% recycled paper, using vegetable-based inks and other eco-friendly practices. Our distribution policy aims to reduce UNEP's carbon footprint.

Upper Amu Darya (Panj) river

Amu Darya river hydrograph 1950-2008, at Kerki (above) and Samanbai (opposite)

Lower Amu Darya river at Nukus

The Amu Darya river basin

When Central Asia and especially the Amu Darya basin region comes to mind, it prompts memories of the Silk Road and ancient civilizations with limitless barren lands and the sands of Karakum and Kyzylkum, the dazzling ice-covered mountains of the Pamir, Alai, Zarafshan and Hindu Kush, the Aral Sea, wild rapid rivers, and the historical centres of Samarkand, Bukhara, Termez, Sogdiana, Balkh, Merv, among others.

In recent decades the Amu Darya has attracted international attention both because of the Aral Sea crisis, and its large hydropower, irrigation and water engineering projects. Under the Soviet Union expert missions warned of the disastrous effects of rapid, massive development of cotton monoculture in Central Asia. The shrinking of the Aral Sea and the increasingly poor environmental conditions in the surrounding region brought it home to policy makers that urgent action was needed to mitigate the sea's disappearance and the resulting socio-economic disaster. In the past 20 years various international conferences and missions by national and international experts have described the deteriorating environmental and socio-economic situation, especially in the Amu Darya delta region.

There is no shortage of well-documented literature on the problems of regional water management in Central Asia. Various reasons, among others the rising number of disputes about water use and hydropower projects, prompted the Environment and Security Initiative (ENVSEC) partners to decide that the Amu Darya basin was a priority. As early as 1994 research identified the Amu Darya delta[1] (Klötzli, 1994) as an environment and security hotspot. Research has shown that instability related to environmental degradation is more likely to occur in marginal vulnerable areas, typically arid plains, mountain areas where high and low-land interact, and transnational river basins (Baechler, 1999), all characteristics of the Amu Darya River basin. Over the years the challenges for the region from an environmental and security perspective have increased and the outlook for the future raises concerns among the general public, national authorities, international organizations and experts.

The Environment and Security Initiative (ENVSEC)

ENVSEC was launched in May 2003 during the Fifth Environment for Europe Ministerial Conference in Kyiv and the OSCE Economic Forum in Prague, by three international organizations with different yet complementary agendas and missions: the UN Environment Programme (UNEP), the UN Development Programme (UNDP) and the Organization for Security and Co-operation in Europe (OSCE). In 2007 the Initiative was joined by the UN Economic Commission for Europe (UNECE), the Regional Environmental Centre for Central and Eastern Europe (REC) and as an associated partner, the Public Division of the North Atlantic Treaty Organization (NATO). Detailed information is available at www.envsec.org

From the outset the Initiative has seen its primary goal as helping the countries to identify, understand and, where possible, mitigate risks to stability and security that may stem from environmental problems and challenges. Traditionally the notion of security has primarily been conceived in terms of neutralizing military threats to the territorial integrity and political independence of the state. However, in recent years, increasing emphasis has been placed on expanding the traditional concept of security to include non-conventional threats and factors promoting tensions and conflict.

One of the strengths of the Environment and Security assessment is that it integrates both known and emerging socio-economic and environmental trends in a basin-wide perspective and analyses them by focusing on the role they play in the security and stability of the region and its communities.

The Environment and Security Initiative is based on a process that starts from the identification of problematic issues and sites, or "environment-security hotspots"[2]. These are identified and prioritized through expert inputs, public consultation, joint field assessments, and information from authoritative international and national sources. Proposals for follow-up actions are developed by national and local institutions and players in collaboration with the organizations partnering the Initiative. Projects on the ground range from in-depth investigations of hotspots and awareness-raising, to helping countries strengthen their institutions, improve policies, find solutions to concrete environmental and security problems, and mount pilot interventions.

In Central Asia, the Environment and Security Initiative has based its initial work on the regional consultation held in Ashgabat in 2003, where representatives of states and partner organizations gathered to define priorities jointly. After the Ferghana Valley and the Eastern Caspian, the third assessment in Central Asia focuses on the Amu Darya River basin. So far the ENVSEC Initiative in the region has been seen as acting as a catalyst, keeping otherwise low priority or little known issues in the picture, while promoting actions on the ground.

The prime aim of this report is to identify the environmental stress points in the Amu Darya basin which have, or may have, security repercussions for the states and population.The report then suggests solutions to the challenges identified during the assessment.

The assessment report is based on a process comprising missions and consultations with state authorities, representatives of the media and civil society in Afghanistan, Tajikistan, Turkmenistan and Uzbekistan in 2007-2010. The process included drafting national contributions on environment and security issues at country and local level, and regional meetings with the countries of the basin. The meeting in Ashgabat (Turkmenistan) in September 2007 focused mainly on issues related to the lower part of the basin[3]. The meeting in Kabul (Afghanistan) in November 2007 discussed upper-basin issues and Afghanistan's perspective[4]. Field visits were made to the upper Amu Darya basin in Tajikistan and its regions adjacent to Afghanistan in spring 2008. Similar field missions to Turkmenistan and Uzbekistan covered the middle and lower parts of the Amu Darya River basin, river delta and the Aral Sea region. All in all, the field missions covered more than 3 000 km. Participants included experts from the region and from international organizations (see Annex 1 for details). Almost 100 experts were directly involved or consulted during the process.

Environment and Security linkages

In general there are two main areas of concern when considering environmental factors as a source of modern conflicts: resource scarcity and degradation; and resource abundance. In both cases the problem is often (unequal) access to critical resources and competition for the control and exploitation of valuable commodities.

When considering the first concern – degradation of resources and scarcity – the two factors are closely linked, as degradation can increase scarcity and tension over distribution and access, while scarcity of natural resources exposes the resource to over-exploitation (Bolma, 2006; UNEP, 2009). When a community depends directly on natural resources, such as land and water, for its survival, the negative changes associated with their loss, serious degradation, and/or inaccessibility threaten livelihood security and increase vulnerability to social and violent conflicts (Stucker, 2006 and 2009). Scarcity, degradation and lack of access to freshwater and agricultural land are specific factors of instability, especially at the communal level.

On the other hand, the abundance of natural resources can also become a source of tension between and within states. Countries whose wealth depends on the export of natural resources face several challenges related to economic and political stability (Collier 2002). How resources are managed and how the resulting revenue is redistributed influences national stability (UNEP, 2009).

Looking specifically at the factors related to transboundary rivers, international research on conflict and cooperation over international water resources shows that although international relations over freshwater resources are overwhelmingly cooperative, conflicting relations between states tend to focus on three main issues: water quantities and allocations; radical institutional change within a basin and infrastructure projects along transboundary basins (Yoffe, Wolf and Giordano, 2003).

The issue of who controls water resources, and how, is often a decisive factor in environment and security relations in the arid lands of Central Asia and Afghanistan. In this region the water question cannot be dissociated from climate change impacts, energy and food security, as a large percentage of the population depends on irrigated agriculture for its livelihood.

From a security perspective, climate change, water, energy and agriculture constitute the main areas of interest for this report, as they reveal the potential for increasing instability and even confrontation. We shall look at water management and allocation mechanisms in the region, the question of deteriorating soil and water quality and energy supply, trans-border industrial pollution, biodiversity loss and natural disasters which have a profound effect on people's livelihoods and exacerbate environmental stress.

A number of factors and issues make it necessary to analyse the basin from several perspectives. The first factor relates to geopolitical changes. From a system with two players (the Soviet Union and Afghanistan) the basin has moved to one with five states (Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan, Afghanistan) along its length.

The region's economy is still mainly based on exploi–tation of natural resources, some non-renewable such as hydrocarbons, others renewable, particularly water. The latter is vitally important to agriculture, a key economic sector in all the states in the region. Overall water consumption is much as in the past, but patterns of water use have evolved in line with changes in agriculture. Cotton is still a strategic crop but wheat and other crops such as rice are playing a bigger role, to improve the food security of Central Asian countries. Large segments of the existing water infrastructure (canals, pumping stations, dams) are facing maintenance and deterioration problems, but new projects (dams and hydropower stations, artificial lakes) are changing the situation, modifying the existing balance and relations between riparian states. Different interests between upstream and downstream countries make regional cooperation and finding common solutions an imperative. Energy and food security considerations influence the policies of the states as well as relations between countries in the region.

In the last 10 years severe drought and extreme cold wave have dramatically exposed the vulnerability of the region's agriculture and energy supply systems to severe weather events. Successive reports have warned of rapid glacier melting in the areas where the region's main rivers rise. Previous natural disasters and severe weather events are testimony to the challenges posed by a changing climate. The effects of climate change are more serious and challenging than previously thought, potentially including more frequent, more intense natural disasters, water and consequently energy shortages, crop failures, pest infestations and food insecurity. These challenges will affect all countries in the region and forward-looking collaborative solutions are needed.

Furthermore, environmental legacies such as cross-border pollution hotspots remain unresolved. Both desert and mountain ecosystems, which previously enjoyed a status of protected areas, are increasingly fragmented by stricter national border regimes. The development of energy and transport routes is an additional burden for regional biodiversity. Unregulated pasture and forest use, pests and invasive species are all factors constraining Central Asia's fragile ecosystems.

Finally, a secure Afghanistan will also play a larger part in relations within the basin. Until now Afghanistan's role in regional water management has been relatively marginal, mainly because of its repeated armed conflicts and widespread insecurity. Existing literature

From the Aral 1988 expedition to the ENVSEC 2008 assessment: what has changed?

Twenty years after the first major warning signs of the consequences of mismanaging natural resources, and confronted with recent reports underlining the risk that Central Asia now faces from climate change and a decline in the key resource for the whole region, namely water, the Environment and Security Initiative assessed the situation and trends affecting the region. To understand the changes that have occurred in the Amu Darya basin and identify the environmental factors that may pose a threat to security, the Environment and Security Initiative carried out several missions in 2008, mainly following in the steps of the Aral 88 expedition, but adding visits to Afghanistan.

The Aral 88 expedition (Reznichenko, 1992) was one of the landmarks in recognizing the Aral Sea crisis[7]. The Novy Mir and Pamir magazines organized the expedition, inviting a group of writers, scientists and journalists to travel all over the Aral region and meet with the governments of republics and districts, the local population, agricultural and water specialists. This expedition covered the entire basin of the Aral Sea – from the high mountains and glaciers of the Pamirs, to the Zarafshan and Ferghana Valleys, and the deserts of Kazakhstan and Turkmenistan. It revealed major problems of water wastage, excessive application of pesticides and soil salinization. A short book and several articles were published in 1992 as the visible results of the expedition with an analysis of the critical situation in the Aral basin. The authority of the well-known scientists and writers who took part in the expedition exposed the Aral Sea problem to the public. A parallel UNEP-Soviet diagnostic study of the Aral Sea in 1988-1991 (UNEP, 1993) broadened the scientific basis and exposed the problem to the international community. The study focused on regional water and land resource management issues, trends in climate change, inadequate environmental monitoring systems and policy-making to respond to the changing and deteriorating environment. An article in the National Geographic magazine of February 1990 (by W. Ellis) – "The Aral: A Soviet Sea Lies Dying" also revealed the major symptoms of Aral Sea region's deteriorating social and environmental conditions.

In comparison to the Aral 88, UNEP 1988-91 and National Geographic expeditions of that time, the Environment and Security field missions in 2008 found several key differences and changes in the situation.

In 1989 the sea split into two separate water bodies (northern and southern parts) and by 2009, the south-eastern part of the sea had virtually disappeared thereby further reducing the size of the former southern sea. The volume and surface area of the sea have now decreased tenfold. The water level in southern part has dropped by 26 metres and the shoreline has receded several hundred kilometres. Sea-water salinity has increased by a factor of 12 to 20, exceeding 120 gr/l in the south-western part. The fishery has disappeared, except for the Amu Darya delta lakes and the Northern "Little" Aral (now part of the Syr Darya River basin) where major national and international conservation efforts have helped to sustain and even revive limited fisheries. The ecosystem of the Amu Darya delta has suffered major degradation, with most wetlands drying up. The shortage of water and its deteriorating quality downstream have driven more people to seek a living in other regions.

on regional water management in Central Asia does not usually refer directly to Afghanistan. However, as a riparian country Afghanistan plays a role in the Amu Darya watershed and is a stakeholder in regional water management mechanisms. ENVSEC partners such as UNEP and UNDP are currently promoting stable livelihoods in Afghanistan through environmental means such as help restoring damaged natural resources (reforestation), providing viable economic alternatives, hydrometeorology and hazard monitoring. The environmental and socio-economic impacts of the conflict in Afghanistan extend far beyond its national borders and in this context, Afghanistan is directly related to the security of the Central Asia states[6].

The ability of countries and communities to deal with change varies, especially when it affects the resources on which their economy or survival depends. The ENVSEC assessment aims to provide a valuable, up-to-date picture of the environment and security challenges facing the region. This should help states to adopt more sustainable strategies for the future. It should also support ongoing processes and help foster dialogue on regional and international conventions.

The effects of climate change are more serious and challenging than previously thought (compared to data in the UNEP 1993 report). In particular the occurrence of severe droughts, glacier cover exhaustion, changes in rainfall patterns, increased land degradation and pest infestation[9] are key sources of concern. The amount of salinized, degraded land has increased, much as the pressure on arable land.

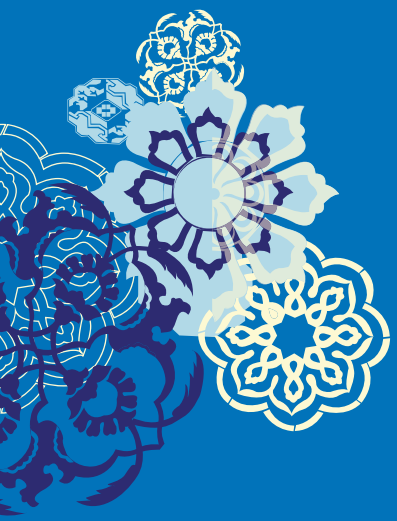
Moreover, states are increasingly apprehensive about regional environment and economic development issues which used to be easier to manage, such as industrial activities (and pollution control) in cross-border areas and large energy and irrigation development projects, are now require up-to-date environmental and socio-economic assessments and adjustments.

Structural imbalances in the regional water system of Central Asia are stirring up tensions over use and distribution of water resources both between countries and at a local level. Growing winter energy deficits in the upstream states, limited economic alternatives and rising demand for exporting electricity are the main factors motivating the development of large hydropower projects in upstream countries. However, these are perceived as modifying access to water resources by downstream countries, which are heavily dependent on agriculture and consequently disagree with most hydropower projects. The change by upstream countries in the operating mode of the hydropower facilities has had intermittent negative impacts downstream – mostly in the Syr Darya basin.

Overall water use per hectare in countries has decreased, but there are major differences between countries and within them. Countries have started to move away from management of water resources based on administrative boundaries to an approach based on hydro-geographic principles, taking into account local user needs. The share of cotton cultivation in the crop structure has dropped.

Vital biological resources such as the tugai ecosystems along the rivers, mountain pastures and forests and globally endangered species are increasingly jeopardized by downstream water deficits, upstream energy problems, weaker national control and poor cross-border coordination between basin states.

States have ratified several international environmental conventions and have developed action plans to address country-specific and regional environmental challenges. However, these processes are not always balanced as all the states have not ratified the same conventions and when they have done so they are implementing action plans at different speeds.



The Amu Darya river basin: geographic and socio-economic context


Amu Darya river basin
Elevation in metres
3 000
2 000
1 000
500
200
Southern Aral Sea
seasonal lake
Amu Darya river delta and lakes
Muynak
Nukus
Sarygamysh Lake
Dashoguz
Golden Age Lake (under construction)
Gyzylgaya
Dashoguz Collector (under construction)
TURKMENISTAN
Karakum
Bereket
Serdar
Kopet Dag
Baharly
Great Turkmen Collector (under construction)
Atrek
Ashgabat
Karakum (Garagum) Canal
Bojnurd
Mashad
Sabzevar
Kashmar
Torba-e Hydariyeh
IRAN
Tayebad
0
250
500
750
1000 km
Map produced by Zoï Environment Network, December 2010


Aralsk
Lake Balkhash
Baikonur
KAZAKHSTAN
Bakanas
Kyzylorda
Moyynkum
Zhanakorgan
Shu
Syr Darya
Taraz
Bishkek
Kara-Balta
Tien Shan
Talas
Shymkent
Toktogul
Naryn
Qyzylqum Desert
UZBEKISTAN
Uchquduq
Zarafshon
KYRGYZSTAN
Tashkent
Angren
Jalalabad
Tuyamuyn
Lebap
Aydar Lake
Olmaliq
Namangan
Andijan
Osh
Ferdana
Nurota
Khujand
Kyzyl-Kyya
Wuqia
Navoiy
Jizzax
Isfana
Alai Range
Sary-Tash
Bukhara
Pandjakent
Samarkand
CHINA
Qorakol
Zarafshan
Ayni
Karakul
Kashkadarya
TAJIKISTAN
Pamir
Turkmenabat
Shahrisabz
Dushanbe
Murgab
Amu Darya
Qarshi
Nurek
Lake Sarez
Denov
Vakhsh
Panj
Kulob
Surkhandarya
Pamir
Atamyrat
Qurgonteppa
Gunt
Khorug
Tejen
Mary
Termiz
Feyzabad
Wakhan
Kafarnigan
Kokcha
Balkh
Kunduz
Sheberghan
Mazar-e Sharif
Hindu Kush
Tejen
Murgab
Dusti dam
Pol-e Khomri
Chitral
Gilgit
Sar-e Pol
Balkhab
Kunduz
PAKISTAN
Mopgora
INDIA
Bamian
AFGHANISTAN
Kabul
Jalalabad
Muzaffarabad
Herat
Hari Rud
Srinagar
Peshawar
Islamabad

Geographic and hydrological features

The Amu Darya extends over 2 540[10] km, making it the longest river in Central Asia. Known as the Oxus in the Greek world and the Jayhun in the Arab world, it has marked the history of the region for centuries. Since ancient times the Amu Darya has not only been the source of life for vast arid lands but has also served as a border and a line of communication[11].

The Amu Darya is formed by the confluence of the Vakhsh and Panj Rivers[12] and flows west-northwest to its mouth on the southern shore of the Aral Sea. Not far below this junction the Amu Darya is joined by additional major tributaries: on the left bank by the Kunduz River and on the right by the Kafirnigan Rivers.

In its upper reaches the Amu Darya forms part of Afghanistan's northern border with Tajikistan, Uzbekistan, and Turkmenistan. The melting snow and glaciers of the Alai Valley of Kyrgyzstan contribute water to the Vakhsh (Kyzyl-Suu) River, whereas the Wakhan Corridor of Afghanistan feeds the Wakhan River, both of them eventually form the Amu Darya. After leaving the highland zone, the river veers northwest to cross the arid Turan Plain, where it forms the boundary between the Karakum and Kyzylkum Deserts, located respectively to the southwest and northeast. The river's lower reaches form part of the boundary between Uzbekistan and Turkmenistan.

Topography, glaciers, precipitation patterns and climate variability are the important factors which greatly influence the flow of water in the Amu Darya basin, which consists of three main zones: an upstream mountainous zone – the mountains of Pamir-Alai and Hindu Kush[13] rising to 7 495 metres generate 90 per cent of the flow; a midstream region – with several distinct large irrigated oases; and a downstream zone[14] of flow depletion with a delta and discharge into the former Aral Sea. The latter two zones consist mainly of deserts, fragments of grassland, arid forests and plains at elevations no greater than 300-500 metres.

The Amu Darya basin

The Amu Darya River basin area and its socio-economic and geographic definitions vary widely depending on the source of data and application.

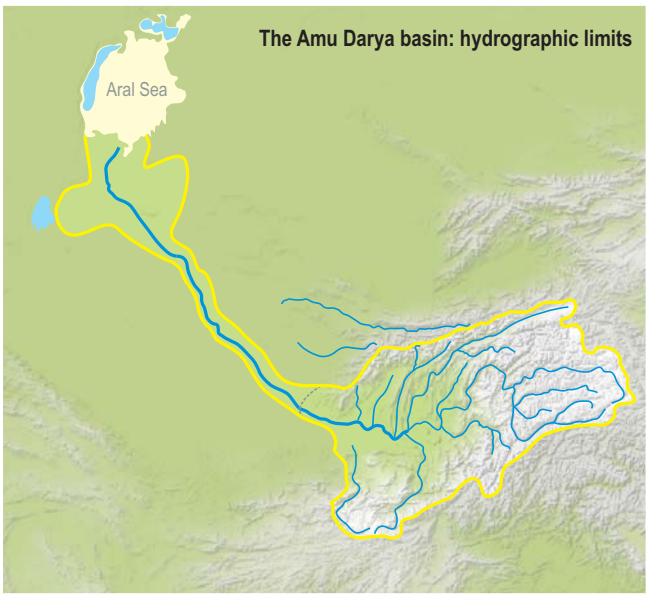
From the hydrological point of view, the upstream catchment area of the Amu Darya River basin contributing water to the main river is 309 000 km^2 at Kerki gauging station in Turkmenistan. This includes a large part of Tajikistan (except its northern Sogd province and the Markansu-Tarim basin), the southwest corner of Kyrgyzstan (the Alai Valley) and the northeast corner of Afghanistan. If the mid and down-stream sections of the potential drainage area in Turkmenistan and Uzbekistan are included, the total catchment area varies from 465 000 km^2 to 612 000 km^2, depending on the source of data[15].

On average, available water resources in the Amu Darya basin are estimated at 78 km^3 a year for surface water and up to 25 km^3 a year for groundwater. The live storage capacity of the man-made reservoirs in the Amu Darya basin amounts to 20 km^3. The basin's water resource availability fluctuates from 58 to 109 km^3 a year[16].

The long-term average flow of the main Amu Darya[17] is about 62 km^3 a year (2 000 m^3/sec) at Kerki[18].The actual flow depends on the climatic conditions in the current year. The amount of snow, spring rainfall and the intensity of glacier melt in summer play a decisive role in the formation of water resources, when flow significantly increases[19] and in extreme cases causes flooding.

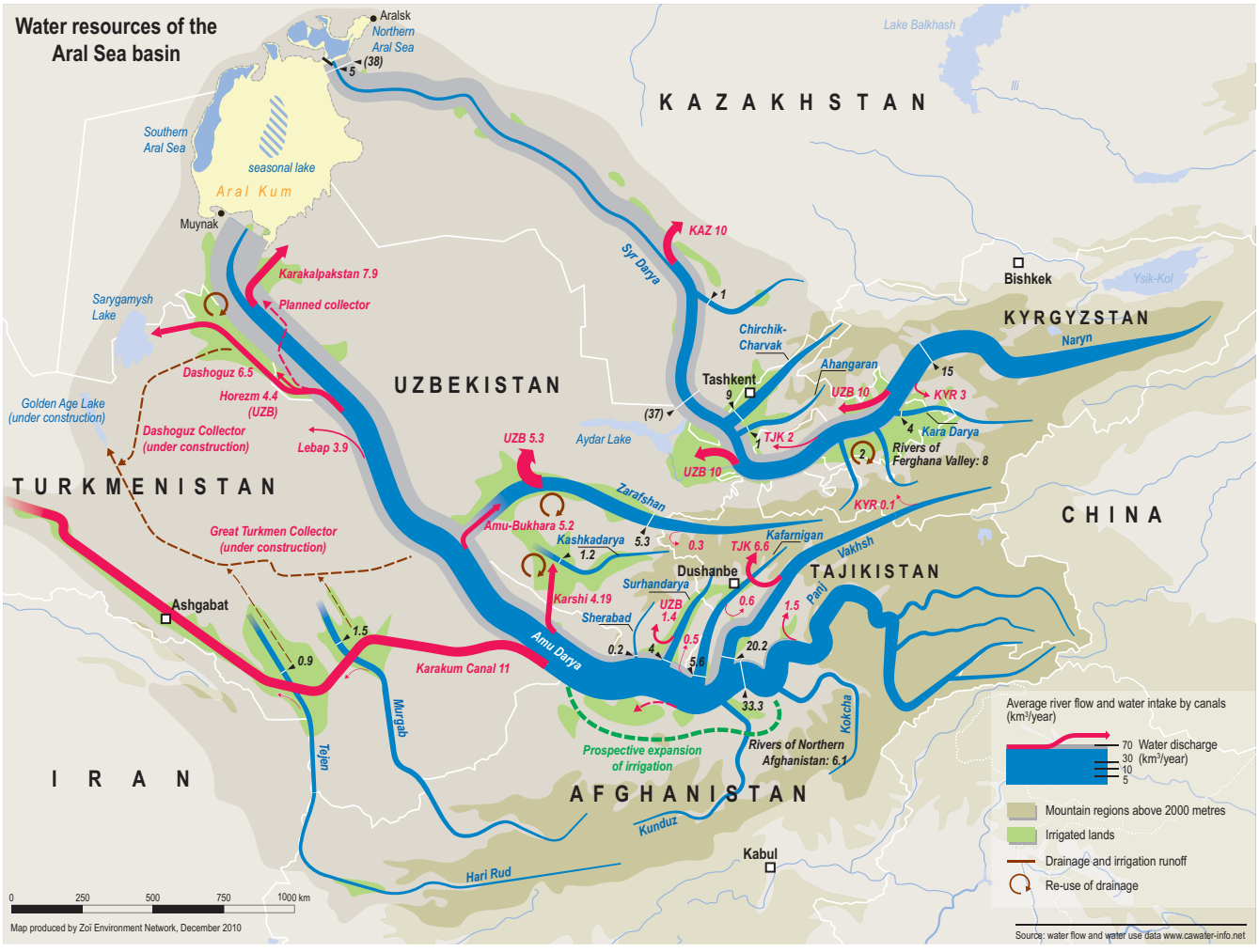
If the major irrigation canals, collectors, small rivers, aquifers and springs related to the Amu Darya basin but not discharging water into the main Amu Darya River are included, the greater Amu Darya basin area amounts to 1.3 million km^2 including a large part of Turkmenistan, more than half of Uzbekistan and a fraction of Iran. The definition of the greater basin was used by the Soviet Union and is still commonly used in regional water affairs and international literature, however, as we shall see below, regional water management pays little attention to the Afghan part[20].

While small and marginal areas of the Amu Darya basin are important, the present report focuses on the four countries which hold the lion's share: Afghanistan and Tajikistan (upstream), Turkmenistan and Uzbekistan (mid and down-stream).



Sources: Amu Darya basin network, SIC ICWC, UNECE Assessment of Transboundary Rivers and Lakes

Sources: "BWO Amu Darya", Central Asia Regional Water Information Database (www.cawater-info.net)



Economic development context

Under the Soviet economic system Central Asia was a source of agricultural products, energy and minerals.

The Soviet Union invested massively in developing an immense system of dams[21], canals and water pumping stations. The period between 1950 and 1990 saw huge investment in the water infrastructure of the region with the construction of reservoirs, irrigation canals, pumping stations and drainage networks. Most rivers were diverted for irrigation to support the cultivation of cotton, wheat, fodder, fruit, vegetables and rice in the arid steppe and desert areas. During this period irrigated areas expanded by 150 per cent in the Amu Darya basin and by 130 per cent in the Syr Darya basin (World Bank, 2004). By 1980 the network of irrigation canals reached into the deserts, covering 7.6 million hectares, mainly in Uzbekistan and Turkmenistan. In 2005-10 the area under irrigation in the Amu Darya basin exceeded on average 5 million hectares[22]. Uzbekistan has the largest area under (large-scale) irrigation followed by Turkmenistan, Tajikistan and Afghanistan[23].

The largest irrigation canal is the Karakum Canal (Garagum Darya), the main section of which was completed in the 1960-70s to carry water from the Amu Darya at Kerki, Turkmenistan, westward to Mary, Ashgabat and ultimately to the Caspian region. Other large irrigation structures include the Amu-Bukhara and Qarshi Canals and water reservoirs such as Nurek in Tajikistan and Tuyamuyun, shared by Turkmenistan and Uzbekistan[24].

The construction of the Soviet irrigation system enabled the development of large-scale agriculture which, in turn generated employment and income for a population that moved (or was moved[25]) into the arid lowlands.

Today, the economies of the region are still essentially agricultural, especially with regard to the predominant occupation of the labour force. In 2007-8 agriculture earned about 20 per cent of national GDP in Tajikistan[26], 25 per cent in Turkmenistan and more than 28 per cent in Uzbekistan. Agriculture employs 67 per cent[27] of the labour force in Tajikistan, 45 per cent in Uzbekistan and 48 per cent in Turkmenistan. In the case of Afghanistan some 80 per cent of the population depends on farming and herding (UNEP, 2003). Wheat is the main crop cultivated on both irrigated and rain-fed land. All countries in the region, except for Afghanistan, rely on primary exports (cotton, oil and gas, gold, aluminium), for hard currency.

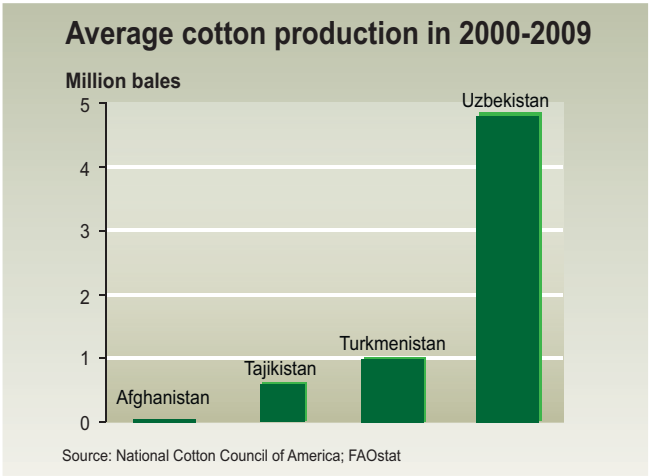
Moving away from cotton

Under the Soviet Union wheat was imported to the Amu Darya basin mostly from other Soviet republics in exchange for cotton. At independence wheat imports had to be paid for in hard currency and this quickly became a major burden for states and also turned into a food security issue, increasing the relevance of the agricultural sector in all states. To cope with this situation and decrease dependency on outside food sources, governments opted to shift production away from cotton to wheat. Since independence was proclaimed in 1991 agricultural output has been greatly diversified. Instead of thirsty crops such as cotton and rice, farmers are increasingly growing less demanding crops, such as wheat and squash.

In the early 1990s about half of irrigated land in Uzbekistan was used to grow cotton, the rest being used for food. At present irrigated cotton only accounts for 30 per cent of the whole, with the other land under irrigation being used for food and feed crops, vital for the well-being of the population. Cereal production in Uzbekistan has thus risen from 1 million tonnes in 1991 to 7 million tonnes in 2010. Uzbekistan currently needs about 5 million tonnes of cereals to meet the demands of domestic consumers. The figures show that it has largely achieved food self-sufficiency, while continuing agricultural reform.

Turkmenistan has substantially increased grain production recently. Tajikistan, with 7.5 million inhabitants remains a net importer of food. It needs 1.7 million tonnes of cereals a year but in 2008-10 Tajikistan harvested 1.2 million tonnes of cereals, and the remaining 20-30 per cent must be imported from Kazakhstan[28].

Cotton cultivation developed during the Tsarist era but it was under Soviet rule that Central Asia became a key supplier of agricultural products and raw materials for the whole Union, a role that required the development of an extensive irrigation infrastructure encompassing its main river basins. The area devoted to cotton has decreased since independence, with some states starting to give priority to food crops such as wheat for food security reasons. But cotton still plays a key role in the political, economic and social life of countries such as Uzbekistan, Turkmenistan and Tajikistan and still essentially dominates the share of agricultural export receipts. In 2005 Central Asia accounted for 6.5 per cent of the world's total production and contributed 15 per cent of overall cotton exports (ICG, 2005).



Oil and gas reserves in the Amu Darya basin

Energy resources are an important factor in the relations of Amu Darya basin countries. There are many oil-gas fields located along the border between Turkmenistan and Uzbekistan, making the region straddling the two countries an area of high strategic and economic value[31].

Turkmenistan and Uzbekistan are well endowed with non-renewable energy resources such as natural gas. Revenue generated by the export of fossil fuels is an essential component in the state budget of these countries. In 1990 Turkmen gas represented almost 11 per cent of total Soviet gas production. In an energy-hungry world the presence of large reserves of fossil fuels has prompted the interest of states and companies alike. After independence Turkmenistan invested in its energy sector and derived considerable advantage from high global market prices for oil[32]. It was able to increase its foreign currency reserves and reduce external debt. Turkmenistan also benefited from improved terms of payment for its natural gas exports to Russia and Ukraine, two of the country's key commercial partners. Furthermore, the recent agreement with China covering the major gas pipeline with capacity up to 40 billion m^3 and the new natural-gas pipeline to Iran marks a major step towards diversification of Turkmenistan's energy routes. Another project under discussion is the Trans-Afghanistan Pipeline (TAP) of similar capacity, which would bring the Turkmen gas to Pakistan and India. Unlike oil, natural gas has no well established price.

Uzbekistan is also a natural gas producer, and a transit country for pipelines going from Turkmenistan to Russia and China. The latest agreement between the Uzbek and Russian authorities provides for a significant increase in the volume of gas exports, up to 15 billion m^3. Moreover, intense oil-gas exploration is currently underway in the southern Aral Sea area and the Amu Darya delta. Uzbekistan uses most of the fossil fuel it produces. The country is also a key energy partner for Tajikistan and Kyrgyzstan, supplying them with natural gas[33].

Currently Afghanistan has very limited capacity for natural gas production and is trying to attract foreign investment to develop several gas fields north of Shiberghan containing over 50 billion m^3. At the same time, exploratory work for natural gas is underway in Tajikistan, assisted by Russia's "Gazprom".

Irrigated agriculture posed other problems with negative impacts on the natural environment as well as on the health and socio-economic conditions of the region's population. The water infrastructure was developed with little concern for the environment. The Aral Sea crisis is testimony to the lack of environmental concern among Soviet agriculture and water planners.

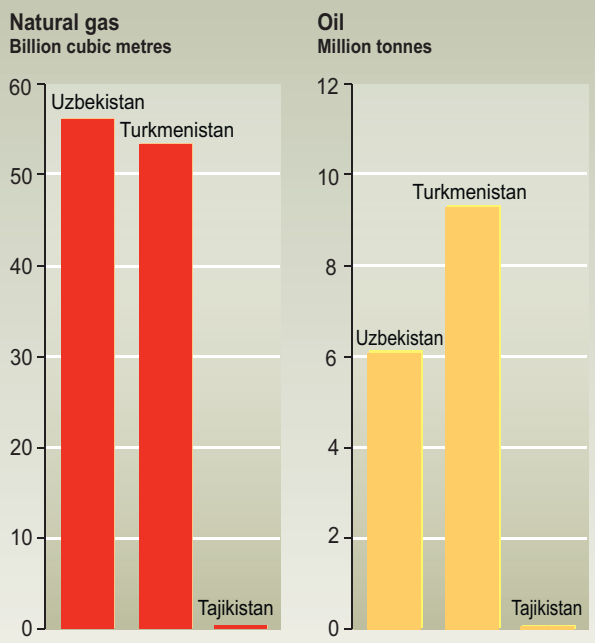
The Amu Darya basin is also a region of energy and mineral production. Gold extraction is an important economic activity for Uzbekistan and also for Tajikistan and Kyrgyzstan[29]. More than 90 per cent of Uzbekistan's oil and gas production is concentrated along the Amu Darya in the Bukhara-Qarshi zone and the largest part of Turkmenistan's gas reserves are also located in the middle Amu Darya basin[30].

The abundance of both renewable and non-renewable energy resources in the Amu Darya River basin will secure the region's geopolitical significance for nearby energy-hungry economies such as China, India, Pakistan and Western European countries and energy-transit countries such as Russia, Afghanistan and Iran. Obtaining a stable energy supply is becoming a matter of national security and the focus of geopolitical and economic concerns. The drive towards energy security and away from extreme energy dependence can have both positive and negative environmental effects, locally and globally, depending on which resources, solutions and technologies are prioritized.

Countries which depend on exports of natural resources are exposed to the risk of price fluctuation. For example, after rising sharply, oil prices fell in 2008 depriving states of part of their revenue. The price of commodities such as cotton and aluminium also dropped further reducing state revenue and hence the governments' capacities not only to deal with external shocks and crisis but also to provide funding for key sectors such as energy, water or agriculture.

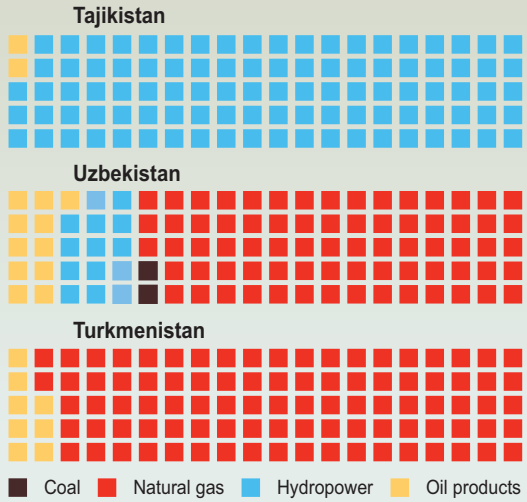

Energy production and flows
RUSSIA
KAZAKHS
UZBEKISTAN
TURKMENISTAN
IRAN
AFGHANISTAN
TAJI
Ufa
Chelyabinsk
Petropavlovsk
Omsk
Penza
Tolyatti
Samara
Saratov
Balavoko
Kumertau
Magnitogorsk
Kostanay
Kokshetau
Rudniy
Stepnog
Orenburg
Atbasar
Oral
Karachaganak
Orsk
Astana
Volgograd
Aktobe
Arkalyk
Temirtau
Zhezkazgan
Astrakhan
Atyrau
Kashagan
Aral
Beyneu
Baikonur
Dzhusaly
Dzhalagash
Kyzylorda
Aktau
Aktau (planned)
Tengiz
Aral Sea
Chiili
Makhachkala
Kentau
Zhanatas
Turkestan
Karatau
Derbent
Nukus
Shymkent
Uchquduq
Dashoguz
Baku
Ali Bayramli
Tashkent
Angren
Guliston
Khujand
Turkmenbashi
Balkanabat
Cheleken
Navoiy
Jizzax
Bukhara
Samarkand
Serdar
Turkmenabat
Nurek
Dushanbe
Baharly
Ashgabat
Qarshi
Kokdumalak
Rasht
Bandar-e Torkeman
Bojnurd
Shirvan
Tejen
South Yolotan Osman
Atamyrat
Qurgonteppa
Gonbad-e Kavus
Mary
Termiz
Karaj
Gorgan
Quchan
Sari
Emamrud
Kunduz
Damghan
Sabzevar
Mashad
Mazar-e Sharif
Tehran
Neyshabur
Torba-e Hydariyeh
Dauletabad
Kabul
Arak
Qom
Kashmar
Torbat-e Jam

Average energy production in 2000-2009

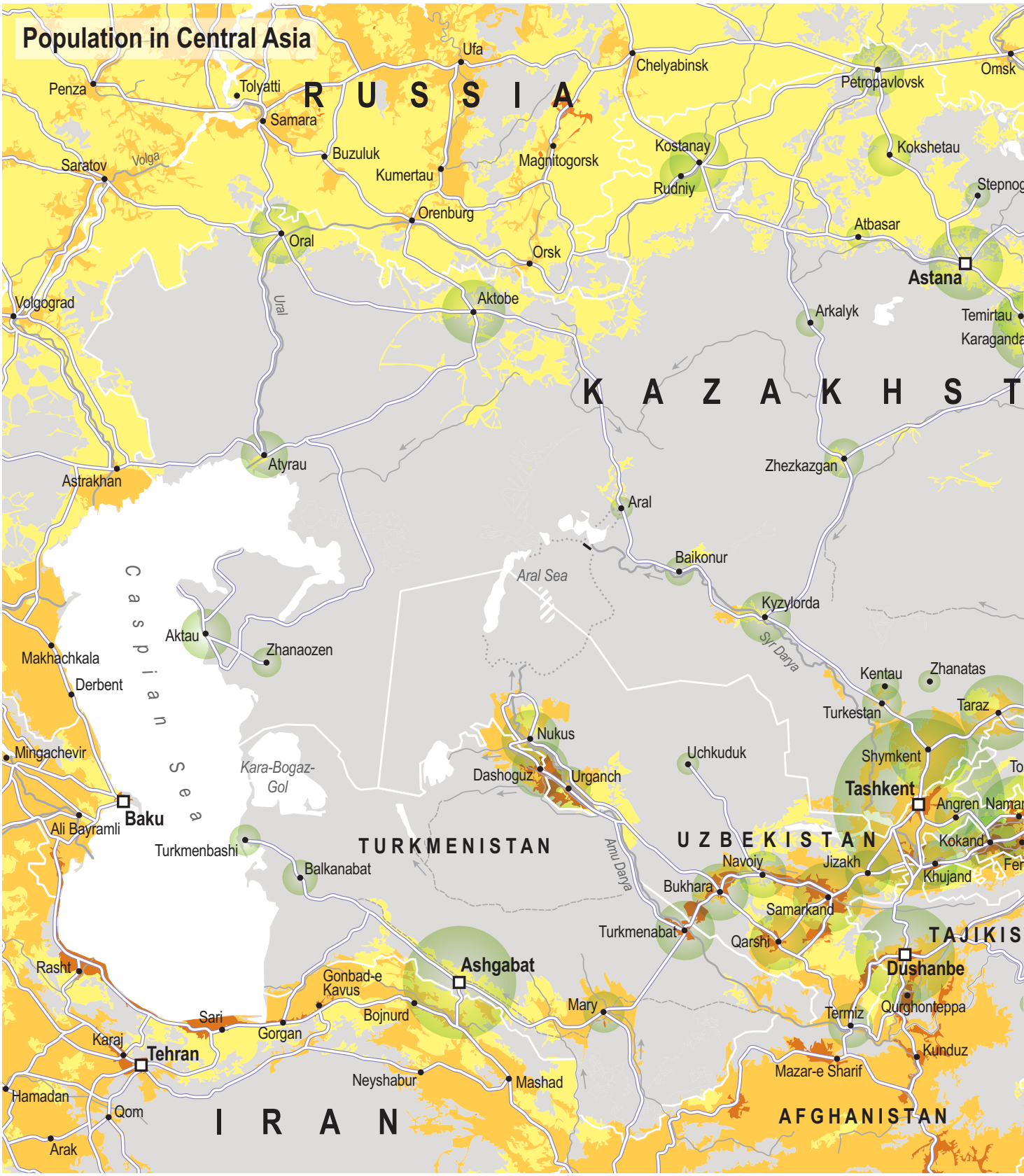


Source: British Petroleum's Statistical Review of World Energy (2010), national data

Sources of electricity (in %)



Sources: national energy data, US EIA A square represents one percent.


Population in Central Asia
RUSSIA
KAZAKHSTAN
TURKMENISTAN
UZBEKISTAN
TAJIKIS
IRAN
AFGHANISTAN
Caspian Sea
Aral Sea
Ufa
Chelyabinsk
Petropavlovsk
Omsk
Penza
Tolyatti
Samara
Saratov
Volga
Buzuluk
Kumertau
Magnitogorsk
Kostanay
Rudniy
Kokshetau
Stepnog
Orenburg
Oral
Orsk
Atbasar
Astana
Volgograd
Ural
Aktobe
Arkalyk
Temirtau
Karaganda
Atyrau
Astrakhan
Zhezkazgan
Aral
Baikonur
Kyzylorda
Syr Darya
Aktau
Zhanaozen
Makhachkala
Derbent
Kentau
Zhanatas
Turkestan
Taraz
Nukus
Uchkuduk
Shymkent
Mingachevir
Kara-Bogaz-Gol
Dashoguz
Urganch
Tashkent
Angren
Baku
Ali Bayramli
Turkmenbashi
Balkanabat
Amu Darya
Navoiy
Jizakh
Kokand
Khujand
Bukhara
Samarkand
Turkmenabat
Qarshi
Dushanbe
Ashgabat
Rasht
Gonbad-e Kavus
Mary
Termiz
Qurghonteppa
Sari
Bojnurd
Gorgan
Karaj
Tehran
Kunduz
Mazar-e Sharif
Neyshabur
Mashad
Hamadan
Qom
Arak

Population

With economic development the population in the basin increased from 14 million in 1960 to about 50 million in 2010. Southwest Uzbekistan (the oasis of Urgench, Qarshi, Bukhara, Samarkand, Khiva, Nukus), southern Tajikistan, particularly the Vakhsh Valley, and Northern Afghanistan (Balkh, Kunduz, Kokcha) are the most densely populated zones of the basin.

After the dissolution of the Soviet Union, the population of the Amu Darya basin states continued to increase: in Turkmenistan the population grew by 190 per cent (up 3 million); in Tajikistan by 31 per cent (up 1.7 million), and in Uzbekistan by 28 per cent (up 7 million); in Afghanistan it almost doubled (increasing by 15 million people, including returning refugees).

Labour migration is a new socio-economic factor relevant to the region. Several million people, predominantly young men from the region's underprivileged or impoverished areas, are now working abroad, mostly in Russia and Kazakhstan to support their families through remittances. This factor has helped alleviate growing population pressure and lack of jobs. At the same time massive migration has left many areas with a shortage of labour.

Upstream and downstream relations

In the Amu Darya basin, as in many regions of the world, topographic, hydrological and climatic factors are closely related to human factors. Mountainous regions upstream, with their plentiful water supply, are sparsely populated and water use is far lower than the available supply (Micklin, 2000). At the same time the water-rich mountains of Central Asia have an unexploited potential for electricity generation but depend on their neighbours for the transit and import of conventional (fossil fuel) energy. In contrast the arid plains downstream are densely populated and most of the water is needed and used for agriculture, while downstream states are endowed with abundant oil and gas deposits. The Amu Darya River thus sets the stage for relations between riparian states.

The presence of large water reserves in the mountains and available land in the plains was one of the main factors in favour of developing large-scale irrigated agriculture in the region. In parallel with the construction of water storage facilities and irrigation canals, the Soviet authorities considered these areas also suitable for hydropower production and started building a large number of reservoirs and associated hydropower facilities, which also served to regulate (or guarantee) the water flow for irrigation needs.

During the Soviet era, the energy and irrigation infrastructure in Central Asia was build so that the five republics would be interdependant. Priority was given to the needs of agriculture and water storage facilities were consequently run in “irrigation mode” (water was released during the vegetation period in spring and summer). In summertime the cheap energy generated during the irrigation season, was also used to operate the many water-lifting pumps used for the basin’s irrigation systems. In post-Soviet times, the upstream countries started shifting to “energy mode”[35], increasing water releases from their dams in winter to meet demand for electricity and reducing summer flow to ensure water accumulated for the winter months.

For the downstream states this has become an issue of paramount importance as they are highly dependent on irrigated agriculture for food security

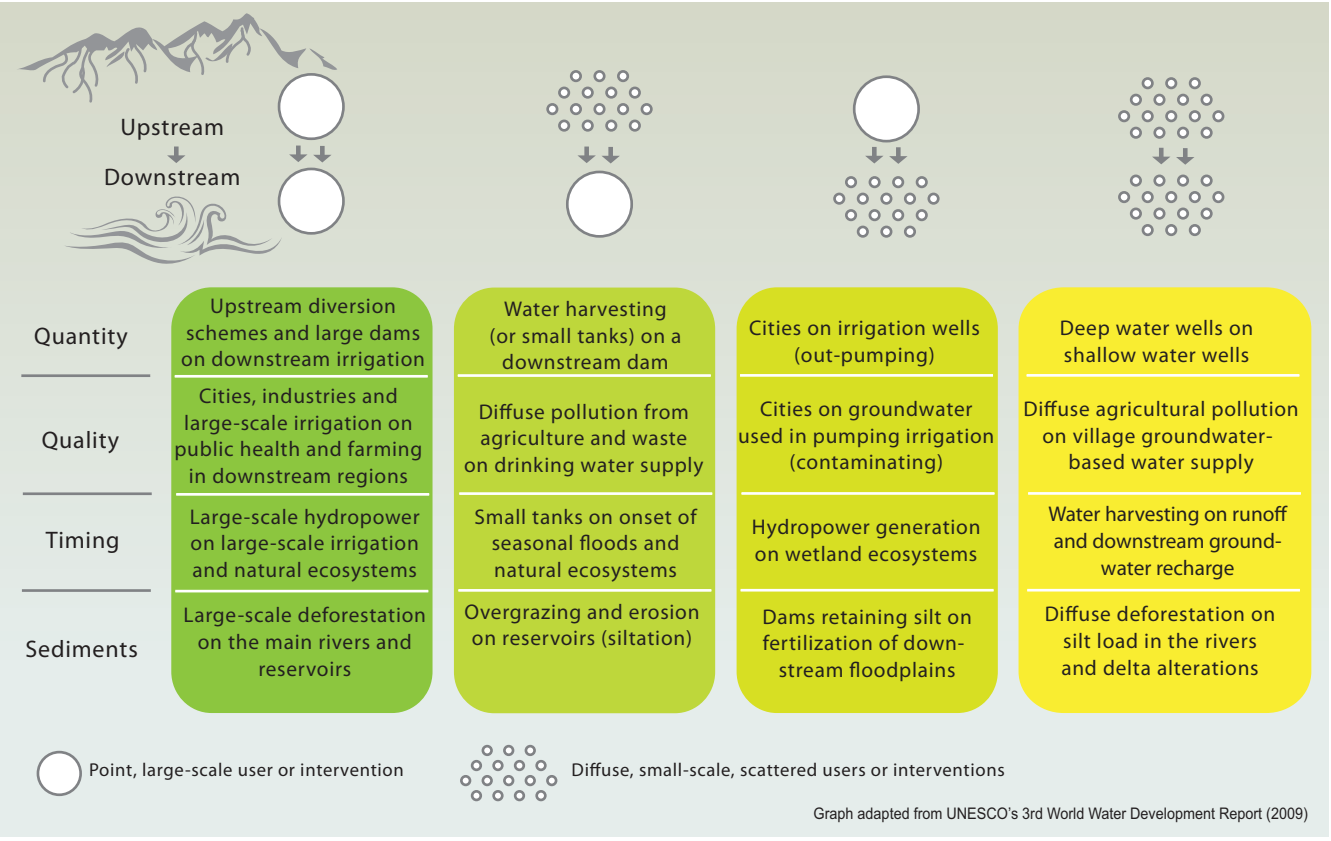
and generating foreign exchange. They must rely on transboundary water sources, since over 90 per cent of Turkmenistan's and Uzbekistan's water supply originate outside their borders.

The three states located in the water generation areas of the major Central Asian rivers, Tajikistan, Kyrgyzstan and Afghanistan[36] intend to develop their hydropower potential to cover growing domestic energy demand, export energy and decrease their energy dependence on hydrocarbon-rich neighbours and suppliers.

Such plans have prompted apprehension in downstream countries, concerned that these developments will affect their access to water for agriculture.

In the past the Amu Darya marked the border between the Soviet Union and Afghanistan. Now the independent countries in the region have to deal with several rivers and canals which are now transboundary water courses, and conduct complex annual negotiations over water and energy in a context in which all states regard access to water and energy as issues of national security importance[37]. Furthermore, the recent and foreseeable impacts of climate change, major droughts and severe natural disasters have strained an already fragile situation.

Although the Central Asian states realise that the water management and inefficient irrigation system inherited from the Soviet Union are not sustainable, they have maintained the status quo and have on the whole been slow to try and change the system's setup. The most important issues which need to be addressed for management of the regional water and energy system along the Amu Darya basin are: the volume and timing of water release; regional and export energy market development; payment for maintaining and operating infrastructure and watershed conditions benefiting several users in the basin; major infrastructure shared by several countries; projects with a transboundary impact. Over the years all these factors and trends have become crucial from the security perspective in the Amu Darya River basin.



Graph adapted from UNESCO's 3rd World Water Development Report (2009)

Sources: Afghanistan Information Management Service; Afghan Geological Survey; Geology and mineral resources of Afghanistan (2008); Railway Gazette

Afghanistan and armed conflicts

Although Afghanistan is not participating in the Environment and Security Initiative, it does play a major role as an upstream country of the Amu Darya River basin and deserves special attention. In Afghanistan, in the southern part of the Amu Darya basin, armed conflict and instability had a significant impact on the energy and agriculture infrastructure. According to the UNEP Post-Conflict Assessment (UNEP 2003), deforestation and overgrazing of pastures are commonplace in Northern Afghanistan where valuable pistachio forests have been severely depleted. Land mines have taken a heavy toll on the population and made vast areas dangerous for use including for agriculture. Ammunition and rocket fuel spillages have polluted the environment. Due to the insecurity in Afghanistan, neighbouring countries maintain a military presence along borders to prevent incursions by armed groups and drug traffickers[38]. Access to border areas is still problematic and in some places dangerous, making cross-border water monitoring and other environmentally-related activities difficult. Afghanistan is not represented in the regional bodies established since the end of the Soviet Union to manage natural resources and especially water. Over the past decade Afghanistan has cautiously expressed its interest in becoming an observer or member of the existing natural resource management mechanisms in Central Asia and is increasingly engaging in bilateral environmental cooperation.

Climate change: a threat to security?


Northern Aral Sea
Aral
Beyneu
Baikonur
K A Z A K H S T
Southern Aral Sea
seasonal lake
Kyzylorda
A r a l K u m
Amu Darya river delta and lakes
Muynak
Qongirot
Nukus
Xojayli
Q y z y l q u m D e s e r t
Kentau
Syr Darya
Shymkent
Sarygamysh Lake
Uchquduq
Dashoguz
Beruniy
Tortkol
Urganch
Zarafshon
Golden Age Lake (under construction)
Dashoguz Collector (under construction)
Gyzylgaya
Tuyamuyn Reservoir
Lebap
U Z B E K I S T A N
Tashkent
Aydar Lake
Olmaliq
Nurota
Guliston
Khujand
T U R K M E N I S T A N
Navoiy
Jizzax
Isfana
Bukhara
Qorakol
Samarkand
Pandjakent
Ayni
Zarafshan
Zeravshan glacier
Bereket
Serdar
K a r a k u m D e s e r t
Amu Darya
Turkmenabat
Kashkadarya
Shahrisabz
Qarshi
Guzor
Dushanbe
T A J I
Kopet Dag
Great Turkmen Collector (under construction)
Baharly
Ashgabat
Atrek
Karakum Canal
Denov
Nurek
Surhandarya
Vakhsh
Kulob
Bojnurd
Tejen
Mary
Atamyrat
Sherabad
Qurgonteppa
Quchan
Termiz
Kofarnihon
Sheberghan
Balkh
Mazar-e Sharif
Kunduz
Mashad
Tejen
Murgab
Dusti dam
Pol-e Khomri
A F G H A N I S T A N
Sar-e Pol
Balkhab
Kunduz
H i n d
Torbat-e Jam
I R A N
Bamian
Kabul
Tayyebad
Herat
Hari Rud
Chaghcharan
Ghazni
0
250
500
750
1000 km
Map produced by Zoï Environment Network, December 2010

Climate change impacts in the Amu Darya river basin

- Rivers with intense water use and increased stress from climatic and hydrological changes
- Large river delta communities and natural ecosystems with increased environmental stress and high risk of water shortages during low water years / regional droughts
- Elevated risk of glacial lake outburst floods (GLOFs) and ice and snow hazards
- Increased sedimentation of reservoirs and essential water infrastructure
- Increased risk of climate-related hazards in the mountains; more intense ice and snow melt and intensified hydro-logical cycle; increased surface runoff
- Increased risk of droughts in grazing areas, rainfed and irrigated croplands; more arid climate conditions; reduced surface runoff
- Impacts of the shrinking Aral Sea on regional climate and dust storms
- Increased heat stress for rural workers on agricultural fields
- Potential risk of cross-border spread of invasive species and new diseases

---

- Deserts
- Areas above 2000 metres
- Important glacier monitoring sites

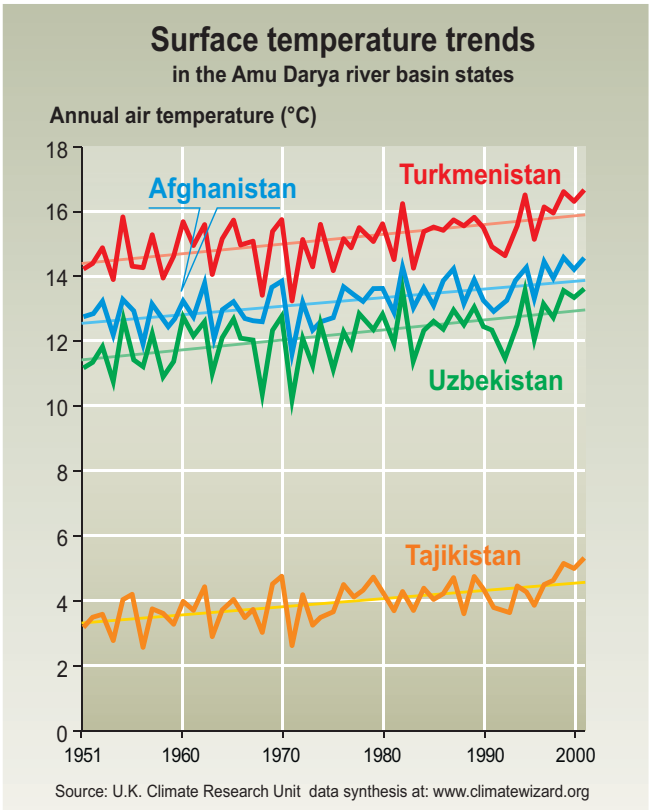
Sources: Second National Communications on climate change of Tajikistan, Turkmenistan and Uzbekistan; Climate Change in Central Asia: A visual synthesis report (2009); Environment and Security Initiative regional consultations in Ashgabat (Sep 2007) and Kabul (Nov 2007) and regional field missions (May 2008).

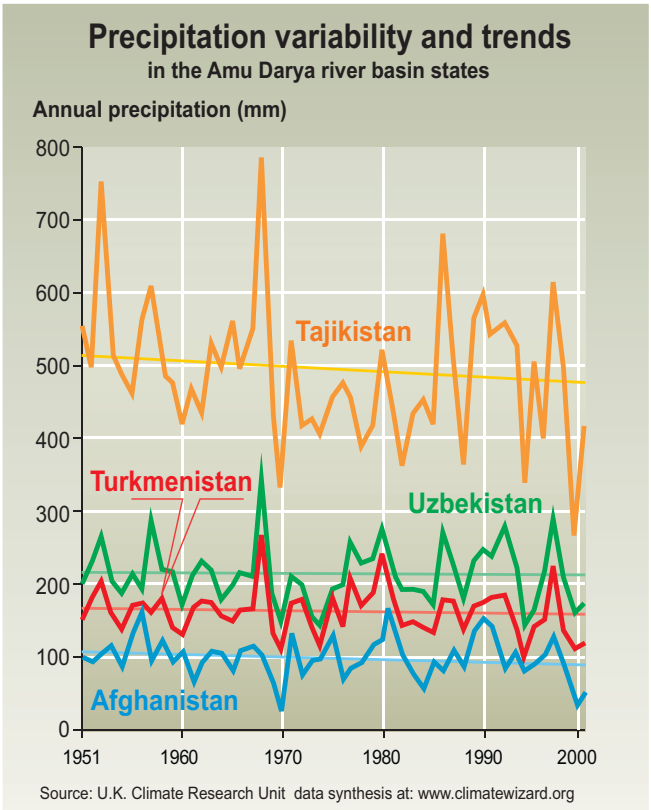
The links between climate change and security may be difficult to quantify but there is little doubt that climate change will bring transboundary and multifaceted challenges to the Amu Darya basin – especially for water resources, land productivity and sensitive biodiversity. Climate change is likely to increase the risk of extreme weather events and related natural disasters which may become humanitarian emergencies.

UN Secretary-General Ban Ki-moon uses the term 'threat multiplier' to describe how climate change could exacerbate existing problems of persistent poverty, weak institutions, mistrust between communities and nations, and inadequate access to information or resources. Given the growing likelihood of natural resources fuelling conflict, environmental diplomacy can be drawn on to identify and address, in advance, potential sources of tension, or defuse tension due to natural resources and the environment[39].

The World Bank (World Bank, 2009) has given the highest vulnerability rank to four of the five Central Asia countries among 28 nations of Europe, Caucasus and Central Asia. The most vulnerable are the small mountain countries – Tajikistan and Kyrgyzstan – also selected by the Poverty and Environment Initiative implemented by UNEP and UNDP.

Pamir Mountains



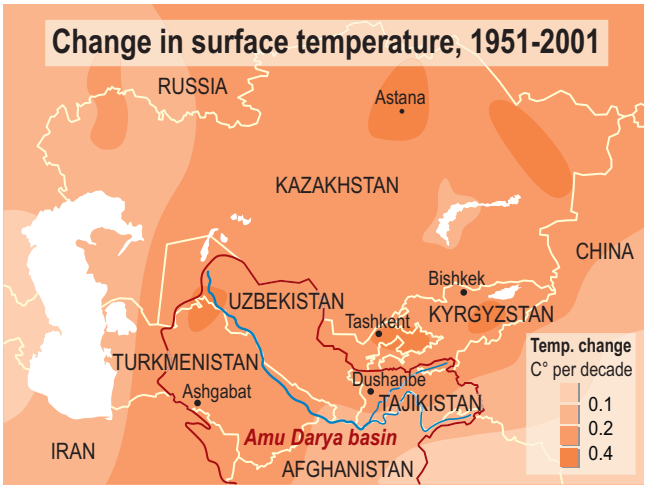


In the past 50 years, air temperatures in the basin have been increasing by 0.1-0.2ºC a decade. Since the 1950s the number of days with air temperatures higher than 40ºC has doubled in the Amu Darya delta region (Uzbekistan SNC 2008). Temperatures are projected to rise by 2-3ºC in the next 50 years. Such an increase in temperatures could lead to significant environmental changes, some of which are already happening: increasing risk of glacier-lake formation and sudden outburst floods, shrinking of glaciers, changes in the hydrology of climate-sensitive river basins, changes in ecosystems, crop failure due to drought and disease.

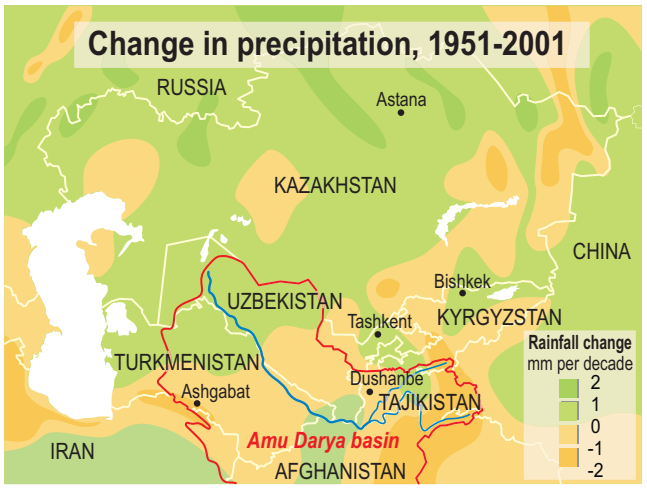
One fundamental element related to global climate warming is the rapid exhaustion of the Amu Darya basin's glaciers and changes in snow accumulation and rainfall patterns. A significant loss of glaciers[40] in Central Asia has been observed since the latter part of the last century continuing into the 21st century, although glaciers at high altitudes have suffered little loss of ice. Overall retreat totals several hundred metres for many large glaciers; hundreds of small glaciers have vanished (UNEP 2007; Tajikistan SNC 2008).

Snow and glacier melt contributes the bulk of flow during the vegetation period, while glaciers play a particular role in drier, hotter than average years, when snow reserves and rainfall are scarce. Agriculture is the economic sector which consumes the most water and is highly dependent on its availability and timing. Without the guaranteed water supply provided by mountain snow and ice, agriculture will be at risk.

With rapid population growth in Central Asia, rising demand for water in agriculture may produce a situation of water scarcity in rivers shared by several countries. Reduced water availability combined with increased demand for water resources could lead to the further depletion of the river basin environment, greater silting up of reservoirs and more widespread desertification (WBGU, 2007).



Sources: U.K. Climate Research Unit (data synthesis is available at: www.climatewizard.org), compilation of information from the Second (and the First) National Communications



Sources: U.K. Climate Research Unit (data synthesis is available at: www.climatewizard.org), compilation of information from the Second (and First) National Communications

Remotely sensed, basin-wide precipitation analysis and modelling (Nezlin 2004, Shiklomanov 2009) reveal that, although in some recent years (1990-92, 1998, 2009-10) precipitation over the Amu Darya watershed was higher than normal[41], water-formation potential in the Amu Darya basin could decline in the future (Shiklomanov 2009). More worrying is a trend towards low-water years, when water levels reach the absolute minimum, as in 2000, 2001, 2008. As a consequence, water availability in Amu Darya is becoming increasingly vulnerable.

Precipitation changes in the past 50-70 years have not been uniform. Lowlands in the middle Amu Darya basin have seen some increase in precipitation. In the upper basin some mountains have seen increased precipitation (Central Pamir, Zarafshan) others a decrease (Eastern Pamir, Hindu-Kush) (Shiklomanov, 2009; Tajikistan SNC, 2008). In mountain areas the declining trend of snowpack is predominant (Uzbekistan SNC, 2008).

Water is both a key resource for agriculture securing the survival of the population, and a strategic resource for electricity generation, so competition for the control of this natural resource is likely to increase (WBGU, 2007). Populated arid regions in the lower Amu Darya basin, especially the ones adjoining the Aral Sea, are already less hospitable for human beings due to decreasing water availability, salinization, declining agricultural productivity, increasing desertification and deteriorating climate conditions overall.

Modelling experiments and expert assessments indicate that water resources in the Amu Darya basin are not expected to change significantly in the next 10 to 20 years. However by the 2050s a 10-15 per cent decrease in run-off is possible (Uzbekistan SNC, 2008; Tajikistan SNC, 2008). Rising air temperatures would contribute to intense glacier and seasonal melting[42] and initially the flow of water and risk of floods would increase. However, once ice reserves are depleted, water flow rates and seasonal hydrography will probably shift, affecting the long-term patters of water availability (Agaltseva 2008, FAO 2010). Glacier shrinking will ultimately affect the summer flow of rivers – the most critical period for irrigation. Higher temperatures and downward precipitation trends may lead to a reduction in snow reserves, and consequently freshwater reserves. In addition to increased water stress, the countries listed in their second national communications on climate change the following important negative impacts with implications for security: higher risk of malaria; heat waves and other health impacts on children, women, and elderly people; increased soil degradation; declining productivity of crops (down 10-15 per cent for cotton and wheat) and rising water requirements for traditional crops (Uzbekistan SNC, 2008); unfavourable conditions for some types of pasture and forest; greater intensity of precipitation and higher risk of water-related hazards and impacts on infrastructure; more frequent spring floods (Uzbekistan SNC, 2008; Tajikistan SNC, 2008).

Agriculture and water

Before the 1990s the upstream states of Central Asia (Kyrgyzstan and Tajikistan) released water during the agricultural season and refrained from storing this water for generating hydropower in winter. In turn, they were compensated by downstream, fossil-fuel rich countries with energy deliveries during winter to cover domestic energy demand. The situation is known as the water-energy nexus, by which a win-win solution is possible if water is released during the period when both sectors can use it at the same time. At independence, downstream states of the Amu Darya River basin needed to secure timely access to water taking into account the operation of the existing and planned storage reservoirs and hydropower facilities controlling flow upstream. At the same time upper riparian countries wanted to achieve energy security, especially in the harsh winter season.

The Zarafshan basin shared by Tajikistan and Uzbekistan serves as an example, where existing water resources are totally used by riparian states, mainly by Uzbekistan[43]. Under these conditions any substantial, long-term changes in water availability due to natural factors, climate change or direct human interference may have a profound impact on the socio-economic development prospects and on the life of the population.

Zarafshan basin

The Zarafshan River rises in the Turkestan and Zarafshan mountains in Tajikistan and flows more than 500 kilometres. Inside Tajikistan, as far as Pandjakent, the river runs mainly down narrow canyons. After leaving the mountains, the river forms a large alluvial fan in Uzbekistan and splits into several branches near Samarkand to feed the ancient oasis. Several issues in the Zarafshan River basin are worth considering from an environment and security point of view.

First, the Tajik authorities plan to develop hydropower potential in the basin, but Uzbekistan is very concerned about such plans[44] due to the high dependence of its downstream provinces on timely and sufficient water supply.

Second, water pollution from industrial operations (construction materials and mining) upstream has been an issue between the two republics since the Soviet era.

Third, there is a critical need for cooperation on sharing climate and water data, especially seasonal and long-term flow forecasts. The lack of data significantly compromises decisions on the use of water resources.

A pilot project started by UNDP in 2010 aims to apply an Integrated Water Management and Water Efficiency Plan to Uzbekistan's part of the Zarafshan River basin[45]. At the same time, in Tajikistan's part of the basin, natural disaster risk assessment and preparedness projects are progressing. Both countries may benefit from establishing a platform for regular exchange of vital hydrological and risk information, including a forecasting system for the basin allowing short term (flood warning) and long-term flow forecasts for irrigation. This may also help provide adequate preparedness and response to the natural and industrial disasters which might affect local communities and economies along the Zarafshan basin.

Qarshi oasis and irrigation system

Irrigation canals and collector-drainage waterways

Water pumping station

Irrigated cropland

Interstate management of the Qarshi pumping stations

The Qarshi pumping cascade shared by Turkmenistan and Uzbekistan is the last major irrigation project from the Soviet period, built between 1973 and 1988. It consists of seven pumping stations – six of which are located on Turkmen territory, and one large water reservoir at Talimardjan. The powerful pumps consume more than 2 200 million kWh a year to raise 5 km^3 of water up 130 metres from the main Amu Darya river to irrigate almost 400 000 hectares of the Qarshi steppe in the Kashkadarya province of southern Uzbekistan and provide drinking water for the main cities and industries. About 2 million people live in the area and depend on this water. Almost 1 million tonnes of cereals and 0.5 million tonnes of cotton are produced here.

Given that the cascade was built in 1970s, the equipment is now near the end of its service life, requiring significant investment in maintenance and refurbishment. A bilateral agreement concluded in 1996 specifies the conditions for managing the irrigation and drainage facilities crossing the territory of the two countries and defines mechanisms for resolving problems. Under this agreement Uzbekistan operates the cascade and pays about US$12 million a year for the lease of the narrow strip of land on which the cascade is built (as well as the lease of land for the Amu-Bukhara canal and Tuyamuyun reservoirs) and diversion of about 10 per cent of the pumped water for the irrigation of 25 000 hectares on Turkmen territory.

The situation is complicated by two factors: the majority of the surface water used by downstream countries rises in upstream countries; the infrastructure that is strategically vital for supplying water to the large irrigation schemes in downstream countries is often located in a single state, but is used for the needs of two countries.

This is the case for the Qarshi and the Amu-Bukhara pumping station cascade systems and the Tuyamuyun water reservoir located in Turkmenistan but shared by Uzbekistan and Turkmenistan. There are also recently completed joint water infrastructure projects between Turkmenistan and Iran[46].

In this complex system, regional interdependency among the countries along the Amu Darya River is important, but what really matters are relations between direct neighbours.

The social and economic changes that followed the end of the Soviet Union prompted the newly independent states to maintain an adequate level of irrigated agriculture to strengthen food security, generate revenue and keep a large share of the region's population occupied. However, the lack of flexibility in the current set-up increases the dependency of riparian states on the supply of water.

It is consequently understandable that the states have made access to predictable quantities of water a national priority. In all the Environment and Security field missions carried out as part of the present assessment, downstream states – especially Uzbekistan – have underlined the importance of maintaining limits on water withdrawals.

In February 1992 in Almaty, one year after independence, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan agreed to maintain water allocation quotas set under the Soviet Union (last settled in 1987).

Limits (quotes) of water withdrawals for the Amu Darya River basin for the normal water year (based on the latest available data from the Interstate Comission for Water Coordination).

Territory / Country	Annual water withdrawal limit
Upper Amu Darya basin	***11.15 km³***
Kyrgyzstan	0.45 km³
Tajikistan	9.5 km³
Surkhandarya province (UZB)	1.2 km³
Middle and lower Amu Darya basin	***49 km³***
Uzbekistan	22 km³ – river's main stream
Turkmenistan	22 km³ - river's main stream
Aral Sea	***4.2 km³***
Khorezm province (UZB)	0.15 km³
Dashkhowuz province (TKM)	0.15 km³
Republic of Karakalpakstan (UZB)	0.5 km³
Total for average year	**60.15 km³**

The table highlights several problematic elements:

First, Afghanistan is not officially considered in the current regional water management scheme, despite being one of the countries in the Amu Darya basin and the second largest source of water formation in the basin. This question will be considered later in the report.

Another element is the disparity in water withdrawals between downstream and upstream countries. Downstream countries account for the largest water withdrawals along the basin, whereas upstream countries are entitled to a smaller share of the water that mostly rises on their land. This reflects the fact that the current water quotas were established when the whole system was operating in "irrigation mode", allowing the expansion of irrigated agriculture.

The amounts indicated in the table are based on average annual flow in the main river (62 km³) and do not include all the water actually used in the basin (re-use of collector-drainage waters), rivers not reaching the main Amu Darya (Zarafshan, Kashkadarya, smaller rivers within Uzbekistan and Turkmenistan), groundwater and the emerging problem of the impact of climate change on the region's headwater area and its water formation potential. The Interstate Commission for Water Coordination of Central Asia (ICWC) decides whether adjustments in water limits are needed depending on the hydro-meteorological situation.

Upstream states, located where the water flow is generated[48], tend to see water as a commodity for which downstream users need to pay. They raise the question of compensating for water storage services and for timely release of water, and for expenditure on managing and maintaining the parts of the system that benefit more than one state. Downstream countries express the need for damage compensation due to "anthropogenic" flooding or drought. These questions are still open and have become a major issue among the concerned states.

Another consequence of the variability of river flow is that minimal flow levels[49] set for downstream provinces and for the Aral Sea (the so called "sanitary releases") are the first to go in low-water years[50]. According to SIC ICWC (SIC ICWC 2010), the Amu Darya delta lakes system (of natural origin and technically assisted) require at least 3.5-5 km³ water supply to sustain minimum conditions for local ecosystems and livelihoods. The Aral Sea would need 10 times more. Several international conferences have underlined the gravity of the impacts of the Aral crisis.

Irrigated agriculture


Northern Aral Sea
Aralsk
Beyneu
Baikonur
K A Z A K H S T A N
seasonal lake
Southern Aral Sea
A r a l K u m
Kyzylorda
Amu Darya river delta and lakes
Muynak
Kentau
Zhanatas
Syr Darya
Nukus
Q y z y l q u m D e s e r t
Shymkent
Sarygamysh Lake
Uchquduq
Dashoguz
Urganch
Zarafshon
Golden Age Lake (under construction)
Dashoguz Collector (under construction)
Tuyamuyn
Lebap
U Z B E K I S T A N
Tashkent
Aydar Lake
Olmaliq
Gyzylgaya
T U R K M E N I S T A N
Nurota
Guliston
Khujand
Jizzax
Bekabad
Navoiy
Bereket
Qorakol
Bukhara
Zarafshan
Samarkand
Pandjakent
Ayni
Serdar
K a r a k u m D e s e r t
Mubarek
Koson
Kashkadarya
Shahrisabz
Qarshi
Guzor
Dushanbe
T A J I
Kopet Dag
Baharly
Great Turkmen Collector (under construction)
Turkmenabat
Amu Darya
Nurek
Atrek
Green belt
Ashgabat
Denov
Vakhsh
Kulob
Bojnurd
Karakum Canal
Atamyrat
Sherabad
Surkhandarya
Kafarnigan
Qurgonteppa
Tejen
Mary
Termiz
Sharitus
Balkh
Kunduz
Sarakhs
Sarahs
Sheberghan
Mazar-e Sharif
Mashad
Murghab
Pol-e Khomri
Tejen
Sar-e Pol
Kunduz
Balkhab
H i n d
Torbat-e Jam
Tayyebad
I R A N
Bamian
A F G H A N I S T A N
Kabul
Herat
Hari Rud
0
250
500
750
1000 km
Map produced by Zoï Environment Network, December 2010

Land degradation issues in the Amu Darya river basin

- Land degradation impacts
- Salinization of irrigated lands
- Water logging
- Depletion of forests and shrubs
- Forest and soil rehabilitation efforts
- Major regional sources of dust, aggravated by human activities
- Salt and dust particles carried by wind storms and affecting human health, agriculture and infrastructure

- Areas above 2 000 metres
- Tugai forests

Sources: LADA Land Degradation Assessment; Central Asian Countries Initiative for Land Management; Environment and Security Initiative regional consultations in Ashgabat (Sep 2007) and Kabul (Nov 2007) and regional field missions (May 2008).

Prior to the development of large-scale irrigation, the average water flow in the Amu Darya delta and input to the Aral Sea was 1 300 m^3/sec (38 km^3/year) at Nukus. The balance of the Aral Sea remained stable for many years. The development of irrigated agriculture from the 1950s to 1980s had serious impacts on river hydrology and water availability, especially in the Amu Darya downstream, culminating in an average water consumption of 53 km^3 per year (www.cawater-info.net) leaving almost no water for the delta and the sea.

Specific water use is high – on average 7 000-12 000 m^3/hectares for irrigation[51] – and there are regions where water usage is twice the average[52]. Only a fraction of the total water is actually used, more than 50 per cent of irrigation water being lost due to lack of canal lining, excessive filtration, evaporation and other reasons before reaching the fields and agricultural plants.

At independence the new states were faced with the complex task of maintaining a largely inefficient, centralized and subsidized irrigation system inherited from the Soviet Union. The rationale that led to construction of the irrigation systems in Central Asia was mainly based on the overall priority of the production needs of the Soviet Union rather than the direct interests of the Central Asian republics.

An insufficient share of the income generated by large-scale agriculture has been re-invested in maintaining and rehabilitating the water infrastructure, which has led to its decline. Infrastructure is consequently in poor condition, efficiency and productivity have dropped, whereas operational costs have risen[53]. Furthermore the confusion as to who is responsible for maintenance has led to increased water use and wastage. More water is needed to sustain areas under irrigation, and when the irrigation systems fail agricultural production drops, often forcing villagers to abandon the fields[54].

Since independence the Central Asian states of the CIS have undertaken agricultural reforms which have resulted in the establishment of private farms. The gradual dismantling of the large collective and state farms and the emergence of large, mostly subsidized private farms, and smaller family-based farming units (less than one hectare as average), have resulted in a significant increase in the number of stakeholders involved in managing water resources. With the rising number of water users, it has become necessary to group new private farms into Water Users Associations (WUAs). Introducing WUAs means replacing the administrative water management system of the Soviet Union and introducing a new form of water governance at the basin and canal level. A challenge associated with this change is that the WUAs in all the countries have mostly been established along the boundaries of former collective farms instead of following hydrographic characteristics[55]. Another challenge is that control over water use at the farm and household levels is not yet well established.

Over-watering at field level requires excess water to be drained out of the fields. Despite its significant volume, collector-drainage (irrigation runoff) waters in general do not count as a resource. A fraction of irrigation runoff is used to supplement irrigation water[56], especially in dry years, while much of it is discharged and lost in the desert, and a significant amount flows back into the middle and lower Amu Darya, increasing the quantity, but substantially decreasing the quality of water and making it unsuitable for drinking. Unlike the agreements regulating water quantities, there are no legally binding provisions on water quality in a cross border context (however, all Central Asian countries of the CIS have national regulations on water quality).

Limited application and incentives for advanced agricultural practices and insufficient agro-meteorological services contribute to the problem. Among the worst affected irrigated areas with soil erosion, especially salinization, are Kashkadarya, Bukhara and Karakalpakstan provinces in Uzbekistan, and Dashkhovuz, Achal and Mary provinces in Turkmenistan (Glantz, 2002; Atlas of environmental indictors of Uzbekistan, 2008). In 2005, in Turkmenistan around 70 per cent (over 1 million ha) of irrigated land displayed medium to high salinity levels (REAP CA 2005). Faced with a situation of soil deterioration and lower yields, these two downstream countries are introducing new measures to improve agricultural productivity and make more rational use of water. Water-logging and consequent soil degradation problems have eroded several archaeological monuments in Turkmenistan. The irrigation and drainage infrastructure and methods, ill suited to the soil in the Yavan valley (Tajikistan) and other irrigated land in the Amu Darya basin, has caused severe soil erosion in some places. There are also extreme cases, when improper planning and operation of irrigation systems has led to fatal results: breakthrough of the Sargazon small reservoir in 1985[57] and Sharora landslide in 1988[58].

Land salinization has additional consequences since it forces farmers to apply increasing quantities of water in winter in an attempt to wash the salt out of the soil, making water application even more wasteful than before (World Bank, 2003) and feeding large amounts of saline water into the drainage system. The resulting leaching uses up to 10-20 per cent of annual available surface water resources. By transporting large amounts of salt and other substances, leaching also contributes to lower water quality in the river.

At present the authorities have adopted several sets of measures to cope with these challenges. First, governments are investing more funds in rehabilitating part of the infrastructure. For example, the Uzbek authorities have launched a number of multi-million dollar projects with national funding and international loans to rebuild the collector-drainage network, pumping stations and improve more than 200 000 hectares of irrigated land. The Decree of the Uzbek President (October 29, 2007) “On measures for the radical improvement of the system of irrigated lands rehabilitation” and establishment of the funding mechanisms under the Uzbek Ministry of Finance significantly contributed to this recent process. Secondly, they are drafting changes in legislation for the water sector. With support from international organizations, governments are also investing in pilot projects to test and adapt advanced irrigation technologies, and automate water management to cut water consumption[59]. These projects are becoming more widespread in parallel with the process of land reform since farmers have started taking responsibility for improved use of land and water at the farm level. Volumetric charges[60] for water provide a better incentive for investing in water-saving technologies.

Relatively simple techniques[61] significantly reduce water consumption, but a more radical change will be needed to use natural resources sustainably. Reducing specific and overall water consumption remains a priority at all levels for the years to come.

Challenging tasks: managing water, energy and agriculture

The management of water under the Soviet Union was a complex matter under the Soviet Union, but the level of complexity has further increased since independence. The first priority for the newly independent states was to avoid short-term disruptions in water allocations and solve the problems posed by regulation of what were now transboundary rivers, with the corresponding international claims on water. After the end of the Soviet Union, Central Asian states continued using existing water policy and institutional frameworks as a basis for sharing regional water resources. The agreement reached by the five Central Asian states in February 1992 enshrines the determination of the Central Asian countries of the CIS to maintain Soviet-era arrangements[62].

The 1992 compact was followed by a number of declarations and general agreements on water reform and then by river-specific agreements especially for the Syr Darya[63]. These agreements (mostly annual agreements and the 1998-2003 Syr Darya Framework Agreement), all involve efforts to balance the demands of upstream states for energy with those of downstream states for water. As for the Amu Darya (or Zarafshan) no agreements comparable to the Syr Darya Framework agreement have so far been reached.

The International Fund for the Aral Sea (IFAS) and its Programmes (the Aral Sea Basin Programmes – or ASBP – 1 and 2) are designed to support the development of sustainable solutions for the Aral Sea basin, including the Amu Darya[64]. The ASBP is a project portfolio funded by governments and donors. The IFAS ASBP-3 and other regional processes planned for 2011-15 take into account the new political and economic realities and trends, including the possible engagement of players, such as Afghanistan, in the regional cooperation.

The IFAS is governed by the Presidents of the five Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan), a solution which should secure a high level of political commitment and provide a basis for joint approaches and actions on environment and development. For this purpose the IFAS structure includes two essential intergovernmental bodies: the Interstate Commission for Sustainable Development (ICSD) and the Interstate Commission for Water Coordination (ICWC)[65] with the associated scientific-information centres and national representations.

After independence, the five Central Asian states agreed to continue operation of the two Basin Water Organizations (BWO)[66] tasked with controlling the flow of the Amu Darya and Syr Darya rivers, and water distribution among the riparian states and their provinces. The ICWC discusses the allocation of water between Central Asian states as well as the regime of operation of the common and regional water infrastructure such as the main canals and water reservoirs. However, ICWC decisions must be taken unanimously and all members have a veto. As a result "agreements are dependent on the 'political will' of [both] upstream and downstream users." (Wegerich, 2008).

For the time being the ICWC is the only regional water management body accepted by all governments of the Central Asian CIS countries with operational capacity in the field. The two BWOs are formally part of the ICWC and work as its operational and monitoring branches. Although, the ICWC's objective is to achieve balanced, sustainable use of water resources for various purposes, one of its key weaknesses is that it is dominated by the needs of the irrigation-agriculture sector. Regional water management is thus mainly considered a matter of serving the needs of agriculture and tends to disregard the needs of other sectors that have been developing since independence such as energy[67] and ecosystem maintenance. Ministries of foreign affairs and diplomats are becoming increasingly involved in climate change, water, energy and environment discussions and processes. This increases the number of players and opens up to the possibility to develop new cooperation mechanisms, including environmental diplomacy. In this context, the potential function of the UN Regional Centre for Preventive Diplomacy in Ashgabat and the role of the Environment and Security Initiative is crucial.

Since water is seen as a resource of national strategic importance, countries have adopted positions that give priority to their perceived national interests. In such a situation, annual negotiations are often a source of tensions among the countries. Furthermore progress towards ratifying (as well as understanding) international conventions on the management of transboundary water resources, such as the Helsinki Convention[68], has been uneven among the Amu Darya River basin riparian states.

At a national level, different ministries should integrate the actions and decisions of inter-state bodies into national strategy, policy and programmes. However, the real extent to which ministries can do this appears to be limited. The policy priorities[69] of water-related ministries differ. It is difficult for ministries and state institutions

with different responsibilities, capacities and budgets to exchange information and coordinate action; as a result there is rarely a cross-the-board approach to water and energy management. In addition, national water and energy balances are not estimated in a regular, uniform manner. When combined with a shortage of skilled staff, this further complicates management tasks.

The structural imbalances inherited from the past, divergent interests between upstream and downstream countries, and increasing dependency on regional water resources hinder the negotiation of new multi-party, multi-sectoral agreements suited to present conditions. Under these circumstances riparian states have so far preferred bilateral, ad hoc solutions to mitigate the recurrent disputes over water and energy, while at the same time formally adhering to previously reconfirmed agreements.

Multilateral fora such as the Shanghai Cooperation Organization[70], the Eurasian Economic Community[71] and the Central Asia Regional Economic Cooperation Forum[72], as well as multilateral institutions such as the Asian Development Bank[73], the World Bank[74] and the UN SPECA programme[75] have all been involved in developing strategies for the use of water and energy resources in Central Asia. These organizations and programmes could be important in the future.

Lack of data

The situation is made worse by the lack of reliable, comprehensive hydro-meteorological monitoring of the upper Amu Darya River basin. Within states the task of monitoring water quality and quantity is fragmented between several agencies. Associated with the low level of trust between some of the Amu Darya basin states with regard to management of regional natural resources is the issue of quality, completeness and exchange of hydro-meteorological, water and land use information.

Hydro-meteorological observations in the upper Amu Darya basin

During the Soviet era the upper Amu Darya River basin, where most of its water resources are formed, was relatively well monitored by a network of hydrometric and meteorological stations, and snow measurement routes, except for Afghanistan. Four river gauging stations in Tajikistan positioned on the river's right bank measured water levels and flow in the Panj River (water discharge data are available from 1960 to 1992) and a dozen stations carried out hydrometric surveys of small tributaries and lakes draining into the Amu Darya. After the Soviet Union folded the whole observation network deteriorated rapidly and the hydro-meteorological services' ability to provide reliable flow and flood forecasts and drought risk warnings was drastically reduced. Despite the fact that snowmelt is of fundamental importance for water generation in the region, there are few observations of snow and no adequate monitoring of glaciers[76] in the mountain area of the Amu Darya basin.

One of the remaining issues is a lack of cooperation channels with Afghanistan resulting in increased uncertainty about hydro-meteorological data and forecasts of flow formation. The hydrometric stations on the Panj River (in Tajikistan), the major tributary of the Amu Darya, cannot be calibrated and safely managed by Tajikistan and Uzbekistan on the border with Afghanistan[77] : limited data is only (irregular) provided for water levels, which is insufficient for accurate flow measurement. Consequently no reliable flow and flood forecasts can be made for the Panj River and as a consequence the whole Amu Darya basin.

Implementation of regional projects supported by various donors[78] has achieved only modest success so far, partly because countries are often unable to provide adequate, sustainable input and maintenance for projects. Funds are short, the brain drain draws qualified personnel away, and though data sharing between hydromets is not a problem, data communication to other users both nationally and internationally is a complicated matter.

The lack of forecasting capacity is certainly problematic for a region so dependent on water and where floods and droughts can have dramatic societal consequences. However, new information tools and Earth observation technologies make it possible to provide seasonal river flow forecasts using remote sensing data, though data availability and field verification remains an issue in the region (Barlow and Tippett, 2008). Another positive sign is that national hydro-meteorological services are increasingly receiving more attention and support from the governments and international community[79].

Several information and expert networks exist and are developing in the Amu Darya River basin. These include, but are not limited to: the Central Asia water information portal (CAREWIB), the Central Asia water network (CAWa), the Aral Sea Basin Hydrological Cycle Observing System (ARAL-HYCOS), the Amu Darya River basin expert network, the OSCE-supported Public Environmental Information/Aarhus Centres and others. Altogether, the full use of their potential could help improve the national and regional capacities of the Amu Darya basin states to adequately assess and address the changing situation regarding water, land and climate, and to improve feedback, efficiency and more widespread implementation of policies, public awareness and technical interventions.

Afghanistan: outside the regional water management framework

Existing regional agreements do not consider Afghanistan as a stakeholder in the basin. Additionally, the majority of available literature discusses the issues related to the Amu Darya basin from the perspective of the post-Soviet Central Asian states. Little attention is paid to the role of Afghanistan as a stakeholder and user of the basin's water system.

The 1946 Frontier Agreement between Afghanistan and the Soviet Union and the ensuing 1958 Protocol on "joint execution of works for the integrated utilization of water resources in the frontier section of the Amu Darya" regulated relations between the Soviet Union and Afghanistan regarding use of the river. These agreements focused primarily on the Amu Darya as an international boundary, but they also dealt with navigation, water quality issues and usage such as irrigation. Water quotas were not directly addressed (Horsman, 2008). The decision #566 by the Scientific and Technical Council of the Ministry of Land Reclamation and Water Resources of the USSR in 1987 envisaged the extraction of 61.5 km^3 of water by the Central Asian Soviet republics[80] and assumed Afghanistan would use 2.1 km^3 of water annually.

There are no reliable data on how much Amu-Darya water Afghanistan really uses but it is estimated to be about 2 km^3 or 3 per cent of average annual river discharge[81]. For this reason experts argue that Afghanistan has been absent from Soviet and post-Soviet allocation agreements because its past and future water demands have been and will be modest. Increasing land under irrigation by 20 per cent would increase total Afghan extraction to 5-6 km^3. The amount of water extracted by Afghanistan – although still slight – is far from negligible, particularly in the context of dry years when relations between riparian states on water allocations become more tense.

The population of northern Afghanistan is mainly rural, so agricultural development issues including the use of water are high on the authorities' reconstruction agenda. This provides for the rehabilitation and even expansion of existing irrigation systems, especially Lower Kokcha, Kelagay and Lower Panj irrigation and hydropower projects[82]. In turn this would increase water demand in northern Afghanistan. Currently, the waters of the Khulm, Balkh, Sar-i Pol and Shirintagao rivers are all used for irrigation to their full extent. In the case of rivers such as the Panj, Kowkchen and Kunduz, although water reserves are still available for expanding irrigated areas (Zonn, 2002) the conflict and lack of maintenance have jeopardized the irrigation infrastructure. Although there is potential for expanding irrigated agriculture in northern Afghanistan, such developments would require security and investment.

At the same time Afghanistan's long-term reconstruction goals depend on increasing both the quality and stability of energy sources. To this end in February 2006 Afghanistan entered an agreement with Tajikistan and Iran to develop a high voltage electricity line connecting the country to hydropower stations, scheduled to be built along the Amu Darya, and to the existing Nurek plant in Tajikistan. This agreement has prompted concern among downstream water users, who fear their access to water resources may be reduced.

A recent study assessing the impact of Afghanistan on water security in the Amu Darya basin (Dipasquale, 2006) shows that prior to 2001, because of the conflict between the Taliban and the Northern Alliance, in Northern Afghanistan, the country took little interest in regional water issues. However since 2002 the new Afghan authorities have been more active in regional water management discussions. Once stability returns, Afghanistan could become a player and stakeholder in the Amu Darya basin and will need to be integrated in negotiations and agreements dealing with water resource management.

Interestingly, Afghanistan sees water relations in the Amu Darya as national basin-level issues and not yet as an overall regional question. Afghanistan consequently tends to consider water relations as bilateral relations with each neighbour (Dipasquale, 2006), which is not conducive to integration into regional basin mechanisms.

A new challenge? The consequences of changing energy demand

The present system of water storage, irrigation and energy production in the Amu Darya basin is characterized by a number of imbalances that make its management a complex and arduous matter. One imbalance relates to changing demand.

Upstream countries are promoting development of their own hydropower resources as the previous (Soviet and post-Soviet) system of exchanging of water regulation services for fossil fuel supplies with downstream counties has proved extremely difficult to implement in the new context. Users in the upstream countries have switched from expensive, unreliable imports of fossil fuel to domestically produced hydropower and electrical heating, thereby increasing demand for electricity in winter. Conversion of the operating mode of upstream reservoirs to increased energy production in winter has altered the flow of the main rivers, especially Amu Darya's neighbour – the Syr Darya River[83] – creating downstream water shortages for irrigation in summer and leading to floods in winter on several occasions. A similar situation is not unrealistic in the future in the Amu Darya basin if large new hydropower projects increase water storage capacity and are used primarily for energy production in the winter.

Nurek, the main hydropower station in the Amu Darya basin is located on the Vakhsh River in Tajikistan. With 4.2 km^3 live storage capacity, it supplies energy to central and Southern Tajikistan an aluminium smelter. It has until recently been run in irrigation mode, controlling the flow of water to support irrigated agriculture downstream. Previously the dam accumulated water from November to April and released it from May to August-September to maximize (or guarantee) water flow for agriculture. The current Nurek operating regime provides for increased water discharge in late winter to generate energy. Downstream this water seems to be used mainly for end-of-season irrigation and off-season leaching. The dam's current operating mode should not significantly affect downstream agriculture[84] since outflow does not contribute a great deal to total flow in the Amu Darya (Wegerich et al., 2007). But silting increasingly impedes Nurek's ability to satisfy demand for irrigation and energy, storage capacity having been reduced by almost 20 per cent in the last 30 years.

In Tajikistan hydropower basically ensures all domestic energy requirements. The nation's electricity supply comes primarily (about three-quarters) from the Nurek plant, supplemented by several thermo-electric, small and medium-sized hydroelectric plants, and imports of electricity from fossil-fuel plants in neighbouring countries. Industry (mainly aluminium production), agriculture (mainly electrical pumps for irrigation) and the public sector are the main users of energy. The amount of electricity consumed by the population has risen more than 300 per cent since independence[85]. The growth of industrial power consumption is linked to increasing aluminium output at TALCO[86].

The Tajik energy supply system has become vulnerable over the years. Energy efficiency has gradually decreased and electricity losses, except for the Nurek-TALCO line, are estimated 30 per cent (2.9 billion kWh). This almost equals the amount of electricity needed during the autumn-winter period to avoid a major energy deficit. In 2008 the Tajik President declared that "is time to put an end to the waste and loss of electricity, natural gas, heat and water. The modern life requires responsible use of energy". His statement emphasized the need to use modern energy-efficient appliances and equipment.

Local power production cannot cover rising domestic energy demand, so the country must continue importing electricity, liquid and gas fuel from its neighbours. Coal-fired power plants are being built in Tajikistan with foreign investments (mainly Chinese) to reduce the winter-energy deficit.

Winter 2007-8 was one of the hardest winters in southern parts of Central Asia for the last 45 years. It highlighted the problems in the energy sector in Tajikistan and other Amu-Darya states. Extremely low temperatures over a longer-than-expected period reduced discharge in rivers and through hydropower turbines, causing severe disruption in the energy supply. Though triggered by the harsh climatic conditions, the problems were rooted in the shortcomings described above. The breakdown of the energy supply further compounded the effects of the cold wave on the population and economy[87]. At the same time, with limited access to electricity in winter[88], people relied on fuel-wood for heating. This not only causes health problems, but also puts pressure on local forests and hastens deforestation. By the end of winter food and water stocks were depleted. The Nurek reservoir was at dead water level at the beginning of the vegetation period in 2008.

Recurrent extreme climatic conditions, such as drought and extreme winter temperatures, combined with an increase in domestic and regional energy demand, have convinced upstream countries that is necessary to

develop their energy resources, especially hydropower. The resulting programmes include plans to build numerous small hydropower schemes with limited environmental impacts on the downstream regions using run-of-river schemes without new large storage facilities. But above all these programmes also aim to build large schemes: Rogun upstream of Nurek in Tajikistan (and Kambarata upstream of Toktogul in Kyrgyzstan). Afghanistan and Tajikistan are also discussing plans to build the large Dusht-i-Jum hydropower station (4 000 MW)[89], on the Panj River, a major tributary of the Amu Darya.

Developing hydropower potential in the upper Amu Darya basin

The media have drawn attention to Tajikistan's plans to complete several hydroelectric projects that could solve the country's energy problems. Tajikistan currently has about 4 000 MW of installed hydropower capacity. The plants under construction would add another 4 000 MW. Even this will make less than 10 per cent of the technically feasible potential for hydropower generation.

Upper Amu Darya basin hydropower potential

Hydropower facilities with minimal water storage (0.01-0.2 km³) and run-of-river schemes: existing proposed

Large (>1000 MW) hydropower facilities with significant water storage capacity (>1 km³): existing proposed

Large schemes capable of altering the timing and amount of river flow: existing under construction

Power generation potential (MW): < 100, > 100, > 500, > 1 000

Power lines: existing under construction

Sources: Resources and Energy Atlas of Russia, Small-scale hydropower strategy of Tajikistan (2007); ENVSEC field mission to Tajikistan (April 2008)

The Rogun dam and power plant is planned on the Vakhsh River, upstream from the Nurek dam, currently Tajikistan's main source of electricity. Started under the Soviet Union, Rogun was still incomplete at independence. It was originally designed as a dual purpose project, its first priority being to manage irrigation water in the Amu Darya River. Hydropower was regarded as a by-product. Tajikistan now sees Rogun primarily as a key component in its energy independence.

The original design[90] for Rogun envisaged a 335-metre high rock-and-earth-fill dam with13 km^3 reservoir capacity and 10.3 km^3 live storage, increasing Tajikistan's control of the Vakhsh River. The hydropower station would have an underground powerhouse with six 600 MW turbine-generators, adding up to 3 600 MW total capacity. Preparatory activities began in 1976, and intense construction started in 1982, involving 5-10 000 people. By 1993 the initial infrastructure consisting of interim dam and many kilometres of tunnels was washed away by flash floods due to inadequate supervision combined with the civil war. Building work was frozen for more than a decade[91], only resuming in 2007. Initially the Government of Tajikistan funded Rogun rehabilitation work out of the state budget[92], but in January 2010 it issued shares for a total of 6 billion Tajik somoni (US$1.3 billion). Between January and March 2010 it raised US$184 million, with US$6 million[93] more in the remaining 9 months of the year.

Smaller power plants are being completed further down the river, such as Sangtuda-1 (670 MW) and Sangtuda-2[94] (respectively with Russian and Iranian investments). A similar development is envisaged on the Zarafshan River, mainly with Chinese capital, provided Uzbekistan and Tajikistan agree on management of the river's water resources. In the Pamir, private companies (such as Pamir Energy) and donors have supported the development of medium and small-scale hydropower units.

Once these projects are completed Tajikistan will be able to generate an energy surplus for export. However, to export electricity it will need to invest in extending the transmission grid[95]. In February 2006 the energy ministers of Tajikistan, Iran and Afghanistan signed an agreement providing for a high-voltage power line to run from Rogun and the other hydroelectric stations on the Vakhsh River to Afghanistan. Afghanistan, Iran and Pakistan, India and China could become the clients for Tajik electricity.

Until now the existing operating mode of Nurek and construction of several smaller hydropower plants in the Vakhsh River basin have not been seen as a threat, but this perception may change with the construction of additional large upstream storage capacity, such as Rogun dam[96].

The Vakhsh is a major tributary of the Amu-Darya, crossing several countries. Downstream countries such as Uzbekistan and Turkmenistan are afraid that once the construction of large storage schemes is completed the situation with regard to water deliveries during the vegetation period will deteriorate, leading to drastic water shortages and increasing water-related conflict between water users inside the country and between riparian countries. Moreover, there are also concerns over dam safety. The changes proposed by the upstream countries - unless agreed on in negotiations - must go through consultations with all information on the table. Furthermore, it is important to stress the principle of reciprocity in the demands between upstream and downstream countries.

Since summer 2008, the Central Asian Presidents have underlined the importance of water and energy on several occasions. Uzbekistan has repeatedly said that all states should have a say in the development of large hydropower projects and has called for a thorough independent, international appraisal of the technical, economic and environmental issues.

The intense diplomatic and economic activity around water and energy issues in Central Asia shows yet again that these questions are high on the agenda for Central Asia and its neighbours. Furthermore, extreme weather events such as droughts (2000-01; 2008), and cold winters (2007-08) have starkly underlined the fundamental importance of water and energy for Central Asian countries and their perceived divergent interests.

A win-win solution

The availability of abundant water resources, combined with the scarcity of fossil fuels, the vulnerability of the energy sector and the policy of reducing dependence on external energy sources are pushing Tajikistan and the Kyrgyz Republic to develop their hydropower potential and reactivate projects designed under the Soviet Union, despite the risk that these projects may reduce or modify the availability of water on which downstream users such as Uzbekistan and Turkmenistan, are heavily dependent to irrigate crops.

Tajikistan and the Kyrgyz Republic currently have difficulty meeting peak winter demand for domestic energy. In the long term, the projected hydropower plants and dams would generate large quantities of electricity that could meet the rising energy needs of these countries at costs much lower than imported energy and help avoid the energy shortages prevailing during the winter months. Surplus power could also be exported to neighbouring countries, including Pakistan, Afghanistan, India and Iran, where electricity is also in short supply and generation costs are 3 to 10 times higher (Linn, 2008a). Major regional transmission lines are under construction or being planned to allow power exports from Tajikistan.

At a conference in Dushanbe in June 2008, international water experts suggested that a viable solution for the Rogun (stage I and II) – Nurek and Kambarata – Toktogul systems could provide for upstream schemes operated in energy mode and downstream schemes in irrigation mode, with compensation (or subsidies) for commercial losses of summer water by the downstream countries (and wide use of the potential for exporting electricity in summer). Furthermore, building stage II of the Rogun dam would allow additional releases from Rogun during a period of drought, increasing water availability for downstream urban and agricultural users. With the additional dams benefits to all riparian states could consequently be increased, depending on the operating mode (Wegerich, 2007). Given their part in plans to expand hydropower in the Amu Darya basin and beyond, countries such as Russia, China, Kazakhstan, Iran, Pakistan and India are clearly stakeholders in the energy, water and agricultural nexus. Through their investments in the region, and specifically in energy projects, they can influence which solutions are adopted for the current regional-water-management problems.

Investing in upstream energy projects could also be an opportunity for downstream countries to assume a decision-making role, if the legal setup is appropriate[97] and the environmental security of the region is not jeopardized.

The conduit for such a solution could be a negotiated multilateral agreement combined with a joint funding mechanism in which riparian states, neighbouring countries and the private sector would participate as a consortium, which decides on how the combined systems should be operated, and what technical and industrial safety parameters are required. This would ensure that all parties have a voice in management of the system and prevent future hydro-energy projects fuelling tension between riparian states.

Mutual trust among riparian states is hindered by the established perception that regional water management is inherently a zero sum game, in which one player's gains are another's losses and any negotiated agreements in the future will need to overcome this barrier. Systemic joint environmental impact assessments of planned transboundary projects carried out under the auspices of an agreed independent institution would help to improve each country's situation and relations between states.

The cost of completing the Rogun project is estimated at US$1.3 to 3 billion (whereas the Kambarata-1 and -2 dams in Kyrgyzstan, with 2 260 MW joint capacity, is estimated at US$2 billion). Due to the huge investments needed to finance these projects – Rogun will cost about 50-75 per cent of Tajikistan's Gross National Income – countries will have to attract public and/or private investors from abroad if they want realize them.

The Tajik Government accepted an offer by the World Bank to provide technical expertise and an appraisal of environmental impacts, for plans to build the Rogun dam and hydropower plant, with input from an independent panel of international experts. The technical pre-feasibility study and socio-environmental impact assessment (SEIA) will be carried out in 2010-11. In the meantime Tajikistan will pursue mainly infrastructure rehabilitation works.

Visiting Central Asia in April 2010, the UN Secretary-General Ban Ki-moon urged all parties concerned to refrain from unilateral action until the World Bank's international assessment is complete, and to show restraint in a growing dispute over the issue. He also urged Central Asian leaders to resolve their problems through talks: "Whether this is oil or natural gas or water, these resources should be used fairly, respecting the interests of neighbouring countries"[98].

The ENVSEC Initiative is active in Central Asia and other regions in the field of dam safety and water management cooperation. The first phase of UNECE's dam safety project (to be completed in 2011) is already recognized by the countries and internationally as an important step towards improving data exchange, design and operational standards and safety assessment methods for dams[99]. The experience of other successful projects on water cooperation – such as in the Dniester basin (Eastern Europe) and project partnerships of OSCE and UNECE on Chu-Talas River basin management – could be replicated in relevant fields in the Amu Darya basin.

The disastrous effects of the 2008 cold spell and the ensuing drought clearly put the governments of Tajikistan and Kyrgyzstan under pressure at home to respond to this emergency. Under the circumstances the authorities naturally tend to give priority to national interests and put the construction of large water storage projects at the top of their political agenda. These projects however constitute a long-term solution to the upstream countries' problems, demanding time[100] and major investments, and do not solve short term shortages. In addition, these projects has prompted a strong reaction from downstream countries.

Upstream countries may consider that the concerns expressed by their downstream neighbours are outweighed by the critical need to obtain winter energy and by major interruptions in the supply of imported energy (as well as by limited opportunities for exporting the energy produced during summer). They at time characterize downstream arguments as political pressure which ultimate consequence is impeding their own economic development[101]. Dispelling these perceptions is one of the key tasks for the future of regional water management in the basin.

Another effect of the attention focused on the large hydropower projects is that although these projects will reap benefits in the long term, in the medium term energy deficits will persist, even under favourable hydrological conditions. Countries cannot focus exclusively their attention on developing large projects. They also need to meet current domestic energy demands in winter. One way of doing this would be to increase winter electricity generation capacity through fossil fuel energy. The World Bank estimates that Tajikistan would need at least 400 MW of winter thermal capacity (and the fuel to fire it) to meet demand through 2012.

Solutions must consider the need to mitigate global climate change. All the countries in the Amu Darya basin are the UNFCCC signatories. There is great potential for improving energy efficiency in their industrial and public sectors. Significant energy savings could be made by reducing energy losses (in energy generation and transmission, and by end users with, for example, better insulation of buildings) and introducing modern energy saving technologies. Small-scale renewable energy projects (solar, small hydropower, biomass) have already demonstrated that climate-friendly technologies could be introduced in both urban and rural areas. Proper incentives, advertisement, technical infrastructure and skills are available. Small-scale energy schemes are essential to the livelihoods and energy security of remote communities – located far from the main electricity lines, or coal and biomass reserves and are implementable in the short term.

Degradation and over-exploitation of natural resources


Amu Darya delta
KAZAKHSTAN
Vozrojdeniya island
Southern Aral Sea
seasonal lake
Aral Kum
Shoreline 1967
Jasliq
Adjibay Lake
Muynak
Jiltirbos Lake
Sudochye Lake
Qozoqdarya
Kokdaryo
Boyxoja
Qoratereng Lake
Qongirot
Oltinkol
Qozonketker
Qoraozak
Taxtakipir
Doutkol Lake
Chimboy
Qanlikol
Kegeyli
Kegeyli Canal
Karakalpakstan
Kerney Lake
Shumanay
Oqmangit
Xalqobod
Vodnik
Nukus
UZBEKISTAN
Xojayli
Taxiatosh
Freshwater pipeline to Nukus
Koneurgench
Bosh Dayoliq coll.
Mangit
Boldumsaz
Qoratov
Ayazkol Lake
Sarygamysh Lake
Drujba kollar collector
Aqtepe
Jumurtov
Gurlan
Boston
Dashoguz
Yangibozor
Beruniy
Dashoguz collector
Shovot
Gorogly
Urganch
Tortkol
Tuyamuyin Reservoir complex
Amu Darya
Qoshkopir
Xonga
TURKMENISTAN
Xiva
Tuyamuyin Reservoir
Hazorasp
Soltansanjar Reservoir
Lebap
Goshbulak Reservoir
0 30 60 90 120 km
Map produced by Zoï Environment Network, November 2010
Irrigated land
Canals and collectors
Dams
Hydropower plant
Gas exploration
Pipelines
Railways

The economic development and political rationale that drove massive investment in irrigated agriculture sought to exploit water resources to their full extent in order to increase output of crops such as cotton. With science and technology mankind was believed to overcome the challenges posed by nature and achieve its objective of "rational use of water resources". In this equation, nature and the environment have an only marginal importance. This rationale had, and still has, far-reaching consequences in terms of depletion of the Amu Darya environment.

The Amu Darya River delta region: a hotspot

Before the 1970s the Amu Darya branched into several subsidiary streams which fed into the Aral Sea through an extensive delta. Increasing withdrawal of water from the Amu Darya for irrigation drastically changed the water balance of the whole Aral Sea basin. The water having been used up before it even entered the Aral, the sea started to shrink. By the 1980s discharge from the Amu Darya into the Aral Sea stopped for one to three months. At present the Aral Sea consists of two main sections: the smaller Aral or northern sea on the territory of Kazakhstan[102] and the southern sea shared between Uzbekistan and Kazakhstan. Its western section is relatively deep, while the shallow eastern part is quickly disappearing. In the east and south of what remains of the Aral Sea a new desert has appeared on the former seabed: the so-called Aral-kum[103].

Many lakes and wetlands fed by the Amu Darya River in downstream and delta dried up or were reduced to a tiny fraction of their former size. This in turn led to the disappearance of 90 per cent of the tugai woodland and reed beds which once covered more than half a million hectares. These vital riparian forests along the Amu Darya were largely cleared to make room for irrigated crops or slowly died out for lack of sufficient water flow.

Poor water quality and shortages have had significant social, economic and health consequences for the areas in the epicentre of the Aral Sea crisis – the Republic of Karakalpakstan and Khorezm province in Uzbekistan and Dashkhovuz region of Turkmenistan.

The Amu Darya delta recurrently suffers from water scarcity, poor water quality and negative impacts on livelihoods and biodiversity. A stable, sufficient water supply to the Amu Darya delta region, sustainable water management, socio-economic development and environmental protection along the Amu Darya basin is consequently one of the most urgent tasks for the basin states. The Amu Darya delta region suffers most from the negative impacts of the Aral crisis. At the same time national and international attention should focus on basin-wide water management.

The Amu Darya and the disappearing sea

In the early 1960s, the waters of the Amu Darya that fed the Aral Sea were diverted by the Soviet Government to irrigate the desert and grow cotton. A direct consequence of this was the gradual disappearance of the Aral Sea. During the ENVSEC field visits in 2008, experts observed obvious signs of continuing environmental degradation. Sand and dust carried by wind erosion and signs of desertification were plainly visible. Despite numerous projects to save the Aral Sea over the past 15 years, the sea has not stopped shrinking, there having been no major change in the region's overall water-consumption patterns. However, the severe impacts of desertification and environmental degradation on the local economy and public health in the Aral region have been somewhat alleviated by the efforts undertaken by the national authorities and international organizations to stabilize the situation by maintaining the delta lakes, pasture and sources of drinking water[104].

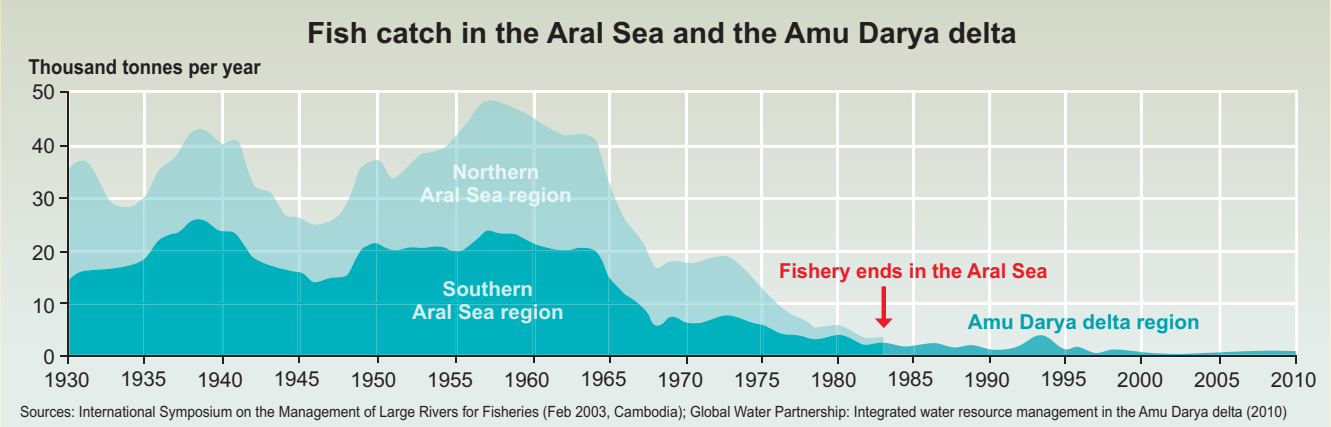
The shrinking Aral Sea

Drying up of the sea has been accompanied by a wide range of other environmental, economic and social problems in the Aral Sea region. As the Aral Sea has shrunk the seabed has been exposed leaving salt deposits mixed with sand and dust, polluted with agricultural chemicals, to be carried by the wind to neighbouring areas and as far as 100-300 km. This is one of the most harmful manifestations of the Aral Sea crisis which impacts on water sources, arable land, crops and human health, causing chronic respiratory and kidney disorders. Ongoing desertification is accompanied by loss of farmland, deterioration of pasture and natural habitats.

In the past the Aral Sea acted as a climate regulator, mitigating heat in summer and cold weather in winter. As it has shrunk the sea has impacted negatively on the local climate, which has gradually become harsher, more continental, with severe winter temperatures and more heat and violent dust storms. Global climate change is making itself felt here faster and more powerfully than in surrounding areas. By 2035-50 the average air temperature in the Aral Sea region may increase by 1.5-3°C (Uzbekistan SNC, 2008).

The sharp increase in irreversible withdrawal of river flow and the inability of rivers to maintain the water balance, combined with a natural trend towards more frequent low water years in recent decades, has upset the balance of water and salt. Ultimately the Aral Sea has almost become a "dead" sea.

The economy of Aral Sea region used to be based on fisheries, livestock grazing, hunting and fur production, supplemented by irrigated agriculture and traditional crafts. Three to four decades ago the total annual fish catch amounted to 35 000 tonnes. Now the Aral Sea, at least its southern part, no longer counts as a fishing ground. Shrinkage of the sea and rising salt levels have affected almost all economically valuable marine species, leading to a complete stoppage of fishing activities in the mid-1980s. Projects supporting the delta lakes already started in the Soviet times are helping to sustain limited fishing activities (2000-3000 t/year).



Sources: International Symposium on the Management of Large Rivers for Fisheries (Feb 2003, Cambodia); Global Water Partnership: Integrated water resource management in the Amu Darya delta (2010)

With the retreat of the sea thousands of local people have lost their typical natural, living and working environment, jobs and a traditional way of life. But now, the local economy seems to be recovering due to promising oil and gas discoveries and exploration work on the former sea bed and in the Amu Darya delta.

Boats on the Amu Darya River. Photo by: Matteo Mode

Ship wreck on the shore of the dried-up Aral Sea


Northern Aral Sea
Aralsk
Beyneu
Baikonur
K A Z A K H S T
Southern Aral Sea
Vozrozhdeniya Island
seasonal lake
A r a l K u m
Kyzylorda
Ustyurt plateau
Muynak
Kentau
Zhanatas
Syr Darya
Q y z y l q u m D e s e r t
Nukus
Xojayli
Shymkent
Sarygamysh Lake
Uchquduq
Beruniy
Zarafshon
Golden Age Lake (under construction)
Dashoguz Collector (under construction)
Dashoguz
Urganch
Tortkol
Tashkent
Gyzylgaya
Tuyamuyn
Lebap
U Z B E K I S T A N
Aydar Lake
Olmaliq
T U R K M E N I S T A N
Nurota
Guliston
Khujand
Navoiy
Jizzax
Bekabad
Bereket
K a r a k u m D e s e r t
Qorakol
Bukhara
Zarafshan river
Pandjakent
Serdar
Seydi
Samarkand
Ayni
Mubarek
Zarafshan
Kashkadarya
Shahrisabz
T A J I
Aluminium smelter TALCO
Dushanbe
Kopet Dag
Baharly
Great Turkmen Collector (under construction)
Turkmenabat
Qarshi
Guzor
Amu Darya
Denov
Yavan
Nurek
Surkhandarya
Vakhsh
Kulob
Atrek
Ashgabat
Karakum Canal
Qurgonteppa
Bojnurd
Atamyrat
Sarband
Mary
Tejen
Termiz
Quchan
Balkh
Kunduz
Sheberghan
Mazar-e Sharif
Sarakhs
Serahs
Sabzevar
Mashad
Murgab
Pol-e Khomri
Dusti
Tejen
Meymaneh
H i n d
Sar-e Pol
Kunduz
Balkhab
Torbat-e Jam
Tayyebad
I R A N
Bamian
A F G H A N I S T A N
Kabul
Herat
Hari Rud
0
250
500
750
1000 km
Map produced by Zoï Environment Network, December 2010

Pollution issues in the Amu Darya river basin and adjacent regions

- Major oil and gas producing areas
- Prospective gas fields in the Aral Sea region
- Sites of peaceful underground nuclear explosions to seal off the underground blowing gas wells
- Uranium mining and processing
- Mining and processing of other minerals
- Risk of transboundary pollution by large industrial complexes
- Lack of cross-border monitoring, limited data exchange and persistent disputes
- Large amount of industrial waste
- Military waste left by the Soviet army in Afghanistan (rocket fuel, etc)
- Soviet chemical weapons testing ground
- Soviet biological weapons testing ground
- Poorly maintained storage containing agricultural and other chemicals
- Local pollution concerns
- Highly mineralized agricultural runoff channeled into rivers
- Highly mineralized agricultural runoff diverted into deserts
- High mineralization
- Moderate mineralization

- Areas above 2000 metres
- Large-scale irrigation schemes

Sources: Environment and Security Initiative regional consultations in Ashgabat (Sep 2007) and Kabul (Nov 2007) and regional field missions (May 2008); national State of the Environment reports.

The increasingly important problem of declining water quality along the basin

The quality of drinking water in many populated parts of the Amu Darya is deteriorating, particularly downstream where it is causing a rise in kidney, thyroid and liver diseases and preventing iron absorption, leading to anaemia[105]. Major pollution sources are collector-drainage (irrigation runoff) waters from irrigated fields in the mid- and downstream reaches of the Amu Darya: about 3-4 km^3 are discharged directly into the river every year[106]. Even greater amounts of collector-drainage water are diverted into the deserts and other lands unsuitable for cultivation. The inflow of these waters from Turkmenistan's irrigated land[107] (Levoberejni collector, mineralization 2-5 g/l), and from the Qarshi and Bukhara oases of Uzbekistan (mineralization 5-8 g/l) account for the majority of irrigation runoff discharged into the river[108]. In addition to regular irrigation in summer months, the practice of washing agricultural soil in winter considerably increases the salinity of return water, and consequently further compromises river quality. These factors clearly damage water quality, making water flowing in the delta region (the last 500 kilometres of the Amu Darya – especially in Dashkhowuz, Khorezm and Karakalpakstan provinces) unsafe for drinking[109] where communities only receive about 50 per cent of the river's original freshwater, the rest being drainage or recycled water. As a result the regions located in the Amu Darya delta are affected by both the river's failure to reach the Aral Sea and by the high level of pollution in the water that does actually reach the area.

Between 1960 and 1990 the average salt content[110] of water in the lower section of the Amu Darya increased from 0.5 g/l to more than 1 g/l[111]. It has not improved since. Basically, the chemical quality of the Amu Darya water deteriorates from the upstream

section at the confluence of the Panj and Vakhsh Rivers (0.5 g/l) by 25 per cent and 100 per cent after 350 and 800 kilometres of flow, respectively. But mineralization levels fluctuate depending on the season and geographical position: levels decrease with the spring-summer increase of river flow. The Environment and Security field missions in April-May 2008 identified the average mineral contents at 0.7 g/l. Water quality was an issue underlined several times during the field missions.

States of the Amu Darya basin still lack a modern system of water-quality monitoring, especially in inter-state border areas, as well as common up-to-date water quality standards and information exchange mechanisms allowing clear and transparent analysis of the problem[112].

To mitigate the problems caused by irrigation drainage waters, Turkmenistan and Uzbekistan have plans (since the Soviet era) to divert collector-drainage waters into the desert. Uzbekistan declared the Amu Darya riverbed as well as all other major rivers and tributaries a protected area[113] and started an inventory and re-location of the potential pollution sources and environmentally hazardous facilities outside the water protection zones. Turkmenistan has embarked on an ambitious project to build the Great Turkmen Collector and "the Golden Century Lake"[114] in the Karashor depression of the Northern Karakum desert. On the other hand riparian states could greatly benefit from experience by drastically reducing the amount of drainage waters produced or in treating irrigation runoff and other effluents (for example using engineered wetland technologies[115]).

Point-source pollution in the Amu Darya basin

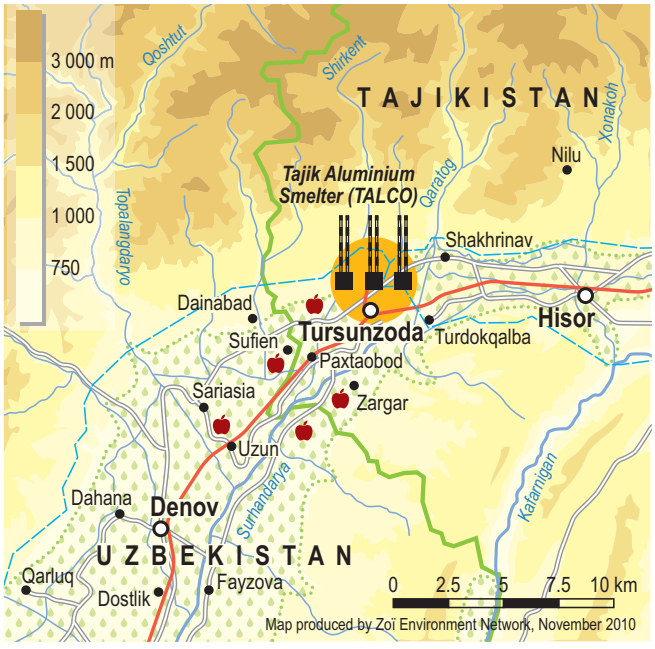
Industrial operations in the Amu Darya basin are another source of pollution and hotspots identified by the Environment and Security Initiative. With independence many industrial plants suffered a drastic drop in activity, but some of the facilities are still major sources of employment, income and also pollution.

The Navoi-Samarkand-Qarshi region[116] of Uzbekistan is highly industrialized and densely populated, with mining, metallurgy and chemical industries. In Turkmenistan, industrial pollution in the Amu Darya basin is generally limited to the chemical processing and energy industries.

At the ENVSEC Initiative regional consultations in Ashgabat in September 2007, local experts suggested that geological exploration and mining (extraction of natural gas[117] and other minerals[118]) in the middle and downstream Amu Darya basin could become a source of environmental pollution, soil degradation and biodiversity disturbance, if no adequate environmental safeguards were taken.

As mentioned in the previous section, the (former) Aral Sea is also a significant source of air pollution in the Amu Darya basin due to wind transport of salt and dust from its dry bed.

Transboundary pollution in the case of the Tajik aluminium smelter is a source of recurrent tensions between Tajikistan and Uzbekistan. The Tajik aluminium smelter was designed in the 1960s and completed in 1975 in conjunction with the Nurek hydropower plant as an energy-metallurgy complex, one of the largest in the former Soviet Union. Originally up to 80 per cent of Nurek's electricity was



Tajik Aluminium Smelter (TALCO)

Irrigated land
Orchards and gardens
Power supply line
Railway

Source: ENVSEC field mission in Tajikistan (April 2008)

intended for this energy-intensive industry. Currently the aluminium plant employs over 12 000 people, produces over 300 000 tonnes of aluminium using 20 million kWh of electricity[119] a day and generating more than 50 per cent of the country's export earnings.

The aluminium smelter emits HF[120] and PFC[121] gases generated by the electrolysis process, as well as other pollutants (sulphur dioxide, carbon monoxide, dust). Massive equipment capturing more than 90 per cent of the total emissions represents an essential part of the production facilities and operating costs.

The plant is located near the Tajik-Uzbek border and is the main environmental concern for local settlements and agricultural crops. Uzbekistan's environmental services indicate that the concentrations of air pollutants from smelter's emissions reach the upper levels of national limits[122]. Given the limited joint monitoring and assessment, only a fragmented picture of the environmental situation in the area is available.

To assess and mitigate cross-border pollution risks there was a joint commission on environmental issues, research and data exchange[123]. However, it activity basically stopped after the middle 1990s. Practical solutions based on mutual trust, better understanding of the environmental impact factors and industrial risks would improve the situation[124].

Development of sanitation and water treatment facilities has lagged behind population growth in the basin, a problem further compounded by increasingly obsolete equipment and technologies. As a consequence, poorly treated sewage is discharged into surface waters (UNECE, 2001), but there are also problems for disposing of organic and non-organic communal waste, mining waste and pesticides. Often located in the vicinity of canals or rivers, badly protected dumpsites can be washed away by natural disasters and extreme weather.

Pesticides and other agricultural chemicals are still used in farming in Central Asia, but the chemical load in agriculture has been reduced tenfold compared with the Soviet period, when the application rates for (currently prohibited) pesticides on cotton fields were 10-25 kg per hectare. In some agricultural regions, the load even exceeded 50 kg per hectare. This helped sustain and even boost crop yields. But the excessive amount of chemicals in the soil was washed into rivers by drainage and rainwater, posing health risks for downstream communities and ecosystems. Now many farmers have switched to biological methods of crop protection, while others still apply chemicals in moderate quantities. However, the legacy of excessive use of chemicals remains, with poorly documented dumps, large and small, containing obsolete, prohibited agricultural chemicals spread over many agricultural districts – near airfields, stations and intensively cultivated areas. One of such regional environmental hotspots, which was identified by the ENVSEC field mission in 2008 in the Amu Darya basin, is the large obsolete pesticide dump in the Vakhsh Valley of Tajikistan, near the town of Sarband[125].

In the Afghan part of the basin, pollution mainly originates from the cement plant in Baghlan, small-scale construction, uncontrolled public works pollution sources and several military-related waste storage sites.

The experience of the (Aarhus) public environmental information centres in the Ferghana Valley facilitated by the OSCE through the Environment and Security Initiative is a good practice that could be adapted and replicated in the Amu Darya River basin. These centres proved effective in improving public awareness of local environmental concerns, especially pollution hotspots, and involving the local authorities, mass media, educational bodies and NGOs in solving local environmental issues. Another type of the ENVSEC intervention in the Ferghana Valley involved rapid environment and health risk assessments of selected hazardous and radioactive waste and polluting industrial sites by the group of national and international institutes and experts, which catalyzed further action on improving environmental baseline information, decision-making and clean-up. Finally, the UNECE Transboundary Effects of Industrial Accidents (TEIA) and Environmental Impact Assessment (Espoo) conventions have proved useful for governments and industrial operators in the UNECE region to improve environmental and industrial planning, safety measures, agree on mutual notification and assistance procedures.

Biodiversity, Ecosystem Services and Watershed Protection


Northern Aral Sea
Aralsk
Beyneu
Baikonur
K A Z A K H S T
seasonal lake
Southern Aral Sea
Kyzylorda
A r a l K u m
Amu Darya river delta and lakes
Muynak
Kentau
Zhanatas
Syr Darya
Q y z y l q u m D e s e r t
Nukus
Xojayli
Shymkent
Uchquduq
Sarygamysh Lake
Dashoguz
Zarafshon
Dashoguz Collector (under construction)
Urganch
Golden Age Lake (under construction)
U Z B E K I S T A N
Tuyamuyn
Lebap
Tashkent
Aydar Lake
Gyzylgaya
Olmaliq
Nurota
T U R K M E N I S T A N
Guliston
Khujand
K a r a k u m D e s e r t
Navoiy
Jizzax
Bereket
Bukhara
Pandjakent
Isfana
Qorakol
Samarkand
Serdar
Seydi
Zaravshan
Ayni
Koson
Kashkadarya
Shahrisabz
T A J I
Baharly
Turkmenabat
Dushanbe
Great Turkmen Collector (under construction)
Qarshi
Guzor
Amu Darya
Kopet Dag
Nurek
Denov
Ashgabat
Atrek
Kulob
Atamyrat
Kerkichi
Surhandarya
Kafarnigan
Vakhsh
Bojnurd
Mary
Sherabad
Qurgonteppa
Tejen
Quchan
Termiz
Karakum Canal
Balkh
Kunduz
Sarakhs
Sarahs
Sheberghan
Mazar-e Sharif
Mashad
Tejen
Murgab
Pol-e Khomri
Dusti
Sar-e Pol
Kunduz
Balkhab
H i n d u
Torbat-e Jam
Bamian
I R A N
Tayyebad
A F G H A N I S T A N
Kabul
Herat
Hari Rud
0
250
500
750
1000 km
Map produced by Zoï Environment Network, December 2010

Biodiversity in the Amu Darya river basin and adjacent regions

- Ecologically important areas, including ecosystem core and buffer zones, and wildlife migration corridors
- Protected areas: nature reserves and national parks
- Planned protected areas
- Biosphere reserves (UNESCO sites)
- Wetlands (Ramsar Convention sites)
- Centres of global plant diversity
- Biodiversity cooperation areas
- Areas not assessed

Fortified borders (fences, military guards, mines):

- Soviet era
- Post-independence

Sources: ADB Central Asia Atlas of Natural Resources (2010); Environment and Security Initiative regional consultations in Ashgabat (Sep 2007) and Kabul (Nov 2007); Atlas of environmental indicators of Uzbekistan (2008); State of the Environment in Tajikistan.

The Amu Darya basin population relies on natural resources for its daily livelihood and depends on an unimpaired flow of ecosystem services: clean water, climate regulation, food production and cultural values. The true scales and implications of biodiversity degradation in the upper Amu Darya basin are poorly understood.

The upstream catchment area of the Amu Darya basin, mainly the mountains of Tajikistan and Afghanistan, has been seriously affected by over grazing and tree cutting for fuel wood due to the socio-economic impacts of the civil war, energy crisis and reduced efficiency of biodiversity conservation. The majority of fruit and mountain forests in Northern Afghanistan were cut or depleted in the last 30 years. Unsustainable forest use and intense human pressure on forests greatly exceed the rates of their natural regeneration and tree planting.

Apart from direct impacts on globally significant biodiversity and land productivity, degradation of mountain ecosystems has a negative effect on river hydrology and the quality of water supplied to downstream areas. Soil compaction and reduction of vegetation cover in the catchment areas of the Amu Darya basin affect natural run-off generation and elevate the risk of local natural disasters such as mudslides and flash floods. Increased erosion of mountain slopes and soils is a factor contributing to high sediment formation and silt loading of the rivers with significant implications for the lifetime and effectiveness of the reservoirs and irrigation canals (due to accelerating siltation) and operation of hydro-electric turbines.

In the lower areas of the Amu Darya basin, the degradation of the environment due to water shortages and pollution has a negative impact on biodiversity along the Amu Darya River. The Uzbek State Committee for Nature Protection estimates that in the Amu Darya delta up to 90 per cent of the tugai, a special type of riparian forest[126], has been destroyed. This has seriously reduced livelihood opportunities: cattle grazing[127], hunting and fishing. Several natural reserves in the downstream section of the basin are increasingly unable to conserve the tugai ecosystems due to very low water levels during natural peak flow and discharge of the saline irrigated runoff waters. One example is the "Baday Tugai" nature reserve in Uzbekistan.

Tugai forests were also severely depleted along the Murgab and Tijen rivers in Turkmenistan by the end of 1950s when land was cleared for crop cultivation; the same land was later abandoned due to salinization problems.

Scattered tugai forests still exist along the Amu Darya basin, with the largest areas remaining in the Amu Darya delta[128] (Uzbekistan) and Vakhsh River lowlands (Tajikistan).

In the upper Amu Darya basin, the tugai ecosystems are also in decline, reducing its ability to protect river banks along the Panj and Vakhsh and increasing damage due to floods and soil salinization. Additional stress on the tugai ecosystem comes from wildlife poaching and fragmentation, which has led to the complete extinction of the Turan tigers, other large predators and a significant drop in the number of Bukhara (Bactrian) deer in the past 50 years. Tugai forests are the key cross-border ecosystem corridors along the Amu Darya and they can only be conserved through interstate collaboration, continuous national and international support for the nature protection areas and provision of sufficient water flow.

The centralized approaches currently used by the governments to address deforestation are not enough to achieve long-term success: thus new concepts and bottom-up community-based approaches[129] need to be mainstreamed into the national forestry and biodiversity conservation activities. Addressing biodiversity degradation is the most promising approach – and the least fraught with political controversy – as improving the stability, quality and sustainability of water management in the river basin benefits all parties.

A belt of sand dunes in Afghanistan lies to the south of the Amu Darya, extending over 250 km in length and up to 30 km in breadth. There has been increased dune movement and dust storm formation in recent years due to the loss of stabilizing vegetation, much of which has died and been harvested for fuel (UNEP 2003). Sand dunes advance into agricultural lands in the small alluvial strip beside the Amu Darya in Northern Afghanistan. Dust winds from these sand dunes as well as from the dry Aral Sea affect the visibility and safety of road and air traffic and other activities in southern parts of the Amu Darya basin. The "green belt" programme of Turkmenistan and country's experience in combating desertification and biodiversity protection, including the areas bordering Afghanistan is considered by many experts as a good practice that could be expanded across borders.

The increasing number of international borders in the Amu Darya basin since 1991 has several implications

for biodiversity. On the one hand border areas are usually well protected and difficult to access, lowering human impact on the environment. But in many cases protected areas and representative ecosystems previously shared between the Soviet republics in Central Asia have stopped functioning as joint entities and professional contacts have been lost[130].

Many large migrating mammals, especially ungulates, became critically endangered in the past decade. For example, Saiga antelopes (Saiga tatarica) have suffered a major drop in population from over 1 million 20 years ago to a mere 25-50 000 now. The main reasons for such decline are diminishing state control over hunting, border barriers on migratory routes and disturbance of the animals' typical habitats. These antelopes migrate from Russia and Kazakhstan through Uzbekistan to Turkmenistan, therefore cross-border cooperation and information exchange play a crucial role in conservation. In the past 30 years the number of Marco Polo sheep in Afghanistan and Tajikistan has dropped by more than 50 per cent. While its population is still viable, significant pressure continues from both local and international hunters and overgrazing by livestock, while biodiversity monitoring and cross-border cooperation is limited.

The Uzbek State Committee for Nature Protection has taken several measures to better protect endangered mammal species and stabilize their population. For example it has added the Saiga to the Red List and is encouraging neighbours to do likewise; it has also signed an agreement on protecting Saiga with the Russian Federation, Kazakhstan and Turkmenistan. The "Dzheiran" biodiversity centre in Uzbekistan, which the Environment and Security mission visited in 2008, is supporting breeding of Bukhara deer and gazelles. Many of these were originally brought from Tajikistan and now the Uzbek nature reserve is helping to re-introduce these species, which were wiped out during the civil conflict in Tajikistan in the "Beshai Palangon (Tigrovaya Balka)" and "Romit" reserves.

Mountain ecosystems in the Amu Darya basin with globally significant genetic resources and ecosystems are in particular need of better protection through regional cooperation. In the Pamir Mountains – the water towers of the Amu Darya basin – high altitude, low temperatures and small rainfall limit the potential for crop cultivation, therefore cattle-grazing is the predominant type of agricultural activity. The local population, especially in the Murghab district of Tajikistan, is considered one of the poorest in the entire Amu Darya basin. Subsidized external supplies of energy to this area dried up after the fall of the Soviet Union leaving people to use teresken bush (Ceratoides papposa) for fuel[131]. This is becoming a dramatic, urgent problem. Teresken, supplemented with dried dung, now replaces conventional fuels and electricity and is consequently becoming a scarce natural resource. It is also one of the main sources of food for cattle and wild animals. Using it for energy degrades pastures for many years. It has been almost totally eradicated around the Murgab, Karakul and Rangkul villages. The former supplies of the animal fodder and coal for the Murgab district by the Alai Valley of Kyrgyzstan ceased, while complicated border crossing imposes constraints on moving yak herds from one valley to another, which leaves local communities in an increasingly precarious situation with few economic alternatives[132]. Measures to promote sustainable grazing and protect the ecosystems[133] are urgently required.

Pressures on biodiversity can become an opportunity for cooperation. For example, two agreements on environmental cooperation signed between Afghanistan and Tajikistan in 2006 and 2007 envisage important nature conservation activities in the upper Amu Darya basin states. In particular, re-forestation of war- and erosion-affected land in pomegranate, pistachio and walnut forests[134] could play a major role in improving the local economy, reducing poverty and minimizing natural disasters risks in the upper basin.

The Wakhan corridor centred in Afghanistan and surrounded by Tajikistan, Pakistan and China is of special interest for cross-border biodiversity conservation. A major opportunity exists here to create a model of international cooperation by implementing cross-border nature conservation to protect Marco Polo sheep, snow leopard and other globally endangered mammals and plants.

Disasters:
a cross-cutting issue


Northern Aral Sea
Aralsk
Beyneu
Baikonur
seasonal lake
Southern Aral Sea
K A Z A K H S T
Kyzylorda
A r a l K u m
Amu Darya river delta and lakes
Muynak
Kentau
Zhanatas
Syr Darya
Q y z y l q u m D e s e r t
Nukus
Xojayli
Shymkent
Uchquduq
Sarygamysh Lake
Dashoguz
Beruniy
Urganch
Zarafshon
Tashkent 1966
Tashkent
Golden Age Lake (under construction)
Dashoguz Collector (under construction)
Gyzylgaya
Tuyamuyn
Lebap
U Z B E K I S T A N
Aydar Lake
Olmaliq
Nurota
T U R K M E N I S T A N
Guliston
Kujand
K a r a k u m D e s e r t
Bekabad
Jizzax
Navoiy
Bereket
Qorakol
Bukhara
Samarkand
Pandjakent
Ayni
Serdar
Seydi
Mubarek
1998
Zarafshan
Khait 19
2003
T A J I K
Kopet Dag
Great Turkmen Collector (under construction)
Turkmenabat
Kashkadarya
Shahrisabz
Dushanbe
Baharly
Amu Darya
Qarshi
Guzor
Qaratog 1907
Nurek
Ashgabat 1948
Ashgabat
Atrek
Denov
2010
Vakhsh
Kulob
Karakum Canal
Anew
Bojnurd
Atamyrat
Surhandarya
Qurgonteppa
Mary
Sherabad
Tejen
Termiz
2005
Kafarnigan
Balkh
Kunduz
Sarakhs
Sarahs
Sheberghan
Mazar-e Sharif
Mashad
Tejen
Murgab
Pol-e Khomri
Dusti
Meymaneh
Sar-e Pol
Balkhab
Kunduz
H i n d
Serhetabat
Torbat-e Jam
Bamian
I R A N
Tayyebad
A F G H A N I S T A N
Kabul
Chaghcharan
Herat
Hari Rud
0
250
500
750
1000 km
Map produced by Zoï Environment Network, December 2010

Natural hazards in the Amu Darya river basin

- Risk of strong earthquakes and damage to infrastructure and property
- Significant historical earthquakes
- Impacts of droughts
- Major recent floods
- Glacial lakes and flood risk areas
- Extreme winter/severe cold 2007-08
- Major recent avalanches

Sources: www.preventionweb.net: Global Risk Data Platform; United States Geological Survey (USGS)

The Amu Darya basin is a disaster-prone area, exposed to natural hazards such as floods, droughts, avalanches, rockslides. It has also suffered recurrent earthquakes: Ashgabat, Tashkent and populated parts of Afghanistan and Tajikistan have all suffered major damage to life and property in the past. It is also vulnerable to man-made disasters related to industrial activities and the radioactive and hazardous waste dumps inherited from the Soviet era. Many risks, such as glacial lake outflow floods, earthquakes, floods and toxic spills may lead to transboundary effects.

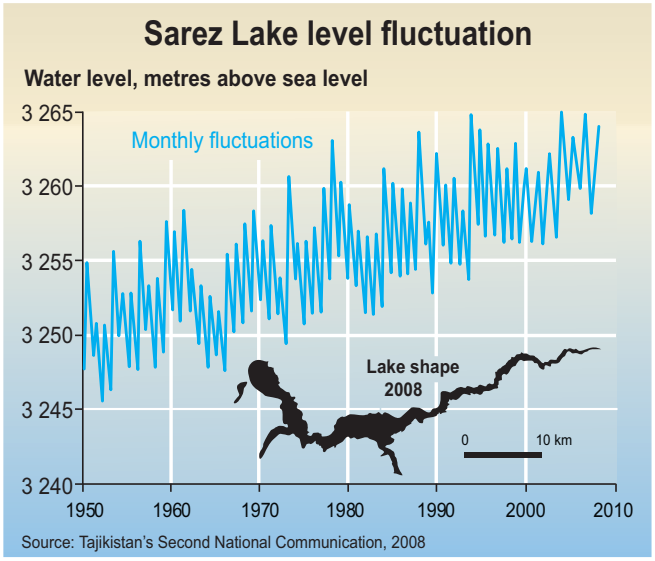
Several factors – population density in disaster-prone areas, high overall population growth, poverty, land and water use, failure to comply with building codes, and global climate change – are increasing the exposures to threats and making the region highly vulnerable to natural and man-made hazards. The incidence of natural disasters involving casualties among inhabitants in risk-prone areas has been rising due to poor preparedness.

In Tajikistan and Kyrgyzstan average annual economic losses from natural disasters reach 1-1.5 per cent GDP. In some years the impact is forecast to reach 5 per cent of GDP.

In the arid lowlands the main natural hazard is drought. In 2000-01 and 2008 drought affected parts of Afghanistan, Tajikistan and Uzbekistan (Karakalpakstan). These extreme cases caused a serious drop in grain output, leading to food shortages. In Afghanistan crop failures triggered mass displacement of population.

Natural disasters resulting in casualties mainly occur in the mountainous areas of the Amu Darya basin, predominantly in Tajikistan, Afghanistan and parts of Uzbekistan. Such disasters consist of landslides, glacier lake outburst floods[135], floods due to torrential rain and rapid snow melting[136], extreme temperatures and avalanches[137]. Natural disasters may also be a serious threat to industrial facilities and waste sites[138].

Potentially dangerous mountain lakes constitute a serious hazard when overtopping triggered by a landslide or failure of glacial lake dams occur. The best known example is Lake Sarez in the centre of the Pamir Mountains. Situated at an altitude of 3 000 metres, the lake is over 60 km long, 500 metres deep and contains 17 km^3 of fresh water. In the case of a landslide into the lake it is feared that a 10 to 150-metre wave could rise and – depending on landslide volume, season and location – flush out the lake, releasing a destructive flood along the Bartang and Panj Rivers, and the Amu Darya River further downstream. Lake Sarez has received high international attention, and a sophisticated monitoring and early warning system has been installed.



Natural disasters will continue to affect the Amu Darya basin in the future. Even though their impacts usually call for solidarity and cooperation, such events may strain relations between neighbouring states, especially if there is no understanding or common agreement on what constitutes adequate preventive measures. The need to prevent such events or mitigate their effect offers a genuine opportunity for cooperation between the relevant authorities, notably the ministries of emergency situations[139]. Involving local authorities, disaster response organizations and the communities in the areas at risk can further enhance the benefits of cooperation, particularly for industrial sites or radioactive waste deposits with a high risk of transboundary pollution.

Conclusions

In the arid basin of the Amu Darya, irrigated agriculture is the main economic sector for riparian countries, the main source of livelihoods, providing employment and income for several million people. But agriculture in the Amu Darya basin is dependent on large, complex irrigation schemes developed and built under the Soviet Union. The gigantic irrigation system allowed environmentally unsustainable agriculture to expand over large areas, seen at the time as an engineering tribute to human progress over harsh nature. But it has led to a deteriorating environment and quality of life; the shortage of water and its declining quality have driven increasing numbers to seek a living in other regions or countries. The system also was based on the interdependency of the former Soviet states, as well as their dependency on the central government.

At independence, with the basin divided between different countries, the number of stakeholders suddenly increased and the riparian states had to find solutions for managing the region's water and solving disputes in an international setting without an external law enforcer. Given the reliance on irrigation for food and fibre production and the importance of agriculture following independence, the authorities in the riparian states agreed to maintain water allocation quotas set under the Soviet Union. These quotas served as the basis for water-sharing arrangements and, as far as possible, states have sought to secure the volume of water provided under these arrangements. Moreover, while the quotas determine the amount of water, they do not take into consideration the quality of water, which is arguably equally important from a security perspective.

The existing arrangements give priority to irrigation as the main regulation mode for the system as a whole. The downstream countries consider that irrigated agriculture, which is of strategic importance for them, lacks flexibility and needs reliable access to set quantities of water. The growing need for upstream countries to achieve energy security and their determination to do so through further development of their own hydropower potential, highlights the need for a new system of water and energy allocation. Increasing energy demand in the wider region – with energy-hungry markets in China, Pakistan, Iran and India, Russian energy interests in Central Asia – are also driving plans to build large water-storage schemes and expand hydropower capacity. The Rogun project raises concerns downstream as countries fear that this project could threaten their access to water resources. The increased importance of energy generation is exerting pressure on the region's capacity to manage a system largely created and organized to deliver water for irrigation.

So far, countries have adopted positions giving priority to their perceived national interests rather than regional cooperation, which can and should be in the interest of all nations. International conventions[140] regulating the use of transboundary waters have been ratified by only one riparian state – Uzbekistan. Since the "business as usual" scenario is no longer an option, countries will need to agree on a new balance or hand over the question to arbitration by a third party.

Greater pressure may be brought to bear in the future through likely demands by Afghanistan for more water to be directed to rehabilitating its agricultural and hydropower sector. The political and security situation of Afghanistan will be one of the crucial factors in the basin's future. A destabilized Afghanistan would have a negative impact on the security and development of its riparian neighbours[141].

Another source of strain on interstate relations is the management of infrastructure shared by several countries. Problems can arise from disagreements over resource allocations or cost sharing, maintenance and investment into common infrastructure – for example the Qarshi pumping station – and facilities providing services for all stakeholders concerned by common resources, such as reservoirs (Tuyamuyn, Nurek) regulating the river flow and allowing the provision of water for all members at the required time.

The geographic position occupied along the river is also an important factor, water users downstream being at the greatest disadvantage, in particular during dry years. Various factors seriously strain relations between and within communities or between communities and local authorities, such as water allocations or the dominant role played by local authorities in decisions on water allocation. Governments in the region are usually well aware of these challenges, and some have started

to move away from water management based on administrative boundaries to a hydrographic approach. However, this fundamental shift is slow to take effect. All too often decision-making is still seen as a matter for technical experts and/or administrative bodies. At the same time, the financial means allocated by states to maintaining the inherited water infrastructure are insufficient to effectively stop the process of decay. In this situation, in the coming five to ten years, the interrelated issues of water, agriculture and energy will be the main regional political questions which the Central Asian states and Afghanistan will have to address.

In the longer term – in the next 30 to 50 years – climate change in Central Asia could have a wide range of impacts. Even now severe climatic events such as drought strain relations among and within riparian states. Increasing variability of precipitation and higher temperatures will exacerbate existing stress factors and probably lead to a reduction in overall water availability, which in turn could affect the agricultural and energy security of the Amu Darya basin states. These effects would be compounded by problems of increasing soil salinity and land degradation related to outdated irrigation techniques.

Finally, if vigorous and effective measures for cross-border conservation of biodiversity are not taken, many rare and vulnerable species of flora and fauna could disappear forever, changing the natural balance of the ecosystem. Tugai and mountain forests along the Amu Darya basin are in danger of depletion as they serve as sources of wood for construction and heating; many pastures are also seriously degraded and stressed. Degradation of these resources increases the risk of usage competition, and will affect livelihoods.

Solutions exist. States and societies are important players when dealing with environment and security issues and their capacities are the key factors in managing environmental issues with security implications. Measures can be taken to mitigate both the causes of problems and the consequences of environment and security stress. And there are encouraging signs that the countries of the Amu Darya basin are willing to work jointly. The next chapter provides an overview of options and recommendations.

Environment and Security issues in the Amu Darya basin

- water
- biodiversity
- geopolitics
- global change
- pollution

Factor: Global Climate Change

Changing precipitation patterns, melting ice, transboundary water resource depletion, natural disasters

Increased uncertainties

Irrigated Agriculture

Soil salinization, chemicals washout, inefficient water use, collector-drainage water management

Impact on livelihoods,
local and cross-border issues

Aral Sea region and Amu Darya delta

Soil and biodiversity degradation, accumulation of toxic chemicals, water pollution and lack of safe drinking and irrigation water

Impact on livelihoods,
environmental migration

Biodiversity

Amu Darya delta ecosystem, tugai

Impact on livelihoods

Cross-border

Irrigation runoff, pol industrial safety

Risk for health ar

TURKMENISTAN

UZBEKISTAN

LOWLAND

Factor: Afghanistan

Insecurity and weak institutions, drug production and trade, displaced population and migration, uncontrolled environment degradation

Direct security risks,
impact on livelihoods

Energy and Hydropower

Disruption of energy supply for population and business, economic development constraints

Impact on livelihoods,
international disputes

Biodiversity

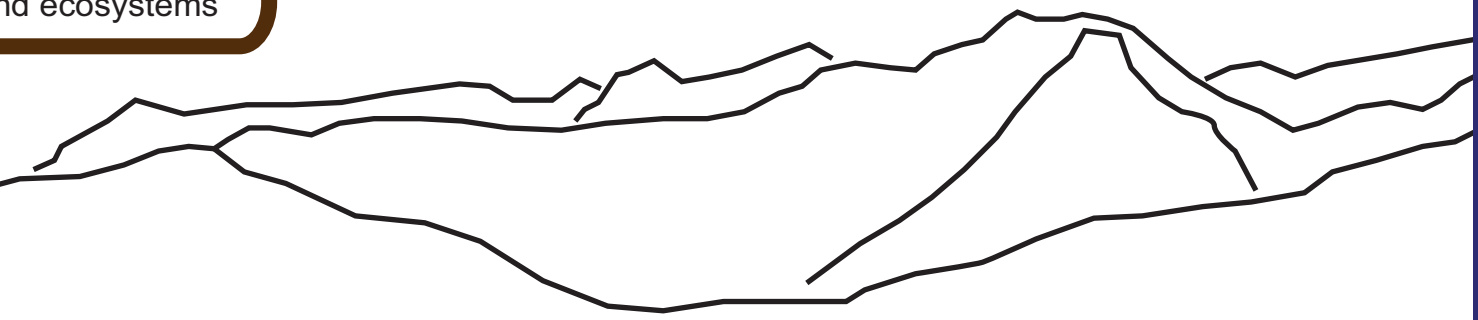
Mountain pastures, agro-biodiversity, rare and globally endangered species

Impact on livelihoods,
income distribution

pollution

lution legacies,

nd ecosystems



AFGHANISTAN TAJIKISTAN

HIGHLAND

Concept: O. Simonett and V. Novikov

Options and recommendations

The recommendations of this assessment are based on research and consultations carried out by the partners in the Environment and Security Initiative, and also benefit from a background of previous thinking, study, discussion and policy. These recommendations are broad and holistic, intended to facilitate decision-making and actions by all interested parties in order to address and reduce the sources of potential environment-related security issues and conflicts. Issues treated as priorities by the ENVSEC [142]. Initiatives are highlighted in a separate table.

Dialogue

Dialogue over a common framework for managing water and energy is important. It is needed both to strengthen trust among states, and ultimately to common understanding and operational agreements. The engagement of the IFAS, development banks, governments, the UN Regional Centre of Preventive Diplomacy in Central Asia and similar international bodies can play a crucial role in offering neutral ground for discussions and sustainable solutions based on an understanding of the region, coupled with their knowledge of existing success cases elsewhere. Afghanistan is considered as part of these discussions.

Dialogue is not only needed at an inter-state level: various economic sectors, social groups, academic institutions, communities and municipalities in the Amu Darya basin can also contribute to building regional trust and an agenda for action. Again, both "harder" (water – energy – livelihoods) and "softer" or 'greener' environmental issues may serve as a starting point for such discussions.

At the same time, existing regional centres of excellence in Central Asia[143] as well as action plans and programmes if consistently implemented, could help fostering environmental cooperation and enhance security. Increasing involvement of diplomats in cross-border water and energy decision-making processes create new opportunities for intervention at the level of environmental diplomacy and overarching political mechanisms.

New geopolitics

While the importance of Afghanistan in the challenges facing the Amu Darya is beyond doubt, the country's involvement in the consultation process is not straightforward for numerous historic, cultural and political reasons. At a more practical level the country's foreseeable water needs may sometimes affect its neighbours and especially downstream states. This makes it all the more important to involve Afghanistan in open discussion of the basin's future. In this respect the international community could also encourage synergies, joint programming and dialogue between Afghanistan and the Central Asian republics. For example, existing capacities in water and weather forecasts need to be strengthened to reduce the impacts of natural disasters and stress factors. Also, afforestation initiatives in Northern Afghanistan (such as former pistachio forest land) could provide sustainable livelihoods, while reducing the cross-border impacts of environmental degradation (erosion, dust storms).

The large powers bordering the Amu Darya region such as Russia and China and the Aral riparian Kazakhstan are fundamentally interested in lasting stability in Central Asia and can play a role in securing it, not least by promoting water and environmental cooperation. In the long term synergies can be found with other European, Asian and North American partners.

Trust Building and Cooperation

Existing regional institutions need reforming to ensure that all stakeholders are equitably included, thus avoiding over-representation of irrigation interests.

Since downstream states fear disruptions in the water flow, confidence-building measures should be put in place such as joint monitoring of water quantity and quality in order to allay these fears. Countries should consider the principle of consultation and exchanging information when dealing with projects and issues that may have transboundary affects. A case in point relates to current dam developments on the Vakhsh River.

The burden of maintaining water infrastructure shared among countries or valuable for several countries should

be shared among the stakeholders. There should be consultation within and among countries on all that contributes to the cost of a fair, properly operated and balanced water system. International support and experience-sharing could be provided to the interested basin countries to move forward in the ongoing discussions.

The ratification of the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes would benefit the riparian countries by providing a common framework for the use of the Amu Darya River. Recently, Afghanistan has been engaging with the Water Convention at the Meeting of Parties in 2009 and at the EU-Central Asia-Afghanistan consultation over shared water resources in 2010. In the meantime, countries could invest in jointly learning from good practice in regulating other major transboundary river basins.

On the environmental side such fundamental discussions can be supported by promoting dialogue and joint action over less security-loaded concerns such as the protection of ecosystem stability and services, particularly those of the critical water catchment areas of the Amu Darya tributaries, reducing common threats of natural disasters, preserving globally significant biodiversity, and building capacity to adapt to changing climate.

Modernization

Priority should be given to improving water management for irrigation. This could require complete restructuring of the irrigation sector from the present administrative to a fully catchment-based irrigation management and governance. New management and governance bodies are needed at various levels: basin – main canals – water users associations – water user groups. The users of water need to find their place at all levels of the water management pyramid.

New irrigation methods and techniques are needed to mobilize substantial water saving potential at the farm and plot level. At the basin and canal level, automated monitoring and limited automated control systems (making due allowance for the pecularities of the Central Asian context) will help improve stability, equity and transparency of water delivery.

Water authorities could also pay more attention to measures that would allow irrigated agriculture to reduce the amount of water used, not least using examples from existing projects. The rationale behind irrigated agriculture and its long-term prospects needs to be reviewed, balancing the amount of water available in the future, the national and regional interests in food security, and the potential of alternative crops, techniques and economic solutions. This will also help re-open discussion on managing the Amu Darya as an ecological system in its own right, not just as a source of add-on irrigation water.

Modernization of regional energy systems and electricity grids should continue and is certain to improve long-term access to energy. As with the water sector, there is ample scope for improving energy efficiency and developing alternative sources of energy.

However sustainable effects can only be achieved in the context of modernization of national economies. As the sectors concerned – macroeconomic policy, food and energy security, public health, employment and the social sector – are all of crucial importance for the riparian states, competing sectoral and national interests need to be reviewed in the light of the challenges to come.

All this requires modernization – reform and re-empowerment – of regional and national bodies to manage the complex challenges. The post-Soviet institutions need further support, or change, to manage the present complexity. Afghanistan makes the puzzle more challenging, introducing a new player, with no historical connection to existing regional bodies, but ultimately in need of being considered by them.

Clearly to achieve the full scale of the modernization discussed above will take many years and concerted efforts by all parties. The key task of the international community is to target support in a way that best enables the countries to move ahead with the required changes. Ultimately systemic reforms in the water management and agricultural sectors depend largely on the political will to undertake change backed with appropriate resources.

Possible action by the ENVSEC partners

The Environment and Security Initiative's partners will strive to support the riparian states of the Amu Darya basin toward action by bringing in expertise, experience and resources. As in other regions where it has worked, the ENVSEC Initiative is committed to bringing to the basin its portfolio:

• Consultation: with the basin-wide participatory assessment completed, the ENVSEC Initiative will continue discussing, identifying and addressing particular situations and hotspots on a more concrete level where concerns are and where the ENVSEC partners are called in;

• Cooperation: support current regional structures as well as policy and dialogue on vital issues (water-energy nexus, environmental impact assessment) and environment-security risks, aiming to improve understanding among states, communities, sectors and people and leading to action;

• Capacity building: continue strengthening and developing institutions and the public to be prepared for environmental and security challenges, bringing in lessons learnt in other regions;

• Communication: bring the concerns of the Amu Darya basin to the international level, but also back to corners of the region where they are not yet fully understood.

Alongside the Environment and Security Initiative itself with its targeted and catalytic efforts, a larger community of donors and international organisations present in the region has resources, tools and expertise to address many of the issues identified in this report. The ENVSEC partners will do their best to contribute to broader international cooperation in the Amu Darya basin and to play their role in a collective effort to improve the environment, lives and security for the people of the great river of Central Asia.

For up-to-date regional context and the list of proposed and ongoing projects and interventions please periodically consult the ENVSEC Initiative's work programme for Central Asia at www.envsec.org.

	Possible ENVSEC interests and activities in the Amu Darya river basin			
	Consultation	Cooperation	Capacities	Communication
Agriculture, Water & Energy	Facilitate efforts and involve relevant stakeholders in environmental and socio-economic impact assessment for large infrastructure projects Dialogue on cost-sharing and mutual benefits in the water-energy nexus Integrated approaches in energy, water and land-use policies	Cross-border and community-level integrated water resource management measures Joint water quality assessment and monitoring, involving all states of the Amu Darya basin and relevant stakeholders Improved management of the irrigation runoff Introduction of Afghanistan's stakeholders in the Amu Darya basin data exchange and consultation processes Strengthening capacities of states to move towards green economy Environmental diplomacy focusing on the water-energy nexus		Dissemination and popularization of the environmental impact assessment results Data availability and transparency on water formation and use in the Amu Darya basin Dissemination and popularisation of results and lessons on sustainable land management, water and energy efficiency Sustainable energy security options for local communities Strengthening the Aarhus environmental information centres network and local environmental data quality and availability Promotion of Econet results in the regional land-use planning Sustainable production and consumption of ecosystem products
Climate change & Disasters	Water and food security scenarios and policy-focused recommendations to address climate change impacts and challenges Mapping of climate change vulnerability, adaptation and mitigation opportunities at community and basin levels	Improved information exchange on cross-border natural disaster risks, preparedness and mutual assistance Improved hydro meteorological data collection and end-user interactions at national and regional levels	Household- and community-level energy efficiency demonstration and up-scaling Promotion of affordable and sustainable energy solutions in environment-stress areas Tackling climate change risks in the priority regions and addressing impacts of extreme weather (droughts) Integration of demonstration and technical projects and assessments in the upper- and middle- Amu Darya basin in Central Asia with activities in Afghanistan's part of the basin	
Biodiversity & Watershed protection	Improved forestry management and reforms with focus on mountains, riparian zones and semi-desert areas Sustainable pasture management in cross-border areas and important watershed zones Improved collaboration and management of cross-border nature protection zones and ecological corridors			
Pollution	Cross-border / local monitoring of environmental hotspots Joint assessments and action plans in the priority areas with identified cross-border / local pollution concerns		Hazardous substances and industrial safety management in mining and chemical industries Pollution legacies (pesticides, mining waste, etc)	

NB: the choice of specific interventions will depend on the interests of the countries and the availability of funds. All proposed activities are envisaged as complementary to ongoing or planned work by the countries and international organizations (i.a. the EU, the WB, the ADB, GIZ, the IFAS) at a regional, country or community levels.

References

ABDULLAEV I., GIORDANO M., RASULOV A. (2007). Cotton in Uzbekistan: Water and Welfare, in KANDIYOTI D. (ed.), The Cotton Sector in Central Asia, London, The School of Oriental and African Studies.

ABDULLAEV I., HASSAN M., JUMABOEV H. (2007). Water saving and economic impacts of land levelling: The case study of cotton production in Tajikistan. In: Irrigation and Drainage Systems. Vol. 21 (3-4), pp. 251-263. Springer.

AFGHANISTAN MINISTRY OF WATER AND ENERGY (2004). Power Sector Master Plan.

AFGHANISTAN MINISTRY OF WATER AND ENERGY (2004). Power sector master plan: Hydrology. Annex C6.

AFGHANISTAN RESEARCH AND EVALUTION UNIT (AREU) (2009). Land conflict in Afghanistan. Building capacity to address vulnerability. Eds. Daschamps C. and Roe. A.

AGALTSEVA N. (2008). Prospective change of the Central Asian rivers runoff with glaciers feeding under different climate scenarios. Geophysical Research Abstracts, v 10.
http://www.geophysical-research-abstracts.net

AGRAWALA SH., BARLOW M., CULLEN H., LYON B. (2001). The Drought and Humanitarian Crisis in Central and Southwest Asia: A Climate Perspective. International Research Institute for Climate Prediction, Lamont-Doherty Earth Observatory of Columbia University.

AHMAD M., MAHWASH W. (2004) Water Resources Development in Northern Afghanistan and its implication for Amu Darya Basin, World Bank Working Paper No. 36.

AINI A. (2007). Water Conservation in Afghanistan. In: Journal of Developments in Sustainable Agriculture 2, 51-58.

AIZEN V. (2008). Is Central Asia really exsiccated? Presentation at the AGU Meeting, Dec 15-19, 2008, San Francisco. Northern Eurasian Earth Science Partnership Initiative.
http://www.neespi.org

ALIEV S., SHODMONOV P., BABAKHANOVA N., SCHMOLL O. (2006). Rapid assessment of drinking-water quality in Tajikistan.
http://www.untj.org/files/reports/RADWQ.pdf

ARAL SEA BASIN INITIATIVE (2005). Towards a strategy for sustainable irrigated agriculture with feasible investment in drainage. ed. J.Kijne.

ARDAKANIAN R., VAN DER SCHAAF CH. (2008). Proceedings of the international workshop on institutional capacity development in transboundary basins. Lessons learned from practical experience.

ASIAN DEVELOPMENT BANK (ADB) (1999). Second Workshop on Economic Cooperation in Central Asia: Challenges and Opportunities in Energy.
http://www.adb.org/Documents/Conference/Carec/Energy/

ASIAN DEVELOPMENT BANK (ADB) (2002a). Afghanistan's environment in transition. A. Azimi, D. McCauley. (Eds.)

ASIAN DEVELOPMENT BANK (ADB) (2002b). The study on water and energy nexus in Central Asia. Biddison J. (ed.), Tashkent.
http://www.adb.org/Documents/Reports/CAREC/Water-Energy-Nexus/water-energy-nexus.pdf

ASIAN DEVELOPMENT BANK (ADB) (2004a). Country environmental analysis for Uzbekistan.

ASIAN DEVELOPMENT BANK (ADB) (2004b). Past experience and future challenges. Cooperation in Shared Water Resources in Central Asia. Bayarsahan T., McKinney D. (Eds.)

ASIAN DEVELOPMENT BANK (ADB) (2008). Land degradation in Central Asia. Revised Draft Final Report. ADB TA 6356-REG: CACILM

ATLAS OF ENVIRONMENTAL INDICATORS OF UZBEKISTAN (2008). Eds. Kim E., Gurova T. Goskomgeodeskadastr, Tashkent.

BAECHLER G. (1998). Why environmental transformation causes violence: A synthesis. Environmental Change and Security Project Report, Issue 4 (Spring 1998): 24-44.

BAECHLER G. (1999). Environmental Degradation in the South as a Cause of Armed Conflict. In: Carius, A. and Lietzmann, K. Eds. Environmental Change and Security: A European Perspective. Berlin: Springer. pp. 107-129.

BARLOW M., TIPPETT M. (2008). Variability and Predictability of Central Asia River Flows: Antecedent Winter Precipitation and Large-Scale Teleconnections., Journal of Hydrometeorology, volume 9, 1334-1349.

BARQI TOJIK, AFGHANISTAN MINISTRY OF ENERGY AND WATER, ASIAN DEVELOPMENT BANK (2006). Afghanistan and Tajikistan: Regional Power Transmission. Environmental assessment report.

BARQI TOJIK. Rogun Hydropower Station Performance Characteristics. Overview.

BERNAUER TH., SIEGFRIED T. (2008). Compliance and Performance in International Water Agreements: The Case of the Naryn/Syr Darya Basin. Global Governance 14 (2008), 479–501.

BHATTACHARYYA K., AZIZI P. M., SHOBAIR S., AND MOHSINI M. Y. (2004). Drought impacts and potential for their mitigation in Southern and Western Afghanistan. Working Paper 91. Colombo, Sri Lanka: International Water Management Institute.

BREU T., HURNI H. (2003). The Tajik Pamirs: Challenges of Sustainable Development in an Isolated Mountain Region. Centre for Development and Environment, University of Bern.

BRILL OLCOTT M. (2004). International Gas Trade in Central Asia: Turkmenistan, Iran, Russia and Afghanistan. Working Paper #28. Program on Energy and Sustainable Development, Stanford University.

BROWN M. (2001). The causes of internal conflict: An overview. Nationalism and ethnic conflict. Cambridge.

BUCKNALL J. (2003). Irrigation in Central Asia. Social, Economic and Environmental Considerations.

CENTER FOR SECURITY STUDIES (2007). Climate Change and Security Policy. Bulletin 2, Dec 2007. ETH Zurich.

CENTRAL ASIA REGIONAL ECONOMIC COOPERATION (CAREC) (2008). Strategy for Regional Cooperation in the Energy Sector. Seniors Officials Meeting Report.
http://www.adb.org/Documents/Events/2008/CAREC-Senior-Officials-Meeting/Energy-Sector-Update-Draft.pdf

CENTRE FOR EASTERN STUDIES (2009). Tajikistan faces crisis of statehood. Falkowski M.
http://www.isn.ethz.ch/isn/Current-Affairs/Security-Watch/Detail/?ots591=0c54e3b3-1e9c-be1e-2c24-a6a8c7060233&lng=en&v33=106521&id=98834

CHAMBERS R. AND CONWAY G. (1992). Sustainable rural livelihoods: Practical concepts for the 21st century. IDS Discussion Paper 296. Brighton.

COLEMAN J. (2004). THE WORLD DELTA DATABASE: THE AMU-DARYA DELTA.

COLLIER P. (2000). Economic causes of civil conflict and their implications for policy. Washington, DC: World Bank.

COLLIER P., ELLIOT V.L., HEGRE H., HOEFFLER A., REYNAL-QUEROL M., SAMBANIS N. (2003). Breaking the Conflict Trap: Civil War and Development Policy. World Bank and Oxford Uni Press.

COLLIER P., HOEFFLER A. (2002). Greed and Grievance in Civil War. Oxford: Centre for the Study of African Economies.

CONCA K. and DABELKO G. (Eds.) (2003). The Case for Environmental Peacemaking. Woodrow Wilson Center.

CROSA G., CALAMARI D. (2002). Pollution management and water quality in the Amu Darya River and Kaparas reservoir (Uzbekistan).

CROSA G., FROEBRICH J., NIKOLAYENKOC V., STEFANID F., GALLID P., CALAMARIA D. (2006). Spatial and seasonal variations in the water quality of the Amu Darya River. Water research 40 (2006) 2237 –2245.

CRUDE ACCOUNTABILITY (2009). Turkmenistan's Crude Awakening Oil, Gas and Environment in the South Caspian. [«Сырое» пробуждение Туркменистана: нефть, газ и окружающая среда Южного Каспия. Отчёт.]

DABELKO G., LONERGAN S., AND MATTHEW R. (2000). State of the Art Review of Environmental Security and Cooperation. OECD.

DE FIGUEIREDO, JR., RUI J., WEINGAST B. (1999). The rationality of fear: Political opportunism and ethnic conflict. In B. Walter, J.Snyder (Eds.). Civil wars, insecurity, and intervention. Columbia Uni Press, pp 261-302.

DE SOYSA I. (2000). The resource curse: Are civil wars driven by rapacity or paucity? In M. Berdal and D. Malone (Eds.), Greed and grievance: Economic agendas in civil wars (pages 113-28). Boulder, CO: Lynne Reinner.

DI PASQUALE J. (2006). Assessing water security in the Amu Darya River basin, Afghanistan. US. Army Command College. Master thesis.

DOEMPKE S. (2008). Pamir-Alai Transboundary Conservation Area. Mission Report. PALM Project, UNU.

DROUX R., HOECK T. (2004). Energy for Gorno Badakhshan: Hydropower and the Cultivation of Firewood Analysis of the Energy Situation in the Tajik Pamirs and its Consequences for Land Use and Natural Resource Management. Joint diploma thesis.

DROZ P., SPACIC-GRIL L. (2002). Lake Sarez risk mitigation project: a global risk analysis. Paper for International Symposium on Hydraulic and Hydrological Aspects of Reliability and Safety Assessment of Hydraulic Structures. May 28 - June 1, 2002, St. Petersburg.

ECONOMIST INTELLIGENCE UNIT (2001). Kyrgyzstan Country Profile.

ECONOMIST INTELLIGENCE UNIT (2003). Uzbekistan Country Profile.

ELLIS W., TURNLEY D. (1990). A Soviet Sea Lies Dying. In: National Geographic Magazine, vol. 177, no. 2, February, p. 73-93.

ENVIRONMENT, SCIENCE, TECHNOLOGY AND HEALTH HUB (2005). Central Asian Highlights. October 2005. In focus: The Southern Aral Sea.

ENVIRONMENT, SCIENCE, TECHNOLOGY AND HEALTH HUB (2006a). Central Asian Highlights. August 2006. In focus: Protected Nature Areas in Central Asia.

ENVIRONMENT, SCIENCE, TECHNOLOGY AND HEALTH HUB (2006b). Central Asian Highlights. September 2006. In focus: The lakes of Central Asia.

ENVIRONMENT, SCIENCE, TECHNOLOGY AND HEALTH HUB (2006c). Central Asian Highlights. October 2006. In focus: Land Degradation in Greater Central Asia.

ENVIRONMENT, SCIENCE, TECHNOLOGY AND HEALTH HUB (2007). Central Asian Highlights. November 2007. In focus: Central Asian Inter-governmental Environmental Agreements.

EURASIAN DEVELOPMENT BANK (2008). Water and Energy Resources in Central Asia: Utilization and Development Issues. EDB Report no.2.
http://www.eabr.org/eng/publications/AnalyticalReports

EURASIAN DEVELOPMENT BANK and INTERNATIONAL FUND FOR SAVING THE ARAL SEA (2009). Impact of climate change on water resources in Central Asia.
http://www.cawater-info.net/library/eng/ifas/impact_climate_change_en.pdf

EUROPEAN COMMISSION (2008). Climate Change and International Security. Paper from the High Representative and the European Commission to the European Council. 14 March 2008.

FAO (2005). Aral Sea Basin Initiative.Towards a strategy for sustainable irrigated agriculture with feasible investment in drainage. Ed. Kijne J.

FAO (2010a). Climate Impact Study on Stream Flow: Present and Future Stream flow in the Panj and Vakhsh Basins. Ed. Hagg. W.

FAO (2010b). Impact of Irrigation in Northern Afghanistan on Water Use in the Amu Darya Basin. Eds. Klemm W., S. Shobair.
http://www.unece.org/speca/documents/ecf/2010/FAO_report_e.pdf

FUCHINOUE H., TSUKATANI T., AND TODERICH K. (2002). Afghanistan Revival: Irrigation on the right and left banks of Amu Darya. Discussion Paper No. 554. Institute of Economic Research, Kyoto University.

GELY J., MULLER M. (2002). Regional water management in Central Asia. In: Workshop Proceedings "Water, Climate, and Development Issues in the Amu Darya Basin", 18-19 June 2002, The Franklin Institute, Pennsylvania.
http://ccb.colorado.edu/centralasia/docs/muller.pdf

GLANTZ M. (2005). Water, Climate, and Development Issues in the Amu Darya Basin. In: Mitigation and Adaptation Strategies for Global Change 10: 23–50.

GLANTZ M. (ed.) (2002). Water, Climate, and Development Issues in the Amu Darya Basin. Summary of Workshop Proceedeings, 18-19 June 2002, Pennsylvania.
http://ccb.colorado.edu/centralasia/docs/summary.pdf

GLOBAL WATER PARTNERSHIP CENTRAL ASIA AND CAUCASUS (2006). Национальный отчет Республики Таджикистан.

GOLDSTONE, J. A.; GURR T. R.; HARFF B; LEVY M. A.; MARSHALL M. G.; BATES R. H.; et al. (2000). State failure task force report: Phase III findings. McLean, VA: Science Applications International Corporation.

HAMDARD Z. (2007). Analytical Paper on the Assessment of the Amu Darya Basin on Environment and Security Issues.

HARDIN, G. (1968). "The Tragedy of the Commons", Science, Vol. 162, No. 3859 (13 December 1968), pp. 1243-1248.

HOMER-DIXON T. (1999). Environment, Scarcity, and Violence. Princeton: Princeton University Press.

HOPKO H. (2008). When oil starts losing value, countries begin competing for water. Inefficient water consumption in Central Asia may lead to serious conflicts in the region. [Когда нефть теряет ценность, страны борются за... воду. ОБЩЕСТВО.
http://www.day.kiev.ua/202818/]

HORSMAN S. (2008). Afghanistan and Transboundary Water Management on the Amu Darya: a Political History. In: Rahaman, M.M. and Varis, O. (eds.): Central Asian Waters, pp. 63-74. Helsinki University of Technology.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) (1997). The regional impacts of climate change: an assessment of vulnerability. A Special Report of IPCC Working group II. Watson, R., M. Zinyowera and R. Moss (eds.). Cambridge: Cambridge Uni. Press.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) (2001). Climate change 2001: Impacts, adaptation and vulnerability. Contribution of working group to the third assessment report of the intergovernmental panel on climate change. J.J. McCarthy, O. Canziani, N. Leary, D. Doken, K. White (eds.). Cambridge: Cambridge Uni. Press.

INTERNATIONAL ALERT (2009). Climate change, conflict and fragility. Understanding the linkages, shaping effective responses.
http://www.international-alert.org/press/Climate_change_conflict_and_fragility_Nov09.pdf

INTERNATIONAL CENTRE FOR TRADE AND SUSTAINABLE DEVELOPMENT (2010). How would a trade deal on cotton affect exporting and importing countries? Ed. M. Jales.

INTERNATIONAL CRISIS GROUP (ICG) (2001). Incubators of Conflict: Central Asia's Localised Poverty and Social Unrest.

INTERNATIONAL CRISIS GROUP (ICG) (2005). The Curse of Cotton: Central Asia's Destructive Monoculture.

ISLAMIC REPUBLIC OF AFGHANISTAN (2007). Energy sector strategy (Draft).

ISLAMIC REPUBLIC OF AFGHANISTAN (2007). Water sector strategy (Draft).

IVAKHNYUK I. (2006). Migration in the CIS region: common problems and mutual benefits.

JARSJÖ J. (2009). Hydrological effects of projected climate changes 2010-2039 in the extensively irrigated Aral Sea drainage basin.

KAHL C. H. (2006). States, Scarcity and Civil Strife in the Developing World, Princeton University Press.

KANDIYOTI D. (2009). Invisible to the world? The Dynamics of Forced Child Labour in the Cotton Sector of Uzbekistan.

KARL T. (1997). The paradox of plenty: Oil booms and petro-states. University of California Press.

KAUFMAN S. (2001). Modern hatreds: The symbolic politics of ethnic war. Cornell University Press.

KHAMZAYEVA A. (2009). Water resources management in Central Asia: Regional and international issues at stake.

KIJNE J. (2005). Towards a strategy for sustainable irrigated agriculture with feasible investment in drainage. SYNTHESIS REPORT.

KLÖTZI S. (1994). The Aral Sea syndrome' and regional cooperation in Central Asia: Opportunities or an obstacle? In Conflict and the Environment. Gledisch n.p (ed.), pp 417-434.

KONOVALOV V. (2007). Long-Term Changes of Water Balance Components in the Basins of Rivers Fed by Snow and Ice. In: Meteorologiya i Gidrologiya, 2007, 8: 77–89.

KOTLYAKOV, V. M. SEVERSKIY, I. (2009). Glaciers of Central Asia: current situation, changes, and possible impact on water resources, (in) Assessment of Snow, Glacier and Water Resources in Asia, IHP/HWRP – Berichte, Heft 8, Koblenz 2009, ISSN 1614-1180 (selected papers from the regional workshop in Almaty, Kazakhstan, 2006).

KRANZ N., VORWERK A., INTERWIES E. (2005). Transboundary river basin management regimes: the Amu Darya basin case study. Report for the NeWater proejct.
http://www.newater.info

KREVER V., PERELADOVA O., WILLIAMS M., JUNGIUS H. (1998). Biodiversity Conservation in Central Asia, Washington.

KUZMITS B. (2005). Local Governance and Fragile Statehood in Amu Darya Borderlands.

KUZMITS B. (2006). Cross-bordering Water Management in Central Asia. Conflict Constellations and Ways to a Sustainable Resource Use. Amu Darya Series Paper No 2, April 2006.

KYOTO UNIVERSITY (2002). Afghanistan revival: Irrigation on the right and left banks of Amu Darya. Discussion paper 554. (Eds.) Fuchinoue, H., Tsukatani, T., Toderich, K.N.

LASHKARIPOUR G., HUSSAINI S. (2007). Water resource management in Kabul River basin.

LE BILLON P. (2001). The political ecology of war: Natural resources and armed conflicts. Political Geography, 20, 561-84.

LEVINE R., WALLACE G. (2000). The mineral industries of CIS countries. USGS.

LINN J. (2008a). The Impending Water Crisis in Central Asia: An Immediate Threat. The Brookings Institution.
http://www.brookings.edu/opinions/2008/0619_central_asia_linn.aspx

LINN J. (2008b). Water-Energy Links in Central Asia: A Long-Term Opportunity and Challenge. The Brookings Institution.
http://www.brookings.edu/opinions/2008/0630_central_asia_linn.aspx#_ftn10

LUTZ W., SCHERBOV S. (2002). The End of Population Growth in Asia. Interim Report 02-060.

MALTAIS A., DOW K., PERSSON A. (2003). Integrating Perspectives in Environmental Security, SEI.
http://www.sei.se

MCKINNEY D. (2003). Cooperative management of transboundary water resources in Central Asia.

MÉDECINS SANS FRONTIÈRES (2003). Karakalpakstan: A Population in Danger. Tashkent.

MICKLIN P. (2000). Managing Water in Central Asia. London: Royal Institute of International Affairs.

MICKLIN P., ALADIN N. (2008). Reclaiming the Aral Sea. In: Scientific American, April 2008.

MOLLE F. (2008). Nirvana Concepts, Narratives and Policy Models: Insights from the Water Sector.

MOROZOV A. (2003). What should precede the diversion of the Siberian rivers runoffs to Central Asia?
http://water-salt.nm.ru/site_en/k_per_sr_en.htm

MOSELLO B. (2008). Central Asia: Liquid Deficit. TRANSITIONS ONLINE.
http://www.tol.org//client/article/19806-liquid-deficit.html?print

MUELLER M. (2008). Where has all the water gone? In WEHRHEIM P., SCHOELLER-SCHLETTER A., MARTIUS C. (Eds). Continuity and change: Land and water use reforms in rural Uzbekistan, Chapter 5, pp. 89-104.

MUNTEAN, N., JERMNI M., SMALL I., FALZON D., FRUST P., MIGLIORATI G., SCORTICHINI G., FORTI A.F., ANKLAM E., HOLST CH., NIYAZMATOV B., BAKHRIDINOV K., AEERTGEERTS R., BERTOLLINI R., TIRADO CH., KOLB A. (2003). Assessment of dietary exposure to some persistent organic pollutants in the Republic of Karakalpakstan of Uzbekistan. In: Environmental health perspectives, v 111: 1306-1311.

NASA (2008). Severe Cold in Southwestern Asia.
http://earthobservatory.nasa.gov/NaturalHazards/shownh.php3?img_id=14734

NATIONAL DROUGHT MANAGEMENT AND MITIGATION PLAN FOR TAJIKISTAN (2007). Eds. M. Safarov, A. Kayumov, A. Khomidov. Agency on hydrometeorology and environmental monitoring of Tajikistan. Dushanbe.

NATIONAL ENVIRONMENT PROTECTION AGENCY and UNEP (2008). Afghanistan's Environment 2008. Executive Summary. Kabul-Geneva.

NEZLIN N., KOSTIANOY A., LEBEDEV S. (2004). Interannual variations of the discharge of Amu Darya and Syr Darya estimated from global atmospheric precipitation. In: J. Marine Systems 47: 67-75.

NORRIS R., COCHRAN T. (1996). Nuclear weapons tests and peaceful nuclear explosions by the Soviet Union. Draft.

NOSENKO G., KOTLYAKOV V. (2009). Assessment of glacier changes in mountain regions of the Former Soviet Union using recent satellite data and historical data sets. Proceedings of the International Workshop on the Northern Eurasia High Mountain Ecosystems, Bishkek, September 8-15, 2009.

OHLSSON L. (2000a). Text of the oral presentation presented at the workshop "Poverty & Environment", the UNDP/Sida conference on poverty reduction, Stockholm 20-21 November 2000.
http://www.edcnews.se/Reviews/Ohlsson2000.html

OHLSSON L. (2000b). Livelihood Conflicts: Linking Poverty and Environment as Causes of Conflict. University of Toronto (2003) The Project on Environment, Population, and Security.
http://www.library.utoronto.ca/pcs/eps.htm

OLCOTT M. (2004). International Gas Trade in Central Asia: Turkmenistan, Iran, Russia and Afghanistan. Working Paper #28.

PASSELL H. (2003). The Navruz Project: Transboundary Monitoring for Radionuclides and Metals in Central Asian Rivers. Data Report. SAND REPORT 2003-1149.

PAVLOVSKAYA L. (2005). Fishery in the lower Amu Darya under the impact of irrigated agriculture.
http://www.fao.org/docrep/v9529e/v9529E04.htm

PEACHEY E. (2004). The Aral Sea basin crisis and sustainable water resource management in Central Asia.

PEARCE F. (2002). Blood diamonds and oil.New Scientist, 36-41.

PENDER J., MIRZABAEV A. (2008). Economic Analysis of Sustainable Land Management Options in Central Asia. Prograss report. ADB.

PETR T., ISMUKHANOV K., KAMILOV B., PULATKHON D., UMAROV P. Irrigation systems and their fisheries in the Aral Sea basin, Central Asia.
http://www.fao.org/docrep/007/ad526e/ad526e0i.htm

POSTEL S., WOLF A. (2001). Dehydrating conflict. In: Foreign Policy, September-October, 60-67.

RAHAMAN M., VARIS O. (2008). Central Asian Waters: Social, economic, environmental and governance puzzle.

RAKHMATULLAEV,S., HUNEAU, F., KAZBEKOV, J., LE COUSTUMER, P., JUMANOV, J., EL OIFI, B., MOTELICA-HEINO, M., HRKAL Z. (2009). Groundwater Resources Use and Management in the Amu Darya River Basin (Central Asia). In: Environmental Earth Sciences 59 (2010). Springer.

RAZAKOV R., RAHMONOV B., RAHMATOV R., ALIEV R. (2003). Experience of drainage water treatment and reuse. International Workshop on Sustainable Strategies for Irrigation in Salt-prone Regions, Cairo, Egypt, 8-10 December 2003.
http://www.nwl.ac.uk/research/cairoworkshop/papers/WASTEWATER/ws2_14.PDF

Regional environmental action plan for Central Asia (2005).

REZNICHENKO G. (1992). The Aral Sea Tragedy: The Diary of an Expedition. Moscow.

ROSS M. (1999). The political economy of the resource curse. World Politics, 51(2), 297-322.

ROSS M. (2001). Timber booms and institutional breakdown in Southeast Asia. New York: Cambridge University Press.

SAIKO T. (1998). Geographical and socio-economic dimensions of the Aral Sea crisis and their impact on the potential for community action. In: Journal of Arid Environments, v. 39: 225-238.

SAVOSKLUL O. et al. (2003). Water, Climate, Food and Environment in the Syr-Darya basin.

SCHLÜTER M., HIRSCH D., PAHL-WOSTL C. (2009). Coping with change – responses of the Uzbek water management regime to socio-economic transition and global change.
http://www.usf.uos.de/~pahl/forschung/AmuDaryaMTF%20Submitted.pdf

SCHLÜTER M., KHASANKHANOVA G., ABDULLAEV U., TALSKIKH V., TARYANNIKOVA R., JOLDASOVA I., KHAMZINA T., IBRAGIMOV R., PAHL-WOSTL C. (2006). Incorporating environmental flows into water management in the Amu Darya River delta.

SCHMIDT R. (2007).Feasibility Study for Completion of the Rogun Scheme. In: J. Hydropower and Dams 3: 102-107.

SCHRAD M. (2006). Threat Level Green: Conceding Ecology for Security in Eastern Europe and the Former Soviet Union. In: Global Environmental Change 16: 400-422.

SEVERSKIY I. (2004). Water-related Problems of Central Asia: Some Results of the (GIWA) International Water Assessment Program. Ambio Vol. 33 No. 1–2, Feb. 2004.

SHIBUO Y., JARSJO J., DESTOUNI G. (2007). Hydrological responses to climate change and irrigation in the Aral Sea drainage basin. Geophysical research letters.

SHIKLOMANOV A. (2009). Hydrological change in the mountainous and downstream regions of Central Asia. Proceedings of the International Workshop on the Northern Eurasia High Mountain Ecosystems, Bishkek, September 8-15, 2009.

SHIKLOMANOV A., LAMMERS R., AGALTSEVA N. (2008). Observed and projected hydrological changes in the Aral Sea basin. The AGU meeting. Water Systems Analysis Group University of New Hampshire, Uzbekistan Hydro-meteorological Service, Tashkent.

SHRAD M. (2006). Threat level green: conceding ecology for security in Eastern Europe and the former Soviet Union.

SIC ICWC (2002). Dialogue on Water and Climate: Aral Sea Basin Case Study. Ed. V. Dukhovny. Tashkent.

SIC ICWC (2003). Lessons on Cooperation Building to Manage Water Conflicts in the Aral Sea basin. Eds. V. Dukhovny, V. Sokolov. Report for UNESCO International Hydrological Programme.

SIC ICWC (2005). Transition to Integrated Water Resources Management in Amu Darya and Syr Darya Lowlands and Deltas.OESI Water project.Eds V. Dukhovny, M. Horst. Tashkent.

SIC ICWC (2007). Interstate Commission for Water Coordination in Central Asia. TA 6163-REG: Improved Management of Shared Water Resources in Central Asia.

SIEGFRIED T., BERNAUER T. (2007). Estimating the performance of international regulatory regimes: Methodology and empirical application to international water management in the Naryn/Syr Darya basin. Water Resources Research, vol. 43.

SIEGFRIED T., BERNAUER T. GUIENNET R., SELLARS S., ROBERTSON A., J. MANKIN., BAUER-GOTTWEIN (2010). Coping With International Water Conflict in Central Asia: Implications of Climate Change and Melting Ice in the Syr Darya Catchment.

SIWI (2010). Regional Water Intelligence Report Central Asia.
http://www.siwi.org/documents/WGF/Reports/Paper-15_RWIR_Aral_Sea.pdf

SMALL I., FALZON D., JOOST B.W. VAN DER MEER, FORD N. (2003). Safe water for the Aral Sea Area. Could it get any worse? European journal of public health 2003; 13: 87–89.

SNYDER J. (2000). From voting to violence: Democratization and nationalist conflict. New York: W.W. Norton & Co.

SPOOR M. (2005). Linking macroeconomic policy to poverty reduction in Uzbekistan.

STAHL K. (2007). Hydrology's of the world international river basins: hydrological parameters for use in global studies of international water-relations. GRDC Report Series. Report 37.

STATE COMMITTEE OF THE REPUBLIC OF UZBEKISTAN ON STATISTICS (2006). Environmental Situation and Utilization of Natural Resources in Uzbekistan: Facts and Figures 2000-2004.

STERN D. (2008). Tajikistan hopes water will power its growth.
http://www.iht.com/bin/printfriendly.php?id=15774986

STONE R. (2008), A New Great Lake or Dead Sea? In Science 23 May 2008: pp 1002-1005.

STRICKMAN R., PORKKA M. (2008). Water and social changes in Central Asia: problems related to cotton production in Uzbekistan.

STUCKER D. (2006). Linking Natural Capital, Rural Livelihoods and Conflict: Toward Governance for Environmental Security and Peace in Tajikistan, University for Peace. (Thesis paper)

STUCKER D. (2009). Environmental Injustices, Unsustainable Livelihoods, and Conflict: Natural Capital Inaccessibility and Loss among Rural Households in Tajikistan. In Julian Agyeman and Yelena Ogneva-Himmelberger (Eds.), Environmental Justice and Sustainability in the Former Soviet Union. Cambridge, MA: Massachusetts Institute of Technology (MIT) Press.

SUPERSBERGER N. (2006). Energy Security and Vulnerability: Options of Risk Minimisation and the Broader European Context, World Security Network News, 29.11.06

TAJIKISTAN MINISTRY OF ENERGY AND INDUSTRY (2001). Future prospect of hydro power engineering in Tajikistan.

TAJIKISTAN MINISTRY OF ENERGY AND INDUSTRY (2007). Strategy for the development of small-scale hydropower.

TAJIKISTAN MINISTRY OF IRRIGATION AND WATER MANAGEMENT, UNDP TAJIKISTAN, THE INTERNATIONAL FUND FOR SAVING THE ARAL SEA (2006). Water sector development strategy.

TAJIKISTAN NATIONAL ACTION PLAN ON CLIMATE CHANGE MITIGATION (2003). Main Administration on Hydrometeorology and Environmental Monitoring under the Ministry for Nature Protection of the Republic Tajikistan. Eds: Makhmadaliev B., Novikov V., Kayumov A., Karimov U.

TAJIKISTAN'S SECOND NATIONAL COMMUNICATION TO THE UNFCCC (2008). Agency on hydrometeorology and environmental monitoring of Tajikistan. Dushanbe.

TCHAIDZE R. (2007). Quasi-Fiscal Deficit in Nonfinancial Enterprises, International Monetary Fund, Working Paper, 07/10.

THE INTERNATIONAL RESEARCH INSTITUTE FOR CLIMATE PREDICTION (2001). The drought and humanitarian crisis in Central and Southwest Asia: a climate perspective.

TRESHKIN S.Y., KAMALOV S.K., BACHIEV A., MAMUTOV N., GLADISHEV A.I. AND AIMBETOV I. (1998). Present status of the tugai forests in the lower Amu Darya basin and problems of their protection and restoration. In Ecological research and monitoring of the Aral Sea Deltas. UNESCO Aral Sea Project 1992-1996. Final Scientific Report, UNESCO Paris.

ULMISHEK G. (2004). Petroleum Geology and Resources of the Amu Darya Basin, Turkmenistan, Uzbekistan, Afghanistan, and Iran. U.S. Geological Survey Bulletin 2201–H.

UNECE and UNESCAP (2001). Special Program for Economics of Central Asia (SPECA). Rational and Effective Use of Water Resources in Central Asia. Diagnostic Study.

UNECE and UNESCAP (2003). Special Program for Economics of Central Asia (SPECA). Strengthening Cooperation on Rational and Efficient Use of Water and Energy Resources in Central Asia.

UNEP (2007). Global Outlook of Ice and Snow.
http://www.unep.org/geo/geo_ice

United Nations Development Programme (UNDP) (2001). National Human Development Report, Kyrgyz Republic.

United Nations Development Programme (UNDP) (2003). Tapping the potential: improving water management in Tajikistan. National Human Development Report.
http://www.untj.org/undp/publications/nhdr2003

United Nations Development Programme (UNDP) (2005). Central Asia Human Development Report. Bringing down barriers: Regional cooperation for human development and human security.
http://www.undp.kg/ru/resources/e-library/article/28-e-library/565-central-asian-human-development-report-2005

United Nations Development Programme (UNDP) (2009). Central Asia Regional Risk Assessment: Responding to Water, Energy, and Food Insecurity.

United Nations Economic Commission for Europe (UNECE) (2001). Environmental Performance Review, Uzbekistan.

United Nations Economic Commission for Europe (UNECE) (2004). Environmental Performance Review, Tajikistan.

United Nations Economic Commission for Europe (UNECE) (2007). The First Assessment of Transboundary Rivers, Lakes and Groundwaters.

United Nations Economic Commission for Europe (UNECE) (2010a). Guidance on water and adaptation to climate change.

United Nations Economic Commission for Europe (UNECE) (2010b). Second Environmental Performance Review, Uzbekistan.

United Nations Environment Programme (UNEP) (1993).Diagnostic Study for the Development of an Action Plan for the Conservation of the Aral Sea.

United Nations Environment Programme (UNEP) (2003). Afghanistan. Post-Conflict Environmental Assessment. Kabul-Geneva.

United Nations Environment Programme (UNEP) (2003). Afghanistan: Post Conflict Environmental Assessment.

United Nations Environment Programme (UNEP) (2004). Environmental indicators: Central Asia.

United Nations Environment Programme (UNEP) (2009). From Conflict to Peacebuilding. The role of Natural Resources and the Environment.
http://www.unep.org/pdf/pcdmb_policy_01.pdf.

United Nations Office on Drugs and Crime (UNODC) (2007). Opium Amounts to Half of Afghanistan's GDP in 2007.
http://www.unodc.org/unodc/en/press/releases/opium-amounts-to-half-of-afghanistans-gdp-in-2007,-reports-unodc.html

United Nations Office on Drugs and Crime (UNODC) (2009). Afghanistan Opium Winter Assessment: January 2009. Vienna.

UNIVERSITY of OSNABRÜCK (2007). Sustainable Aquaculture in Recirculating Systems – Feasibility Study for the Catchment Area of the Aral Sea. Eds. Wecker, B, Karimov, B. et al.

UZBEKISTAN SECOND NATIONAL COMMUNICATION TO THE UNFCCC (2008). Centre of Hydrometeorological Service under the Cabinet of Ministers of the Republic of Uzbekistan.

VALENTINI K., OROLBAEV E., ABYLGAZIEVA A. (2004). Water problems of Central Asia.

VIVIROLI D., WEINGARTNER R. (2004). The hydrological significance of mountains: from regional to global scale. In: Hydrology and Earth System Sciences, 8(6), 2004.

VORWERK A., KRANZ N. (2006). Research on transboundary regimes in the Amu Darya Case study. Interim Report WP 1.3. Draft.

WEGERICH K. (2001). Natural drought or human made water scarcity in Uzbekistan? London, SOAS, Published in CENTRAL ASIA AND THE CAUCASUS, No. 2 (14), 2002.

WEGERICH K. (2007). A critical review of the concept of equity to support water allocation at various scales in the Amu Darya basin.

WEGERICH K. (2010). Politics of Water in Post-Soviet Central Asia.

WEGERICH K., OLSSON O., FROEBRICH J. (2007). Reliving the past in a changed environment: Hydropower ambitions, opportunities and constraints in Tajikistan, Energy Policy 25, 3815-3825

WEHRHEIM P., SCHOELLER-SCHLETTER A., MARTIUS C. (eds) (2008). Continuity and change: Land and water use reforms in rural Uzbekistan, Leibniz Institute of Agricultural Development in Central and Eastern Europe, Volume 43.
http://www.iamo.de/dok/sr_vol43.pdf

WEINTHAL E. (2004). Environmental Peacemaking in the Aral Sea Basin. In CONCA K., DABELKO G. (Eds.) (2004). Environmental Peacemaking. Woodrow Wilson Center Press, Washington.

WGBU (2007). World in Transition: Climate Change as a Security Risk. Berlin.

WOLF A. (1998). Conflict and cooperation along international waterways. In: Water Policy 1(2):251-265.

WORLD BANK (2003). Irrigation in Central Asia: Social, Economic and Environmental Considerations. Eds. Bucknall J., Klytchnikova I., Lampietti J., Lundell M., Scatasta M., Thurman M.

WORLD BANK (2004). Water Energy Nexus in Central Asia: Improving Regional Cooperation in the Syr Darya Basin. Eds. Sharma R., Markandya A., Ahmad M., Iskakov M., Krishnaswamy V. Washington

WORLD BANK (2008). Weather and climate services in Europe and Central Asia. A regional review. World Bank working paper № 151.

WORLD BANK (2009). Adapting to Climate Change in Europe and Central Asia.

WWF (2006). Climate change and water problems in Central Asia.

YOFFE, S., WOLF A. T., and GIORDANO M., 2003. Conflict and Cooperation Over International Freshwater Resources: Indicators of Basins at Risk. Journal of the American Water Resources Association (JAWRA) 39(5):1109-1126.

ZAKARIN E. (2008). Geoinformation Modeling of Radionuclide Transfer from the Territory of the Semipalatinsk Test Site. Scientific Report 08-06.

ZAVIALOV P. (2005). Physical Oceanography of the Dying Aral Sea. Berlin: Springer.

ZEF Bonn (2006). Cross-bordering Water Management in Central Asia. Conflict Constellations and Ways to Sustainable Resource Use. Kuzmits B. (Ed.)

ZEF Bonn (2006). Scope and Constraints for Tree Planting in the Irrigated Landscapes of the Aral Sea Basin: Case Study in Khorezm Region, Uzbekistan.

Additional selected sources in Russian:

АБР (2007). Проект RETA 6163. Совершенствование управления совместно используемыми водными ресурсами в Центральной Азии. Отчёт «Выработка и согласование детальных методических рекомендаций по учету общебассейновых затрат, сбору данных и оценке фактических ущербов от режимов использования водных ресурсов рек Амударья и Сырдарья».
http://www.cawater-info.net/reta/documents/pdf/report_subgroup_3_ru.pdf

АБР (2007). Проект RETA 6163. Совершенствование управления совместно используемыми водными ресурсами в Центральной Азии. Отчёт «Оценка русловых потерь р. Амударьи в её среднем и нижнем течениях».
http://www.cawater-info.net/reta/documents/pdf/report_subgroup_2_ru.pdf

АБР (2007). Проект RETA 6163. Совершенствование управления совместно используемыми водными ресурсами в Центральной Азии. Отчёт «Реестр объектов, сооружений, гидропостов, которые с учётом мировой практики и аналагов, по независимой оценке соответствует или отвечает водам международной принадлежности по бассейну Амударья».
http://www.cawater-info.net/reta/documents/pdf/annex_1_report_subgroup_5_ru.pdf
http://www.cawater-info.net/reta/documents/pdf/annex_2_report_subgroup_5_ru.pdf

АБР (2008). Проект RETA 6163. Совершенствование управления совместно используемыми водными ресурсами в Центральной Азии. Отчёт об основных результатах.
http://www.cawater-info.net/reta/documents/pdf/report_2007_ru.pdf

АЛИБЕКОВ Л., АЛИБЕКОВА С. (2007). Социально-экономические последствия процесса опустынивания в Центральной Азии. Вестник Российской Академии Наук, 2007, том 77, № 5, с. 420-425.

БАЛЛЫЕВ К., ЭСЕНОВ П. (2005). Управление водными ресурсами Туркменистана.

ГАЕВАЯ Т., ПИСАРЕВА В. (1993). Экологическая ситуация в Узбекистане.
http://www.igpi.ru/bibl/igpi_publ/uzb_eco.html

ГЛОВАЦКИЙ О., ПАК О. (2006). Проблемы управления системами машинного водоподъема в Республике Узбекистан в бассейне Аральского моря. Экстремальные гидрологические события в Арало-Каспийском регионе. Труды международной научной конференции Москва, 19-20 октября 2006 г.

ДУХОВНЫЙ В., СОРОКИН А. (2007). Оценка влияния Рогунского водохранилища на водный режим реки Амударьи. НИЦ МКВК: Ташкент.

ЕВРАЗИЙСКИЙ БАНК РАЗВИТИЯ (2008). Водно-энергетические ресурсы Центральной Азии: проблемы использования и освоения.

ЕВРАЗИЙСКИЙ БАНК РАЗВИТИЯ и МФСА (2009). Влияние изменения климата на водные ресурсы в Центральной Азии.

ЖИЛЬЦОВ С., ЗОНН И. (2008). Битва за воду. Независимая газета 2008.
http://www.ng.ru/energy/2008-04-08/19_water.html

Материалы международной конференции «Проблемы Арала, их влияние на генофонд населения, растительный и животный мир и меры международного сотрудничества по смягчению их последствий».11-12 марта 2008 г., Ташкент.

МИНИСТЕРСТВО ОХРАНЫ ПРИРОДЫ ТУРКМЕНИСТАНА (2008). Состояние окружающей среды Туркменистана.

МИНИСТЕРСТВО ОХРАНЫ ПРИРОДЫ ТУРКМЕНИСТАНА. НАЦИОНАЛЬНЫЙ ИНСТИТУТ ПУСТЫНЬ, РАСТИТЕЛЬНОГО И ЖИВОТНОГО МИРА (2006). Проблемы освоения пустынь. Международный научно-практический журнал. 3.

МИНИСТЕРСТВО ОХРАНЫ ПРИРОДЫ ТУРКМЕНИСТАНА. НАЦИОНАЛЬНЫЙ ИНСТИТУТ ПУСТЫНЬ, РАСТИТЕЛЬНОГО И ЖИВОТНОГО МИРА (2008). Проблемы освоения пустынь. Международный научно-практический журнал. 1.

МОРОЗОВ А. ПРОБЛЕМЫ ИСПОЛЬЗОВАНИЯ ВОДНЫХ, ЗЕМЕЛЬНЫХ И ГИДРОЭНЕРГЕТИЧЕСКИХ РЕСУРСОВ ЦЕНТРАЛЬНО-АЗИАТСКОГО РЕГИОНА.
http://water-salt.nm.ru/s_tend_isp_mv.htm

НИЦ МКВК (2007). Афганистан: Возвращение к мирной жизни. Тенденции развития и направления регионального сотрудничества. Взгляд из Центральной Азии. Ред. Д. Зиганшина, И. Беглов. Ташкент.

НИЦ МКВК (2008). Адаптация к изменению климата: проблемы региона в свете мирового опыта. Ред. И. Беглов. Ташкент.

Посольство Республики Таджикистан в Кыргызской Республике (2009). Пресс-релиз о сложившейся в Республике Таджикистан сложной ситуации в области гидроэнергетики.

РАХИМОВ А. Предварительный отчет оценки воздействия на окружающую среду Яванской ГЭС в Республике Таджикистан.

РЕЗНИЧЕНКО Г. (1992). Аральская Катастрофа. Дневник экспедиции. Москва.

САПАРОВ У. (2006). Трансграничное сотрудничество в управлении водными ресурсами и перспективы ИУВР в Туркменистане.
http://www.gwpcacena.net/ru/news/12_june_2006_helsinki/saparov.pdf

САПАРОВ У. (2008). Технико-экономическое обоснование ИУВР в низовьях Амударьи. Семинар «Социально-экономическая стабильность и продуктивность воды: продовольственная и водная безопасность в Центральной Азии», Ташкент, 18-20 марта 2008 г.
http://www.icwc-aral.uz/workshop_march08/pdf/saparov_ru.pdf

СОКОЛОВ А. (1952). Гидрография СССР. Л.: Гидрометеоиздат.

СОРОКИН А. (2008). Сценарии будущего развития бассейна Аральского моря. НИЦ МКВК: Ташкент.

ТРОФИМОВА Г. (2008). Влияние речного стока Амударьи на количество кормовых видов растений в ее дельте. География и природные ресурсы, в 2008.
http://www.izdatgeo.ru/

УЗГЛАВГИДРОМЕТ (2007). Динамика изменения ИЗА по городам Республики Узбекистан за 1988-2006 гг.

ХАМРАЕВ Ш. (2006). Задачи интегрированного управления водными ресурсами бассейна Амударьи с позиций стратегических интересов Узбекистана. Труды международной научной конференции “Экстремальные гидрологические события в Арало-Каспийском регионе”, Москва 19-20 октября 2006 г.
http://caspi.ru/HTML/Conf/Trud-r-6/Hamraev.pdf

ХУДАЙБЕРГАНОВ Ю. (2005). Ключевые проблемы бассейна реки Амударьи. Круглый стол «Совершенствование механизма управления трансграничными водными ресурсами в Центральной Азии», Алматы 2005. Проект АБР RETA 6163.
http://www.cawater-info.net/reta/documents/pdf/khudayberganov280405.pdf

ХУДАЙБЕРГАНОВ Ю., ЛЫСЕНКО О. (2007). Межгосударственное распределение воды в бассейне реки Амударьи.
http://www.icwc-aral.uz/15years/pdf

ХУДАЙБЕРГАНОВ Ю., ЛЫСЕНКО О., СОРОКИН А. (2006). Анализ фактического состояния управления водными ресурсами в бассейне реки Амударья на региональном уровне. Труды международной научной конференции “Экстремальные гидрологические события в Арало-Каспийском регионе”, Москва 19-20 октября 2006 г.
http://caspi.ru/HTML/Conf/Trud-r-6/Hudayberganov.pdf

ЦИГЛЕР Д. (2008). Трансграничное управление водными ресурсами в Центральной Азии.
http://www.unece.org/env/water/meetings/Almaty%20conference/GTZ%20Water%20Almaty%20171108_RU.pdf

ЧУБ В., ОСОСКОВА Т. (2008). Глобальное изменение климата и оценка его последствий на экологическую ситуацию в регионе. Ташкент.

ШАМСИЕВ Ф., ЧЕМБАРИСОВ Э. (2008). Гидроэкологическая оценка бассейна рр.Сырдарья и Амударья комплексным методом. Международная научно-практическая конференция «Проблемы изменения климата, управления водными ресурсами, руководства и развития потенциала в Центральной Азии», Бишкек, 28-29 мая 2008 г.

ШИРОКОВА Ю., МОРОЗОВ А. Причины засоления и современное состояние орошаемых земель Узбекистана.
http://water-salt.nm.ru/cs_cs_uz_s.htm

ШУЛЬЦ В. Л. (1965). Реки Средней Азии, 2 изд., ч.1-2, Л.: Гидрометеоиздат, 690 с.

News articles:

Asia-Plus (2007). Таджикский Алюминиевый Завод: Пресс-Релиз. http://www.asiaplus.tj/articles/31/1004.html

Asia-Plus (2008). "Талко" достояние нации. http://www.asiaplus.tj/articles/96/2228.html

Reuters (2008). Frozen Tajikistan appeals for aid in winter crisis. http://www.alertnet.org/thenews/newsdesk/L0674491.htm

Voice of Freedom (2008). В Таджикистане люди бегут от ожидаемого следующей зимой нового энергокризиса. http://www.vof.kg/tj/publications/?publications=318

On-line databases:

Amu Darya Basin Network: http://www.amudaryabasin.net

Central Asia Regional Water Information Base: http://www.cawater-info.net/index_e.htm

U.S. National Weather Service web-page on Afghanistan: http://www.cpc.noaa.gov/products/fews/AFGHANISTAN

Endnotes

[1] In addition to the Amu Darya delta, Klötzli identified the Zarafshan valley, and the Ferghana valley as regions where there are regularly incidents over water use. In the case of the Zarafshan and Ferghana valley, despite the very local character of the conflicts, the presence on post-independence international borders and / or the implication of communities of another ethnic group, have “loaded” the conflict with ethnic and / or trans-border dimension.

[2] The term ‘hotspot’ in the context of ENVSEC refers to areas where environmental problems may cause considerable security risks and challenges.

[3] Environment and Security Initiative (ENVSEC). Summary of the Regional Environment and Security Meeting.17-18 September 2007, Ashgabat / Резюме региональной встречи по окружающей среде и безопасности г. Ашхабад, 17-18 сентября 2007 г.

[4] Environment and Security Initiative (ENVSEC). Summary of the Regional Meeting on Environment and Security in the upper Amu Darya River basin between Afghanistan and Tajikistan. 20-21 November 2007, Kabul / Резюме региональной встречи по окружающей среде и безопасности в верхней части бассейна р. Амударьи между Афганистаном и Таджикистаном, г. Кабул, 20-21 ноября 2007 г.

[5] A livelihood comprises the capabilities, assets (resources, claims, and access) and activities required for a means of living (Chambers&Conway, 1992).

[6] President I. Karimov stated at the 2008 NATO Summit in Bucharest that “achievement of peace and stability in Afghanistan is a decisive factor of security which opens up opportunities to resolve the vitally important problems of sustainable social and economic development of the entire Central Asian region”. Full text is available at: http://mfa.uz/rus/pressa_i_media_servis/news/080408r_1.mgr

[7] Another important milestone in governmental acknowledgement of the Aral Sea crisis was the Decree by USSR’s Cabinet of Ministers #1110 from 19.08.1988 “On radical improvement of environmental and sanitary conditions in the Aral Sea region”.

[8] Construction of Kokaral dam in the northern part of the Aral Sea fed by Syr Darya River in Kazakhstan.

[9] Pest attacks in Southern Tajikistan in 2003-05 halved the cotton harvest in the most hit districts.

[10] If measured from the sources of its headstream, the Panj-Wahan River in the Pamir and 1415 km if measured from the confluence of Vakhsh and Panj.

[11] In the historical times (the most recent period is 13th-17th centuries), the Amu Darya emptied into both the Aral and the Caspian Seas, the latter via Uzboy. In the Soviet times, a plan to divert the flow of Siberian rivers to Central Asia, including the Amu Darya basin, was developed in the 1970s, but then abandoned in 1986 due to financial and environmental considerations.

[12] Two rivers contribute on average 54 km^3 per year, which is more than 80% of the main Amu Darya flow.

[13] In the Pamir-Alai, the Hindu Kush and the Zarafshan mountains, the main source areas of the Amu Darya River, annual atmospheric precipitation exceeds 1'000-2'000 mm, except for the high-altitude plateau in the Eastern Pamir, where precipitation is very low (less 100 mm).

[14] In the lower reaches of the Amu Darya, mean annual precipitation is less than 100 mm, while evaporation exceeds 1 500 mm.

[15] Sokolov (1952), Water Resources of the USSR (1971), University of New Hempshire database:
http://www.grdc.sr.unh.edu/html/Stn/B43.html

[16] A guaranteed flow formation in 95% and 50% of the time accordingly.

[17] Without tributaries which do not reach the main Amu Darya: Zarafshan, Kashkadarya, rivers and springs of Northern Afghanistan, Iran, Southern Turkmenistan, small rivers of Uzbekistan.

[18] The scheme of the complex Amu Darya River basin use designed in the USSR in 1987 envisaged 54 km^3 and 63 km^3 of water formation per year (a guaranteed flow rate 90% and 50% of the time accordingly) in the upper part of the basin at Kerki. Hydrological observations at Kerki show the maximum river flow at 7500 m^3/sec and minimum at 350 m^3/sec. Uzbekhydromet reports average flow of the Amu Darya at 62 km^3/year (1970 m^3/sec) for the period 1959-2005 as referred in the UNECE's (2007). First Assessment of Transboundary Rivers, Lakes and Groundwaters. "BVO Amu Darya" reports 61 km^3/year.

[19] Almost 80% of Amu Darya flow is formed in the period from April to September. The flow abates from October to March.

[20] The total Afghan part area belonging hydrographically to the Amu Darya cover 167 thousand km^2, of which 90 thousand km^2 is actively drained towards the Amu Darya River, and the remaining part forms the blind rivers of Northern Afghanistan.

[21] The first in Central Asia major dam – "Pervomaiskaya" – serving mainly irrigation needs was constructed on the Zarafshan River (in Uzbekistan) in 1930.

[22] The actual area under irrigation depends on the climatic conditions of the current year as authorities decide how much land can be put under irrigation.

[23] Uzbekistan 2.3 million ha; Turkmenistan 1.7 million ha; Afghanistan 0.4 million ha in the Kunduz, Kokcha, and Panj River sub-basins; Tajikistan 0.5 million ha (Horsman, 2008; FAO, 2007, BVO, 2008).

[24] Afghanistan uses water from the main Amu Darya only for irrigating a narrow strip along the river. Irrigation has mostly developed in Amu Darya's sub-basins of Balkh, Kunduz and Kokcha.

[25] In the 1960s, at least 50 000 people in Tajikistan were moved from the mountains to the lowlands to work in agriculture, especially for cotton cultivation. Many villages were completely abandoned for decades and only in the 1990s were people able to return to their homelands.

[26] Excluding remittances from the labour migrants.

[27] This figure does not reflect over 1 million Tajik labour migrants working abroad, mainly in Russia and Kazakhstan.

[28] In 2008, the amount of grain imported by Tajikistan equalled US$ 200 million.

[29] Gold production in Kyrgyzstan (17 t/year) generates almost half of country's export earnings.

[30] The largest oil-gas discoveries in the middle-lower part of the Amu-Darya basin include: the Dauletabad gas field with reserves 60 TCF, the Kokdumalak oil-gas field with reserves of 2 000 million barrels of oil equivalent and the supergiant South Yolotan-Osman gas field. The estimates for South Yolotan-Osman gas field vary from 140 TCF to nearly 500 TCF. The best estimate is 260 TCF, which makes South Yolotan-Osman one of the five largest gas fields in the world, five times larger than the Dauletabad field, previously Turkemistan's and Amu Darya region's largest. Operation of this gas field would double Turkmenistan's current gas production. Source: USGS 2004.

[31] As an example, Kokdumalak is the largest oilfield exploited by Uzbekistan though it is mostly located in Turkmenistan. In south-western Uzbekistan and especially in the Uzbek part of the Ustyurt Basin are located the country's richest gas and condensate fields.

[32] Reaching US$136 a barrel of crude oil in the middle of 2008, but decreased since.

[33] Uzbekistan was a member of the United Energy System of Central Asia and until recently played a role in transit of electricity to/from Tajikistan.

[34] Aluminium prices reached US$3 200 a tonne in July 2008, but have fallen to less than US$1 500 a tonne by the end of 2008 (Metal Bulletin, 2008). The smelter, known as TadAZ, accounts for around half of Tajikistan's export revenues.

[35] In the "energy generation mode", to cover peak demand during the winter months when river flow is at a minimum, it is necessary to store water during the snow melt period and release it in the winter. On the other hand, water users downstream need maximum water supply in summer and spring during vegetation season.

[36] According to the Afghan Energy Information Centre, around 15 per cent of the population in urban areas has access to electricity, and 6% in rural.

[37] ICWC Ashgabat meeting held in 2010 did not reach the consensus.

[38] In the political economy of conflict selling narcotics can offer a lucrative way of financing the hostilities. Drug traders take advantage of the fact that a large proportion of the Afghan population subsists on small-scale agriculture, with limited alternative livelihoods. The link between lack of security and opium cultivation in selected Afghan provinces (mainly Hilmand, Kandahar, Uruzgan, Day Kundi, Zabul, Farah and Badghis) is clearly evident, where cultivation is located in districts classified as having high or extreme security risk.

[39] UN, Climate Change and its Possible Security Implications, Report of the Secretary-General, 2009. A/64/350. Sixty-fourth session, Item 114 of the provisional agenda, Follow-up to the outcome of the Millennium Summit.

[40] Glacier area reduced by 10-35 per cent in the Amu Darya basin depending on the geographic region. The loss of glaciers in the basin does not necessarily reduce the total river runoff since winter-spring precipitation pattern and its changes are most significant factors in runoff formation and changes. When glaciers melt to significant extent, river hydrograph could affected (less water available in summer).

[41] In 2009-10 snow accumulation and water formation was normal and higher than normal in the Amu Darya basin.

[42] Future rates of glacier retreat are estimated at 0.2-1 per cent a year, similarly to the recent pace of change (Uzbekistan's SNC, 2008).

[43] Annual water abstraction from the Zarafshan River is 5 km^3, which corresponds to complete use of natural river flow; actual water usage exceeds 5.5 km^3 due to the re-use of collector-drainage waters and use of underground waters.

[44] GTZ-assisted feasibility study and environmental assessment have not yet convinced Uzbek authorities to support the proposed hydropower projects.

[45] UNDP project on Integrated Water Management and Water Efficiency Plan for Zarafshan River Basin in Uzbekistan: http://www.undp.uz/en/projects/project.php?id=159

[46] The Dusti dam (translated as "Friendship") on Tijen River.

[47] The 1987 Soviet decision envisaged the following proportions for the Amu Darya basin surface water use by the republics: Kyrgyz SSR – 0.6%, Tajik SSR – 15.4%, Uzbek SSR – 48.1%, Turkmen SSR – 35.8%.

[48] This is mostly relevant for the Syr Darya basin.

[49] The 1987 Soviet decision stated that 100 m^3/sec is considered as the minimum for maintaining the Amu Darya delta and its environment.

[50] During an ENVSEC field mission in May 2008, the Amu Darya BWO staff confirmed that "sanitary releases are done only if there is water". This underlines the fact that the idea of the Aral Sea and Amu delta being a "stakeholder" in the regional water management has remained a declaration of intents.

[51] Dynamics of general development indicators in the Aral Sea basin states: http://www.cawater-info.net/analysis/water/asb_dynamics_en.pdf. Variability of water use per hectare highly depends on the hydrometeorological conditions in the given year (wet, dry) and geographic location.

[52] For example in the Khorezm area. Source: State Committee of Nature Protection of the Republic of Uzbekistan, Atlas environment indicators of Uzbekistan, 2008.

[53] Another issue having a negative impact on water infrastructure is the question of increasing siltation. Silt in reservoirs (such as Tuyamuyun or Nurek) and canals, if not regularly removed (which needs resources in machinery and funding), is decreasing the lifetime of the affected infrastructure.

[54] According to the authors of the study "some turn to animal husbandry, some migrate within the country or to Russia, and others become day labourers or work in the local bazaar. Few seem to migrate, even in the face of great hardship in the area. Villagers report that this is because of the scarcity of alternative opportunities elsewhere, because of strong cultural and family ties to the area, and because most villagers cannot afford the relocation costs" (World Bank, 2003).

[55] Certain amendments and revisions to the Law of the Republic of Uzbekistan "On Water and water use" were introduced in 2009 to improve water management in the territory of the WUAs, to ensure the rational and economic use of water and promote water conservation.

[56] CDWs in Uzbekistan are increasingly used for irrigation after mixing it with water from natural sources (based on specific recommendations). In February 2010, the Governments of Uzbekistan and Korea signed grant project to develop techniques for salt reduction of collector-drainage water for reuse.

[57] Flood up to 1000 m^3/sec; Sargazon-Bolo village with 53 houses destroyed, Tajikistan.

[58] Reportedly 274 people killed by landslide in the Hissar valley, Tajikistan.

[59] For example, the Uzbek and Turkmen authorities have financed the establishment of advanced irrigation systems in selected small farms. Experts point out a recent good practice supported by donors (Switzerland) to implement the SCADA system (supervisory control and data acquisition) in the southern Ferghana Valley districts at the main water intakes, water balance gauging points, control and dispatch systems and monitoring of water distribution.

[60] Clearly this would require installing and calibrating reliable water measuring devices.

[61] Re-arranging the water conduit and furrow system on field level to reduce distances; laser levelling of uneven fields would be relatively simple means that would help reducing water consumption by 10-20% and more.

[62] Which was seen as a temporary solution for the countries at that time.

[63] For a list of the agreements and declarations see Sievers 2002, notes 125 to 131.

[64] While some stakeholders question the existing capacity of IFAS to efficiently advance regional cooperation and concretely build confidence between the countries, it remains the key forum for regional dialogue and umbrella for joint activities.

[65] According to the 2005 UNDP Central Asia Human Development Report, the Interstate Commission for Water Coordination was established in 1992 under IFAS to determine water management policy for the region, allocate available water resources for different purposes, determine future water supply programmes and coordinate construction of major works. The commission comprises officials (generally ministers or deputy ministers) from the Ministries of Water and Water Resources Agencies of all the member countries. Under it, the two basin water management organizations take responsibility for allocating water and monitoring water flows in the Amu Darya and Syr Darya Rivers. The Scientific Information Center (SIC) provides support at the interstate level.

[66] BWOs were established in the 1980s by the Ministry of Water Economy of the USSR in order to deal with water shortages/low water years and with disputes over water allocations.

[67] Flow regulation in the large water reservoirs with hydropower plants in the upper Amu Darya basin (such as Nurek or in the future Rogun) is also dependent on national decisions, where energy ministries play significant role.

[68] Uzbekistan has ratified in 2007 the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (the Helsinki Convention). The Convention is intended to strengthen national and cross-border measures for the protection and ecologically sound management of transboundary surface waters and groundwaters. Uzbekistan is the only basin state that has ratified this convention.

[69] For example, the Ministry of Energy and Water in Afghanistan and the Ministry of Agriculture and Water in Uzbekistan.

[70] SCO members: China, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Uzbekistan.

[71] EurAsEC members: the Republic of Belarus, Kazakhstan, the Kyrgyz Republic, the Russian Federation, Tajikistan, Uzbekistan (suspended 2008).

[72] CAREC participants: Afghanistan, Azerbaijan, China, Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Uzbekistan.

[73] The ADB has supported the study on water and energy nexus in Central Asia and facilitated the regional project on Improvement of Shared Water Resources Management in Central Asia in 2005-2007.

[74] The World Bank is supporting elaboration of a Regional Energy Development Framework for Central Asia which would look at existing and potential energy generation resources and propose a sequence of actions that will ensure adequate attention to and proper balance between the urgent domestic energy needs of the upstream countries during winter, and environmental and hydrological needs of the downstream countries during summer.

[75] The SPECA working group on energy and water resources in Central Asia produced in 2004 a Regional Cooperation Strategy to promote the rational and efficient use of water and energy resources in Central Asia. Due to unresolved political issues and the lack of finances, only restricted components of this strategy are so far being implemented.

[76] The Abramov glacier monitoring station (located in Kyrgyzstan, on the border with Tajikistan) was destroyed in a guerilla attack 1999. The Fedchenko glacier station (in the Pamirs) stopped operating in 1995 for lack of funds.

[77] Hydrometeorological services in both countries have drafted cooperation agreements and submitted to Afghanistan for consideration.

[78] In the past 10-15 years, several international bodies have supported the hydro-meteorological services to rebuild the observation network particularly in the flow formation zone and to improve their communication systems and forecasting capabilities. To improve regional hydrometeorological data provision in the Aral Sea Basin, the Regional Centre of Hydrology (RCH) was established under the aegis of the IFAS in 2004, over 30 automatic weather and data transmission stations in the mountain and remote areas installed and pilot snow-melt models tested.

[79] Such as the Swiss, USAID and the WB support programmes for hydromets and IFAS ASBP-1, -2 projects.

[80] Kyrgyzstan 0.4 km^3, Tajikistan 9.5 km^3, Uzbekistan 29,6 km^3, Turkmenistan 22 km^3. The decision (1988) by the Soviet Cabinet of Ministers projected decrease in water consumption and increase of environmental flow into the Aral to 20 km^3 by 2005.

[81] The annual average water formation in Afghanistan section of the Amu Darya basin is estimated from 6 to 17 km^3 depending on the source of data.

[82] These projects envisage expansion of irrigated lands by additional 200 thousand ha, resulting in a total irrigated area in Afghanistan's active drainage part within the Amu Darya basin of 600 thousand ha with projected consumption of 6 km^3 of water.

[83] Since middle 1990s, the main Kyrgyz reservoir on Naryn (Syr Darya) – Toktogul – has been operated in an energy mode.

[84] Nevertheless, although a modification of the releases should have a minor impact Wegerich et al. (2007) warn that small changes in flow releases might have an impact on downstream agricultural users since one has to consider that fact that water distribution between the administrative units (provinces and districts) within the downstream states is not always equitable.

[85] Communal electricity consumption increased from 1.4 billion kWh in 1990 to 4.1 billion kWh in 2004.

[86] Tajikistan produced 450 thousand tonnes of aluminium in 1991; after independence the production declined to a low of 196 thousand tonnes in 1998, but then increased to more than 413 thousand tonnes in 2006. In 2009 Tajikistan produced 360 thousand tonnes of Al. Energy use per 1 tonne of aluminium production is 15 thousand kWh.

[87] The energy crisis in winter 2007-08 in Tajikistan caused an economic damage estimated by the Tajik National Bank at US$250 million.

[88] In Tajikistan, electricity supply during winter is only 4-8 hours a day in semi-urban and rural areas and even in urban areas it averages 10-14 hours a day. In winter 2008-09 all urban and rural areas experienced major energy shortages. The Sangtuda-1 hydropower plant started electricity generation in early 2010. This has lowered energy deficit from 4.5 billion kWh to 2 billion kWh.

[89] Provisional design envisages 300 m high rock-filled dam and water reservoir of 17km^3 total storage capacity.

[90] Design by the Soviet Central Asian Hydro Project Institute based in Tashkent.

[91] In 2004, RUSAL of Russia and the Government of Tajikistan reached an agreement to resume construction work, with the aim of completing the first phase (225 m) primarily for the energy supply for the existing and new aluminum smelters. Study conducted under this agreement considered the dam height of 285 m (phase two) as an optimal solution for the proposed business project. The agreement was cancelled by Tajikistan in 2006.

[92] Almost US$ 80 million was allocated in 2009.

[93] In January 2010 President Emomali Rahmon launched a share purchase program where he asked "every son of the nation and countrymen abroad to support Tajikistan through financial and moral help by acquiring share in the Rogun". Later in April 2010 it was decided to suspend media and local campaign on a voluntary-compulsory share purchase.

[94] By the end of 2010, construction works were still ongoing.

[95] Especially after Uzbekistan has left the Central Asian united energy system in December 2009.

[96] Tajikistan would gain control of the river's flow only in the case the Rogun dam would be constructed in its full height (Stage III, 330 m) (Wegerich, 2007).

[97] In February 2009 the Tajik parliament passed the legislation which does not allow privatization of the Nurek and Rogun dams and aluminium smelter. This may have important implications for international investors planning to co-fund into upgrade of the existing facilities or the construction of new ones.

[98] Reuters news:
http://in.reuters.com/article/worldNews/idINIndia-47471920100406

[99] While addressing national dam safety legal and institutional frameworks and regional cooperation mechanisms on dam safety, the project is building confidence and trust between the respective countries through permanent outputs (legislation, standards, identifies institutions responsible for dam safety) and experience sharing.

[100] During a visit to the site of the Rogun dam, the Tajik Prime Minister, who accompanies the international visitors, explained that the dam should be finished in stages over the next 8-10 years, and will take up to 18 years to fill (Linn, 2008a).

[101] Press-release of the Tajik Embassy in the Kyrgyz Republic, Bishkek, 5th February 2009.

[102] In 2003-5 with support from the World Bank, Kazakhstan constructed the Kokaral dam, 17 km in length, separating the Northern Aral Sea fed by the Syr Darya waters from the main, currently mostly dry, former sea. This helped to restore fisheries with annual catch about 2 000 tonnes.

[103] Area exceeds 4.5 million hectares.

[104] The Aral Sea basin projects implemented in the region in 1995-2005 totalled US$ 825 million, including US$ 441 million of international loans and investments, governmental funds of US$ 194 million, and technical assistance and grants US$ 190 million. About half of them aimed directly at Khorezm and Karakalpakstan regions of Uzbekistan.

[105] According to FAO "studies show that of the 700'000 women in Karakalpakstan, more 90 per cent are anaemic with haemoglobin levels in their blood well below the World Health Organization's standards and probably with the highest rates in the world (source http://www.fao.org/news/1997/970104-e.htm)

[106] Overall, the CDW constitute 30% of the water consumption in the Amu Darya basin.

[107] In recent years Turkmen discharges have slightly decreased after partial diversion to the future main collector to the Golden Century Lake.

[108] The Environment and Security field mission measurements in May 2008 showed salinities in the range of 4-5 g/l from collector-drainage waters.

[109] Although this kind of water would be suitable for fish farming it is far from being usable for household and drinking needs.

[110] Minerals discharged mainly constitute sulfates and chlorides.

[111] At Darganata station at the time of high water salinity decreases (0.4-1.4 g/l) and during the low water it increases (0.6-2.4 g/l).

[112] UNECE and EU are helping the Central Asian countries to improve cooperation and policies on water quality, including common principles and best practices for the measurement of water quality, joint assessments and information exchange.

[113] In many cases in all countries of the basin, national legislation (Water Code) prohibits economic activities within vicinity of waterways, however the main problem is that this legislation is not observed.

[114] The lake will be fed mainly by drainage waters from Turkmen cultivated lands. The projected water input is 10-14 km^3 per year. Local experts fear the Amu Darya waters may be tapped to improve the inflow into the lake, which could lead to water shortages in downstream areas.

[115] The Egyptian Environmental Affairs Agency (EEAA), UNDP and the GEF, have collaborated on the introduction and demonstration of an engineered wetland for treating agricultural drainage water that is mixed with sewage and industrial waters. The experience shows that engineered wetland technologies may be used to or expanding the reuse of drainage water in irrigation that will increase overall national water use efficiency.

[116] Located mostly in the Zarafshan River basin.

[117] Peaceful underground nuclear explosions were carried out to successfully extinguish fires that had started in gas exploration wells in Uzbekistan in 1966-68 and Turkmenistan in 1972.

[118] Potassium salts extraction for fertilizers production is rapidly increasing in Labap, Turkmenistan (especially Koytendag).

[119] Al smelter receives 85-95% of the Tajik electricity at $US 0.01/kWh; energy accounts for 20% of the production costs.

[120] HF (hydrogen fluoride) gas in excessive concentrations causes damages to ecosystems and human health.

[121] PFC (perfluorocarbons) are chemically inert, non-toxic but extremely potent greenhouse gases with high Global Warming Potential (6'500-9'200 CO_2-eq).

[122] In 2000-7 Uzbekhydromet had reported atmospheric HF concentrations in the range of 0.002-0.008 mg/m^3 in Sufien, Dainabad and Sariasia areas. Smelter emissions could be carried by the wind to neighbouring districts of Uzbekistan and cause environmental problems, such as air pollution, crop damage and health impacts.

[123] Agreement concluded in 1994 between the Governments of Tajikistan and Uzbekistan on improving the ecological situation around TADAZ.

[124] UNECE Transboundary Effects of Industrial Accidents Convention Secretariat has offered to Uzbekistan, Tajikistan and Kyrgyzstan participation in the assistance programme to improve national capacities and cross-border cooperation on industrial emergencies and industrial safety.

[125] The site was built in the 1970s on the area 12 ha and contains around 8 000 tonnes of hazardous chemicals: DDT, lindane, arsenates, solid and liquid copper compounds. Initially, the site was fenced and watched by technical personnel and guards to prevent unauthorized access. Pesticides were buried (in some cases in concrete trenches) and covered to prevent pollutants being spread by wind, rain or surface runoff. The fence was destroyed during the civil war and the dump became accessible. At present the pesticide dump is not marked, open for access to humans and animals, and subject to the impact of environmental factors. The ENVSEC mission observed signs of illegal excavation of pesticides, a factor which heightens the risks for the environment and public health. Urgent action is required to carry out detailed risk assessment, minimize the spread of pollution, and clean-up the site. The Tajik Government has requested international donors, including the World Bank to support environmental assessment and risk reduction measures.

[126] Tugai are unique floodplain forests in Central Asia dominated by poplar and willow trees and shrubs (tamarisk, oleaster, sea buckthorn, reedgrass). They are typical habitats of the endangered deer (Cervus elaphus bactrianus).

[127] Before 1970s, pastures, reeds and grazing lands in the Amu Darya delta region covered 900 thousand hectares.

[128] For the purpose of conservation and restoration of tugai ecosystems possessing unique and valuable biodiversity and having major socio-economic and ecological importance there a joint project of the Government of the Republic of Karakalpakstan and UNDP-GEF "Conservation of Tugai Forests and Strengthening Protected Areas System in the Amu Darya Delta of Karakalpakstan" has been recently implemented.

[129] E.g. activities facilitated through GTZ in the Pamirs, the GEF-WB biodiversity project in Dusht-i-Jum and Swiss-supported projects in Kyrgyz forests.

[130] In 2003-7, the joint UNEP-GEF WWF's ECONET Central Asia project has already made the initial progress in mapping national and cross-border protected areas, ecological corridors and buffer zones and establishing expert contacts. ECONET has identified that key biodiversity corridors and high value biodiversity hotspots need to be better protected and the existing protected area network should be modified.

[131] Each household uses 10-20 m^3 of teresken a year, equivalent to the load of 2-3 trucks.

[132] Recent land transfers from Tajikistan to China, including pastures around the Rangkul Lake, have added to the prevailing depression among farmers.

[133] Several international projects, including the cross-border Tajikistan-Kyrgyzstan Pamir-Alay UNEP-GEF sustainable land management and GTZ High Badakhshan projects, are trying to alleviate this gloomy situation.

[134] Fruits and nuts production has traditionally been an important part of Afghan exports. Formerly this sector contributed 40% of export earnings.

[135] Examples of GLOFs in the Amu Darya basin: Yaldamich (Tajikistan, 1969, 69 casualties), Dasht (Tajikistan, 2002, 24 casualties), Vanch river flash floods.

[136] Several major floods that have occurred in the recent past include: Dushanbe and Kulob floods in 1992 (1350 casualties, economic damage US$300 million), Gharm, Vose and Zarafshan valley floods in 1998, Varzob River floods in 2004, Panj River floods in 2005, southern Kyzylsuu River (Kulob city) in 2010.

[137] More than 150 were killed in avalanches in Afghanistan and Tajikistan in 2009-10.

[138] Takob mining tailing waste wash-out by torrential rains in spring 2004, Tajikistan.

[139] Central Asian ministers for emergencies met in Almaty in October 2010 to sign the Memorandum on establishment of the Central Asian centre for emergency response and risk reduction.

[140] While not prohibiting the construction of large hydro-electric projects, such conventions provide guidelines and rules that apply to the process of project development and regional consultation.

[141] For example, marginalized regions such as the hideaway Pamir valleys could turn into regional incubators of insecurity.

[142] Prioritization has been made on the basis of whether issues fall directly under the ENVSEC mandate, and are technically and financially viable within the scope of its resources.

[143] i) Scientific Information Centre of the Interstate Commission on Water Coordination (in Tashkent) and its national branches; ii) Scientific Information Centre of the Interstate Commission on Sustainable Development (in Ashgabat) and its national branches; iii) Regional Environmental Centre (in Almaty) and its national branches; iv) Regional hydrometeorology centre and institute (in Tashkent); v) Regional Mountain Centre (in Bishkek); vi) Aarhus centers; vii) Regional glaciology centre under UNESCO, category II (in Almaty); viii) Regional centre for emergency response and risk reduction.

Glossary

Afforestation

Establishment of forest plantations on land that is not classified as forest.

Climate change

Any change in climate over time, whether due to natural variability or as a result of human activity. The UN FCCC defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."

Deforestation

Conversion of forested land to non-forest areas.

Drainage basin (also called watershed, river basin or catchment)

Land area where precipitation runs off into streams, rivers, lakes and reservoirs. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge.

Ecological (environmental) security

A condition of ecological safety that ensures access to a sustainable flow of provisioning, regulating and cultural services needed by local communities to meet their basic capabilities.

Ecosystem

A dynamic complex of plant, animal and microorganism communities and their non-living environment, interacting as a functional unit.

Effluent

In issues of water quality, refers to liquid waste (treated or untreated) discharged to the environment from sources such as industrial process and sewage treatment plants.

Environmental assessment

An environmental assessment is the entire process of undertaking a critical and objective evaluation and analysis of information designed to support decision making. It applies the judgment of experts to existing knowledge to provide scientifically credible answers to policy relevant questions. It reduces complexity but adds value by summarizing, synthesizing and building scenarios, and identifies consensus by sorting out what is known and widely accepted from what is not known or not agreed.

Integrated water resources management (IWRM)

A process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

Land degradation

The loss of biological or economic productivity and complexity in croplands, pastures and woodlands. It is due mainly to climate variability and unsustainable human activity.

Monitoring (environmental)

Continuous or regular standardized measurement and observation of the environment (air, water, soil, land use, biota).

Pollutant

Any substance that causes harm to the environment when it mixes with soil, water or air.

Run-off

A portion of rainfall, melted snow or irrigation water that flows across the ground's surface and is eventually returned to streams. Run-off can pick up pollutants from air or land and carry them to receiving waters.

Salinization

The buildup of salts in soils.

Security

Relates to personal and environmental security. It includes access to natural and other resources, and freedom from violence, crime and war, as well as security from natural and human-caused disasters.

Index

Annex 1

Contributed to the collection of material and observations. The following regional consultations and visits:

- Regional meeting in Dushanbe (July 2006)
- ICSD meeting in Bishkek (June 2007)
- Regional meeting in Ashgabat (September 2007)
- Regional meeting in Kabul (November 2007)
- Regional meeting in Almaty (June 2010)

Field missions to Uzbekistan, Turkmenistan and Tajikistan (April 2008), including visits to:

- up, mid and downstream districts of the Amu Darya
- the Aral Sea region (Nukus-Muynak)
- sub-basins, including Zaravshan, Vakhsh, Panj and Kunduz
- major (and cross-border) canals, pumping stations, water reservoirs, cotton and grain production areas
- industrial and agricultural pollution sites with potential cross-border or regional risks
- important biodiversity reserves and ecosystems
- remote, environmentally stressed, economically underdeveloped parts of the basin
- disaster-prone regions and affected areas

A list of meeting participants and full documentation is available at www.envsec.org

Annex 2

List of abbreviations:

ASBP	Aral Sea Basin Programme
BWO	Basin Water Organizations
CDW	Collector Drainage Waters
ENVSEC	Environment and Security Initiative
ICSD	Interstate Commission for Sustainable Development
ICWC	Interstate Commission for Water Coordination of Central Asia
IFAS	International Fund for the Aral Sea
OSCE	Organization for Security and Co-operation in Europe
SCADA	Supervisory Control and Data Acquisition
TALCO	Tajik Aluminium Company
TCF	Trillion Cubic Feet
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UN FCCC	United Nations Framework Convention on Climate Change
UN SPECA	United Nations Special Programme for the Economies of Central Asia
WB	World Bank
WUAs	Water Users Associations

The United Nations Environment Programme (UNEP), as the world's leading intergovernmental environmental organisation, is the authoritative source of knowledge on the current state of, and trends shaping the global environment. The mission of UNEP is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.

The United Nations Development Programme (UNDP) is the UN's Global Development Network, advocating for change and connecting countries to knowledge, experience and resources to help people build a better life. It operates in 166 countries, working with them on responses to global and national development challenges. As they develop local capacity, the countries draw on the UNDP people and its wide range of partners. The UNDP network links and co-ordinates global and national efforts to achieve the Millennium Development Goals.

The United Nations Economic Commission for Europe (UNECE) strives to foster sustainable economic growth among its 56 member countries. To that end UNECE provides a forum for communication among States; brokers international legal instruments addressing trade, transport and the environment; and supplies statistics and analysis. The broad aim of UNECE's environment activities is to safeguard the environment and human health, and to promote sustainable development in its member countries in line with Agenda 21.

With 56 participating States, the Organization for Security and Co-operation in Europe (OSCE) is a pre-eminent instrument for early warning, conflict prevention, conflict management and post-conflict rehabilitation in continental Europe, the Caucasus, Central Asia and North America. Since its beginnings in 1973 the OSCE has taken a comprehensive view of security, including through the protection and promotion of human rights and fundamental freedoms, economic and environmental cooperation, and political dialogue.

The Regional Environmental Centre for Central and Eastern Europe (REC) is a non-partisan, non-advocacy, not-for-profit inter-national organisation with a mission to assist in solving environmental problems in Central and Eastern Europe. The centre fulfils this mission by promoting cooperation among non-governmental organisations, governments, businesses and other environmental stake-holders, and by supporting the free exchange of information and public participation in environmental decision-making.

The North Atlantic Treaty Organisation (NATO) embodies the transatlantic link that binds Europe and North America in a unique defence and security alliance. In response to recent changes in the overall security environment, NATO took on new fundamental tasks. These include addressing both instability caused by regional and ethnic conflicts within Europe and threats emanating from beyond the Euro-Atlantic area. NATO's "Science for Peace and Security" programme brings scientists together to work jointly on new issues and to contribute to security, stability and solidarity among nations.

ENVSEC Environment & Security

UNEP

UNDP

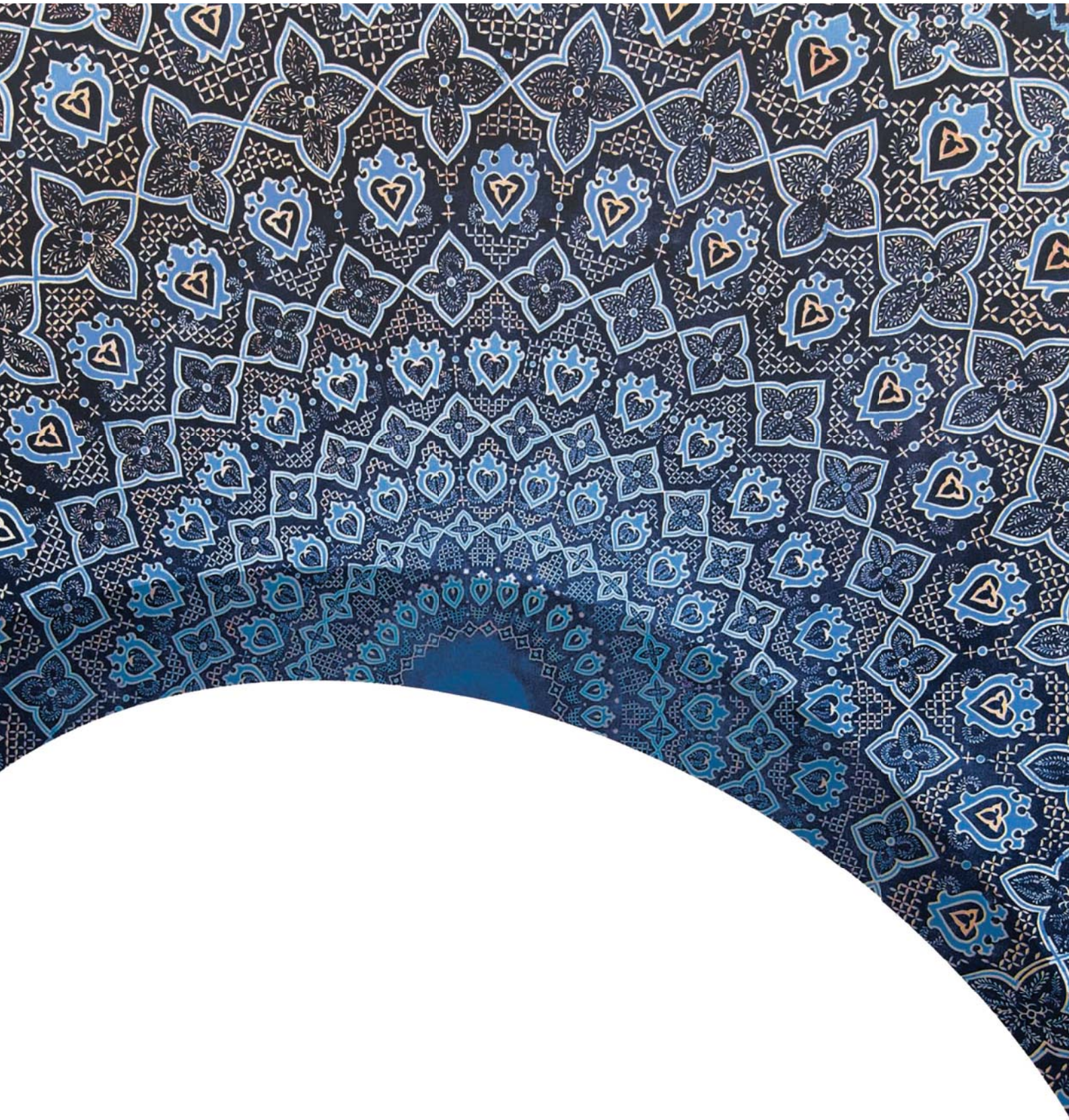
UNECE

OSCE

REC

NATO OTAN

www.envsec.org



www.unep.org

United Nations Environment Programme
P.O. Box 30552 Nairobi, 00100 Kenya
Tel: (254 20) 7621234
Fax: (254 20) 7623927
E-mail: uneppub@unep.org
web: www.unep.org

UNEP