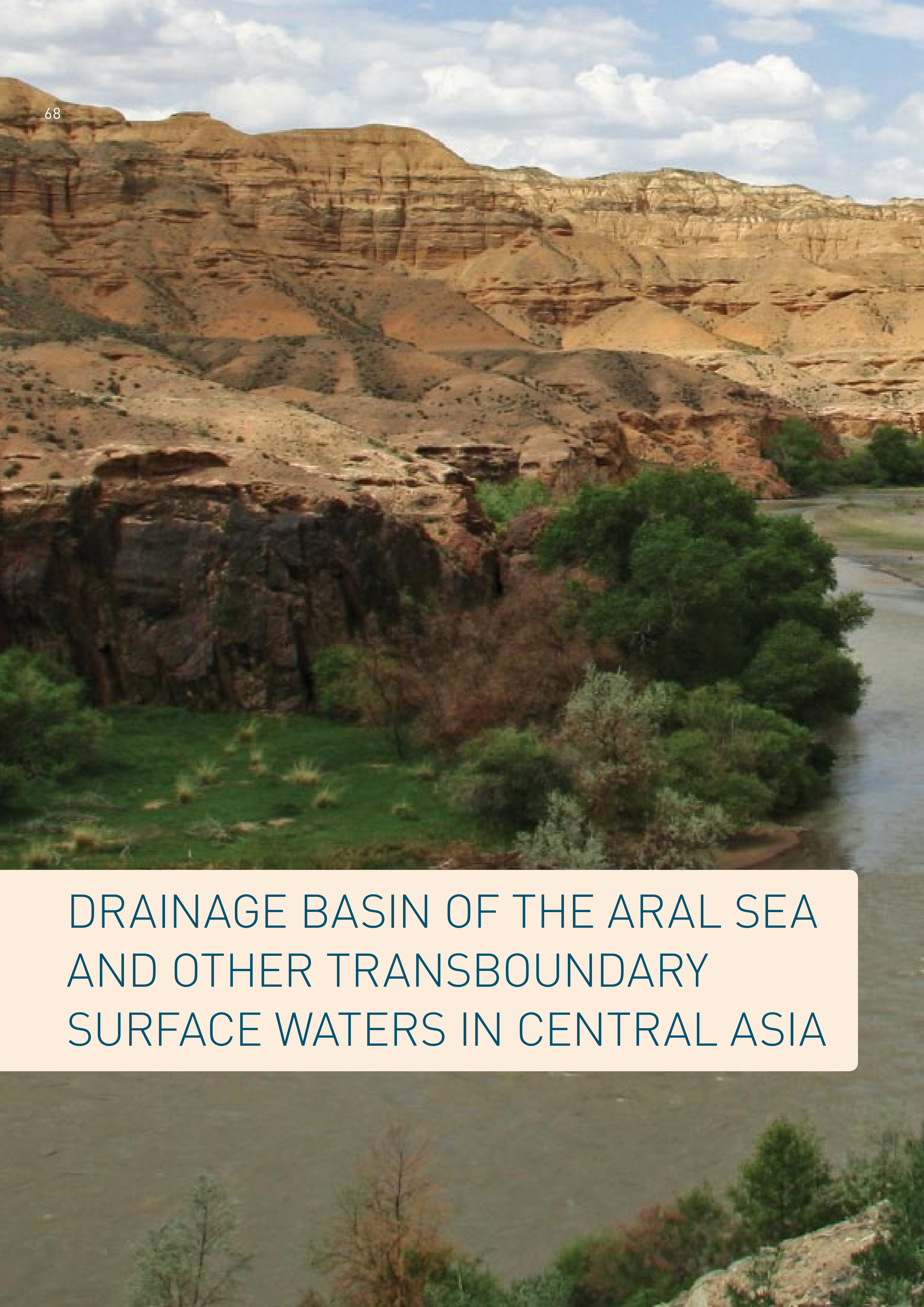


DRAINAGE BASIN OF THE ARAL SEA AND OTHER TRANSBOUNDARY SURFACE WATERS IN CENTRAL ASIA

71 AMU DARYA RIVER BASIN
75 ZERAVSHAN RIVER BASIN
76 SYR DARYA RIVER BASIN
83 ARAL SEA
84 CHU-TALAS RIVER BASINS
89 ILI RIVER BASIN
91 LAKE BALQASH
91 MURGAB RIVER BASIN
91 TEJEN RIVER BASIN

This chapter deals with major transboundary rivers in Central Asia which have a desert sink, or discharge either into one of the rivers (or their tributaries) or the Aral Sea or an another enclosed lake. It also includes lakes located within the basin of the Aral Sea. Practically all of the renewable water resources in this area are used predominantly for irrigation, and the national economies are developing under conditions of increasing freshwater shortages.

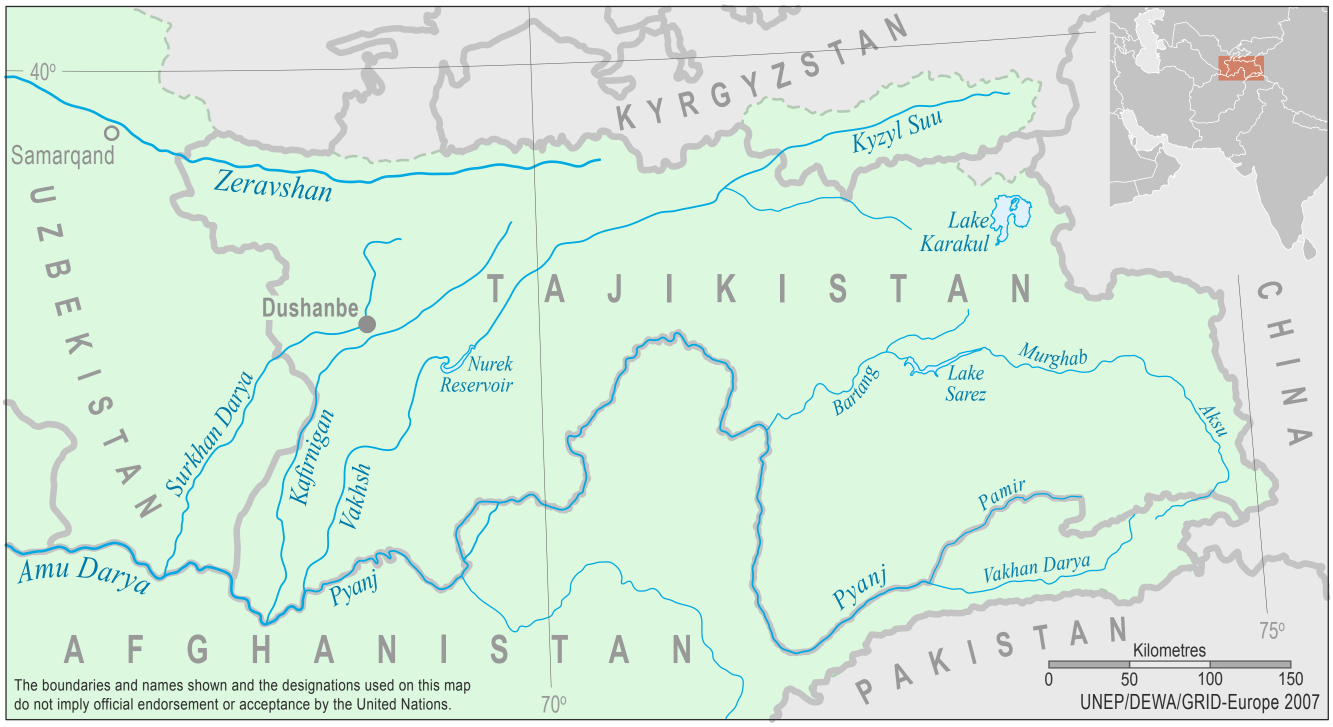
TRANSBOUNDARY WATERS IN THE BASIN OF THE ARAL SEA AND OTHER TRANSBOUNDARY SURFACE WATERS IN CENTRAL ASIA[1]

Basin/sub-basin(s)	Total area (km²)	Recipient	Riparian countries	Lakes in the basin
Amu Darya	…[2]	Aral Sea	AF, KG, TJ, UZ, TM	Aral Sea
- Surkhan Darya	13,500	Amu Darya	TJ, UZ	
- Kafirnigan	11,590	Amu Darya	TJ, UZ	
- Pyanj	113,500	Amu Darya	AF, TJ	
-- Bartang	…	Pyanj	AF, TJ	
-- Pamir	…	Pyanj	AF, TJ	
- Vakhsh	39,100	Amu Darya	KG, TJ	
Zeravshan	…[2]	Desert sink	TJ, UZ	
Syr Darya	…[2]	Aral Sea	KZ, KG, TJ, UZ	
- Naryn	…	Syr Darya	KG, UZ	
- Kara Darya	28,630	Syr Darya	KG, UZ	
- Chirchik	14,240	Syr Darya	KZ, KG, UZ	
-Chatkal	7,110	Chirchik	KG, UZ	
Chu	62,500	Desert sink	KZ, KG	
Talas	52,700	Desert sink	KZ, KG	
Assa	…	*Desert sink*	*KZ, KG*	
Ili	413,000	Lake Balqash	CN, KZ	Lake Balqash
Murgab	46,880	Desert sink	AF, TM	
- *Abikajsar*	…	*Murgab*	*AF, TM*	
Tejen	70,260	Desert sink	AF, IR, TM	

[1] The assessment of water bodies in italics was not included in the present publication.
[2] The basin area is difficult to determine, see the assessment below.

AMU DARYA RIVER BASIN[1]

Afghanistan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan share the basin of the Amu Darya River. While some literature sources quote a basin area of up to 534,700 km², the water divide can only be correctly established in the mountainous part of the basin; therefore many hydrologists refrain from giving figures for the total basin area.



Hydrology

The confluence of the two transboundary rivers, the Pyanj and the Vakhsh (see the separate assessment below), is taken as the beginning of the Amu Darya.

Of these two, only the Vakhsh is regulated (Nurek reservoir, 10.5 billion m³); therefore, floods often occur between the rivers' confluence and the Tyuyamuyunsk reservoir on the Amu Darya (7,270 million m³). Downstream of this reservoir, the Amu Darya is fully regulated.

Discharge characteristics of the Amu Darya River upstream of the Karakum Canal		
Q_{av}	1,970 m³/s	Average for: 1959–2005
Mean monthly values:		
October – 1,740 m³/s	November – 957 m³/s	December – 898 m³/s
January – 816 m³/s	February – 820 m³/s	March – 979 m³/s
April – 1,670 m³/s	May – 2,670 m³/s	June – 3,800 m³/s
July – 4,500 m³/s	August – 3,470 m³/s	September – 1,950m³/s

Source: Hydrometeorological Service of Uzbekistan.

[1] Based on information provided by the State Agency for Environment Protection and Forestry of Kyrgyzstan, the Ministry of Agriculture and Nature Protection of Tajikistan, the Ministry of Nature Protection of Turkmenistan and the State Committee for Nature Protection of Uzbekistan.

Like other rivers in Central Asia, the Amu Darya is subject to strong hydraulic processes (e.g. deformation of the river bed, meandering, bank erosion).

In addition to the Pyanj and the Vakhsh, a number of other transboundary waters are located in the Amu Darya basin, including the Pamir, Kafirnigan, Surkhan Darya and Zeravshan rivers (assessed separately below).

Pressure factors, transboundary impact and trends

The pressures, transboundary impact and trends for the transboundary rivers in the Amu Darya River basin are described in the following sections. In general, the joint sustainable use and protection of water resources of these transboundary rivers is a particular challenge for this region.

SURKHAN DARYA RIVER[2]

The Surkhan Darya is a transboundary tributary to the Amu Darya and has its source in Tajikistan. The catchment area is 13,500 km^2; the major part of this area is located in Uzbekistan.

Hydrology

The natural flow of the river is heavily disturbed by water management activities in the catchment area. Whereas some 120 m^3/s are estimated to originate in the mountain part, the inflow into the Jujnosurkhansk reservoir (Uzbekistan) is only 74.2 m^3/s (see the following table).

Discharge characteristics of the Surkhan Darya (Uzbekistan) (Inflow into the reservoir; summary values for the Shurchi gauging stations on the Surkhan Darya and the gauging station at the river mouth)		
Q_{av}	74.2 m^3/s	Average for 1970–2005
Mean monthly values:		
October – 25.3 m^3/s	November – 34.4 m^3/s	December – 42.01 m^3/s
January – 45.3 m^3/s	February – 47.6 m^3/s	March – 72.8 m^3/s
April – 157 m^3/s	May – 196 m^3/s	June – 166 m^3/s
July – 72.3 m^3/s	August – 17.2 m^3/s	September – 15.3 m^3/s

Source: Hydrometeorological Service of Uzbekistan.

KAFIRNIGAN RIVER[3]

The common border between Tajikistan and Uzbekistan is formed by the Kafirnigan River and it is of some 30 km. Most of the Kafirnigan's catchment area of 11,590 km^2 belongs to Tajikistan.

Hydrology

The average discharge is on the order of 170 m^3/s. As a rule, the maximum discharge occurs in May (Tartki gauging station, located some 50 km upstream of the river mouth, upstream catchment area some 9,780 km^2).

As a consequence of heavy rainfall, mudflow has a considerable impact on the ecological regime and the safe operation of hydrotechnical installations.

[2] Source: Environmental Performance Review of Tajikistan, UNECE, 2004.
[3] Source: Environmental Performance Review of Tajikistan, UNECE, 2004.

Discharge characteristics of the Kafirnigan at Tartki (Tajikistan)		
Q_{av}	169 m³/s	Average for 1929–2005
Mean monthly values:		
October – 60.0 m³/s	November – 62.9 m³/s	December – 63.1 m³/s
January – 59.6 m³/s	February – 62.2 m³/s	March – 187 m³/s
April – 295 m³/s	May – 405 m³/s	June – 389 m³/s
July – 270 m³/s	August – 129 m³/s	September – 70.1 m³/s

Source: Hydrometeorological Service of Uzbekistan.

PYANJ RIVER[4]

Afghanistan and Tajikistan share the catchment area of the Pyanj River, located in the Amu Darya River basin, as shown in the following table. Of the Pyanj's total catchment area, 107,000 km² are in the mountains and the rest (6,500 km²) in the lowland part of the catchment area.

Sub-basin of the Pyanj River			
Area	**Country**	**Country's share**	
113,500 km²	Afghanistan	47,670 km²	42%
	Tajikistan	65,830 km²	58%

Source: Hydrometeorological Service of Uzbekistan.

Hydrology

The Pyanj and Pamir rivers form the border between Afghanistan and Tajikistan.

Usually the confluence of the rivers Vakhan Darya (Afghanistan) and Pamir (forming the border between Afghanistan and Tajikistan) is considered as the beginning of the River Pyanj. However, hydrologists consider the source of the Vakhan Darya in Afghanistan as the beginning of the River Pyanj, as the Vakhan Darya is the "natural prolongation" of the Pyanj towards the east.

The total length of the Vakhan Darya/Pyanj is 1,137 km; from the confluence of the Vakhan Darya and Pamir, the river is 921 km long.

The lake percentage is 0.42%, based on data for 1987.

[4] Based on information provided by the Hydrometeorological Service of Uzbekistan.

Discharge characteristics of the Pyanj River at Nijniy Pyanj (Tajikistan), 35 km upstream of the confluence with the Vakhsh River		
Q_{av}	1,012 m^3/s	Average for 1965–1992
Mean monthly values:		
October – 643 m^3/s	November – 516 m^3/s	December – 445 m^3/s
January – 389 m^3/s	February – 406 m^3/s	March – 503 m^3/s
April – 828 m^3/s	May – 1,290 m^3/s	June – 2,000 m^3/s
July – 2,300 m^3/s	August – 1,960 m^3/s	September – 1,050 m^3/s

Source: Hydrometeorological Service of Uzbekistan.

Downstream of the confluence of the Vakhan Darya and the Pamir, a number of tributaries join the Pyanj, such as the Gunt, the Bartang, the Jasgulem, the Vanj and the Kyzylsu (right-hand-side tributaries), and the Koktsha (a left-hand-side tributary which flows exclusively through Afghanistan).

Knowledge concerning the hydrological regime of the Pyanj is very limited. Moreover, due to the closure of the Nijniy Pyanj measuring station in 1992, there are no discharge measurements by Tajikistan on the Pyanj River. Currently, only water levels are measured at a number of stations (Ishkashim, Shidz, Shirmandsho); but these stations do not operate regularly. With the exception of Lake Sarez (on the Bartang-Murghab-Oqsu tributary, having its source in Afghanistan, too) and a reservoir on the Gunt River, the flow of the Pyanj is not regulated, which results in severe flooding. June, July and August are the months with peak flow (on average 2,000 m^3/s).

Pressure factors

Besides the general pressure factors in the Amu Darya and Syr Darya basins, the Pyanj catchment area has the following relevant specific features: The Sarez Lake (16.1 km^3), formed by an earthquake in the upper part of the Bartang River, is a potential threat to the population (some 5 million people) living near the middle and lower Amu Darya. In Tajikistan, water use for irrigational agriculture in the Pyanj catchment area is relatively small and mostly limited to the Kyzylsu catchment area.

Transboundary impact

According to the 1946 agreement between the Soviet Union and Afghanistan, Afghanistan is entitled to use up to 9 km^3 a year from the River Pyanj. Afghanistan currently uses about 2 km^3 yearly.

Trends

Full use of Afghanistan's quota for water use from the Pyanj (9 km^3/a), fixed by the 1946 agreement, could radically change the water flow along the Pyanj and would have a significant impact on the downstream flow regime of the Amu Darya.

VAKHSH RIVER[5]

Kyrgyzstan (upstream country) and Tajikistan (downstream country) share the catchment area of the Vakhsh River, which in Kyrgyzstan is called the Kyzyl Suu. Of the total area of 39,100 km^2, 34,010 km^2 are located in the mountainous part.

Sub-basin of the Vakhsh River			
Area	**Country**	**Country's share**	
39,100 km^2	Kyrgyzstan	7,900 km^2	20.2%
	Tajikistan	31,200 km^2	79.8%

Source: Hydrometeorological Service of Uzbekistan.

[5] Based on information provided by the Hydrometeorological Service of Uzbekistan.

Hydrology

The flow regime of the Vakhsh is regulated, mainly due to the Nurek reservoir. Since the Nurek reservoir became operational, the "natural" flow rate of the river has been measured upstream at the station Darband (former Komsomoladad), which was opened in 1976. This value is also taken as the inflow value for the reservoir. The catchment area above the gauging station is 29,190 km^2.

Pressure factors, transboundary impact and trends

The planned extension of the mining and aluminium processing plant in Tursunzade (Tajikistan) may cause significant transboundary impact.

The Government of Tajikistan is also planning to resume the construction of a big reservoir at Rogun (total volume 12,400 million km^3, exploitable volume 8,700 million km^3). The future hydro-energy production at this reservoir will be used mainly to satisfy the higher energy demand of the mining and aluminium processing plant in Tursunzade.

Discharge characteristics of the Vakhsh River at Darband (Tajikistan)		
Q_{av}	1,012 m^3/s	Average for 1965–1992
Mean monthly values:		
October – 334 m^3/s	November – 245 m^3/s	December – 205 m^3/s
January – 177 m^3/s	February – 172 m^3/s	March – 213 m^3/s
April – 447 m^3/s	May – 795 m^3/s	June – 1,220 m^3/s
July – 1,600 m^3/s	August – 1,350 m^3/s	September – 697 m^3/s

Source: Hydrometeorological Service of Uzbekistan.

ZERAVSHAN RIVER BASIN[6]

Tajikistan (upstream) and Uzbekistan (downstream) are riparian countries to the Zeravshan River. Due the sheer impossibility of determining the size of the catchment area, many hydrologists simply give a figure of 12,200 km^2 for the mountain part of the catchment area. Currently, the most upstream weir of the irrigation system for the Karakul Oasis is considered the "mouth" of the Zeravshan River.

Hydrology

The Zeravshan River was formerly a tributary to the Amu Darya but lost this function with the development of irrigation in the lowland parts of the catchment area. Some hydrologists therefore consider the Zeravshan an independent river; others still attribute it to the Amu Darya basin.

Discharge characteristics of the Zeravshan River downstream of the confluence of the Magian Darya River		
Q_{av}	161 m^3/s	Average for 1997–2005
Mean monthly values:		
October – 91.3 m^3/s	November – 63.4 m^3/s	December – 49.3 m^3/s
January – 42.4 m^3/s	February – 39.7 m^3/s	March – 38.6 m^3/s
April – 57.1 m^3/s	May – 150 m^3/s	June – 362 m^3/s
July – 477 m^3/s	August – 370 m^3/s	September – 193 m^3/s

Source: Hydrometeorological Service of Uzbekistan.

[6] Based on information provided by the Ministry of Agriculture and Nature Protection of Tajikistan and the State Committee for Nature Protection of Uzbekistan.

Pressure factors

Currently some 96% of the water resources are used for irrigation, mainly in Uzbekistan.

Transboundary impact

Based on information supplied by Uzbekistan, Tajikistan is planning to construct a reservoir and hydropower station in the upper reaches of the Zeravshan River which might have an adverse impact on the quantity of water in the downstream part of the river.

Trends

Given the planned construction of a reservoir in Tajikistan, Uzbekistan has voiced the need for an agreement on the joint use of the Zeravshan River responding to the various forms of water use: hydropower generation in Tajikistan and irrigation in Uzbekistan.

SYR DARYA RIVER BASIN[7]

SYR DARYA RIVER

Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan share the basin. Some literature sources quote a basin area of up to 782,600 km^2 (of which 218,400 km^2 is in Kazakhstan). As with the Amu Darya, the water divide can only be correctly established in the mountainous part of the basin. Thus, many hydrologists do not give a figure for the total basin area but state that 142,200 km^2 of the basin area is upstream of the point where the river leaves the Fergana Valley.

Hydrology

The confluence of the transboundary rivers Naryn and Kara Darya (see separate assessments below) in the eastern part of the Fergana Valley is considered the beginning of the Syr Darya. Its total length is 2,137 km.

The river flow is strongly regulated. Major reservoirs include the Kajrakkum reservoir (design capacity 3,400 million m^3) and the Chardarin reservoir in Kazakhstan (design capacity 5,200 million m^3).

The long-term average river discharge is a calculated value of discharges into the Naryn/Syr Darya cascade of reservoirs. This value is seen as the normative-natural flow of the Syr Darya downstream of the run-off formation area in the mountainous part of the basin. The discharge characteristics are as follows:

[7] Based on information provided by the Ministry of Environment Protection, Kazakhstan, the State Agency for Environment Protection and Forestry of Kyrgyzstan, the Ministry of Agriculture and Nature Protection of Tajikistan, and the State Committee for Nature Protection of Uzbekistan.

Discharge characteristics of the Syr Darya, based on discharges into the Naryn/Syr Darya Cascade of reservoirs		
Q_{av}	34.1 km^3/a	Average for 1958–2005
Mean monthly values:		
October – 2.25 km^3	November – 2.08 km^3	December – 2.03 km^3
January – 2.10 km^3	February – 2.04 km^3	March – 2.43 km^3
April – 3.03 km^3	May – 4.27 km^3	June – 4.47 km^3
July – 3.97 km^3	August – 3.21 km^3	September – 2.53 km^3

Source: Hydrometeorological Service of Uzbekistan.

In the downstream parts of the Syr Darya, frequent flooding of human settlements, including the town of Kyzylorda, occurs in winter. This is caused by the operation of the Toktogul reservoir in Kyrgyzstan for maximum hydropower production during wintertime.

Pressure factors, transboundary impact and trends

As to specific pressures on the river, Uzbekistan and Tajikistan report water pollution by industrial wastewaters and/or agriculture (return water from irrigational agriculture flowing into the river through a system of channels).

At the Kokbulak monitoring station (in Kazakhstan, on the border with Uzbekistan), the Syr Darya has elevated concentrations of nitrates, manganese, sulphates, iron (2+) and copper. Pollution peaks are observed in autumn.

In Kazakhstan itself, the pollution load of the Syr Darya (and its non-transboundary tributaries, Arys and Keles rivers) is increased by industrial wastewater discharges, emissions from agriculture (discharges from drainage channels) and livestock breeding.

Water pollution characteristics of the Syr Darya River in Kazakhstan (Kokbulak measuring station)					
Year	Water pollution index[8]	Determinands	Average concentration in mg/l	Factor by which the MAC is exceeded	Water quality
2001	1.26	Manganese	78.120	1.95	Class 3 (moderately polluted)
		Sulphates	662.41	6.63	
		Iron (2+)	0.018	3.6	
		Copper	0.0028	2.8	
2002	1.36	Manganese	58.628	1.47	Class 3 (moderately polluted)
		Sulphates	555.661	5.56	
		Iron (2+)	0.037	7.45	
		Copper	0.0039	3.9	
2003	2.13	Manganese	59.956	1.5	Class 3 (moderately polluted)
		Sulphates	486.012	4.86	
		Iron (2+)	0.036	7.19	
		Copper	0.0042	4.19	
2004	1.92	Manganese	63.768	1.59	Class 3 (moderately polluted)
		Sulphates	515.402	5.15	
		Iron (2+)	0.046	9.2	
		Copper	0.0034	3.38	
2005	2.03	Nitrites-nitrogen	0.04	2.0	Class 3 (moderately polluted)
		Sulphates	469.9	4.7	
		Manganese	53.4	1.3	
		Copper	0.0031	3.1	
2006	2.18	Nitrites-nitrogen	0.045	2.3	Class 3 (moderately polluted)
		Sulphates	507.3	5.1	
		Manganese	51.8	1.3	
		Copper	0.0034	3.4	

Source: Ministry of Environment Protection of Kazakhstan.

The following sections describe the pressure factors, transboundary impact and trends for the transboundary rivers of the Syr Darya River basin. The joint sustainable use and protection of the water resources of these transboundary rivers is a particular challenge for the Central Asian countries.

NARYN RIVER

Kyrgyzstan (upstream) and Uzbekistan (downstream) are riparian countries to the Naryn River. The literature gives various figures for the size of the catchment area, from 58,370 km^2 to 59,900 km^2.

Hydrology

The River Naryn originates in the Tien Shan Mountains in Kyrgyzstan and flows through the Fergana Valley into Uzbekistan. Here it confluences with the Kara Darya River (assessed below) to form the Syr Darya (assessed above).

The river is 807 km long and contains many multipurpose reservoirs, which are particularly important for hydropower generation. The largest one, the Toktogul reservoir, contains some 19.9 km^3 water, which is used for hydropower

[8] The water pollution index is defined on the basis of the ratios of measured values and the maximum allowable concentration of the water-quality determinands.

generation in Kyrgyzstan and for irrigational water supply and protection against floods in Uzbekistan.

Downstream of the Toktogul reservoir, the flow of the river is totally regulated. Therefore, the river discharge figures refer to the inflow into the reservoir as the sum of the discharge of the Naryn at the Uchterek gauging station and the discharge of three smaller rivers directly communicating with the reservoir.

Discharge characteristics of the Naryn River		
Q_{av}	381 m^3/s	Total inflow into reservoir (Naryn plus three smaller rivers). Average for 1950–2005
Q_{av}	342 m^3/s	Discharge of the Naryn at the Uchterek gauging station only. Average for 1959–2005
Mean monthly values (total inflow into the reservoir):		
October – 229 m^3/s	November – 198 m^3/s	December – 164 m^3/s
January – 152 m^3/s	February – 147 m^3/s	March – 159 m^3/s
April – 283 m^3/s	May – 606 m^3/s	June – 942 m^3/s
July – 844 m^3/s	August – 577 m^3/s	September – 324 m^3/s

Source: Hydrometeorological Service of Uzbekistan.

Unfortunately, of the former 15 gauging stations, only three are currently operational in the Kyrgyzstan part of the catchment area; this greatly reduces the accuracy of flood forecasts.

Pressure factors

The main pressure factors include untreated and insufficiently treated wastewater from municipal/domestic sources, discharges from industry and livestock breeding, wastes from ore mining and unauthorized storage of domestic waste from nearby human settlements.

Pollution hot spots are found in the populated lower section of the river, where high concentrations of nitrates (above 3 mg/l), nitrites (0.7 mg/l), oil and grease (0.5 mg/l), phenols (above 0.001 mg/l) and pesticides are still detected.

In the upper stretches, the water quality is assessed as “very good” or “good”.

Trends

In addition to direct human impact on water quality and quantity, which will not significantly decrease, there is the growing potential of an adverse impact (mostly on water quantity) from the melting of glaciers due to rising air temperature and pollution of the glaciers.

KARA DARYA RIVER

Kyrgyzstan (upstream) and Uzbekistan (downstream) share the Kara Darya River catchment area of 28,630 km^2. Upstream of the Andijan reservoir, the catchment area is 12,360 km^2.

Hydrology

The river is heavily regulated. In 1978, the Andijan reservoir became operational, which had a significant impact on the river's flow regime (see the following table). Downstream of this reservoir, the much smaller Teshiktash and Kujganya reservoirs also became operational.

Discharge characteristics of the River Kara Darya		
Q_{av}	122 m^3/s	Inflow into the Andishan reservoir for 1978-2005
Q_{av}	136 m^3/s	Discharge at the Uchtepe gauging station at the river mouth for 1978–2005
Mean monthly values (total inflow into the reservoir):		
October – 62.2 m^3/s	November – 67.1 m^3/s	December – 58.9 m^3/s
January – 50.8 m^3/s	February – 49.4 m^3/s	March – 63.1 m^3/s
April – 170 m^3/s	May – 290 m^3/s	June – 324 m^3/s
July – 324 m^3/s	August – 101 m^3/s	September – 61.9 m^3/s
Mean monthly values (river mouth):		
October – 122 m^3/s	November – 147 m^3/s	December – 133 m^3/s
January – 108 m^3/s	February – 102 m^3/s	March – 117 m^3/s
April – 175 m^3/s	May – 210 m^3/s	June – 199 m^3/s
July – 199 m^3/s	August – 124 m^3/s	September – 87.1 m^3/s

Source: Hydrometeorological Service of Uzbekistan.

Pressure factors, transboundary impact and trends

The hydrological regime of the river in the Fergana Valley can be characterized as follows: the river water is used for irrigation purposes (abstraction), and there is considerable water inflow from groundwaters and return waters from irrigational areas (input). Therefore, the main problems are the correct calculation of water abstraction and compliance with the "abstraction norms".

CHIRCHIK RIVER

Kazakhstan, Kyrgyzstan and Uzbekistan are riparian countries to the Chirchik River. The total catchment area of the Chirchik River is 14,240 km², of which 9,690 km² are in the mountains (upstream of the Charvads reservoir).

Hydrology

The Chirchik originates in Kyrgyzstan, at the confluence of two rivers, the Chatkal (shared by Kyrgyzstan and Uzbekistan) and the Pskem. Currently both rivers supply the Charvak reservoir.

Downstream of the Charvak reservoir, the Chirchik river is fully regulated. There are two relatively big tributaries, the Ugam on the right and the Aksakata on the left. Further downstream, in the lowland part, the Chirchik is used intensively for irrigational water supply through a comprehensive system of canals. The biggest include- the Zakh, Bozsu and Northern Tashkent canals, which, although artificial, look like real rivers.

Discharge characteristics of the Chirchik River at the Chinaz gauging station		
Q_{av}	104 m³/s	Average for1923–2005
Mean monthly values (inflow into the reservoir):		
October – 98.1 m³/s	November – 86.0 m³/s	December – 72.4 m³/s
January – 64.2 m³/s	February – 61.8 m³/s	March – 82.7 m³/s
April – 218 m³/s	May – 417 m³/s	June – 550 m³/s
July – 414 m³/s	August – 232 m³/s	September – 135 m³/s

Source: Hydrometeorological Service of Uzbekistan.

Pressure factors

The river is used mainly for irrigation and hydropower generation. From time to time, there is inter-basin water transfer into the catchments of the Keles and Akhangaran rivers.

Major industrial enterprises in the Chirchik basin include the Khodjikent asphalt and concrete plant, the manufacturing firm Electrokhimprom and the Uzbek industrial complex for metal manufacturing. According to recent data, wastewater discharged from Electrochimprom still exceeds MAC values as follows: suspended matters 24 times, ammonia nitrogen up to 10 times, nitrates up to 7 times and oil products 3 times. One can expect a similar picture for the other industrial sites in the Chirchik basin.

In the upper stretches of the lowland part, the Chirchik carries a high sediment load (above 1 t/m³). To protect the Chirchik-Bozsu Cascade of hydropower stations from this mudflow, a great number of facilities for mud removal and/or its “harmless” passing through the cascade have been built.

Trends

With the ongoing economic development and population growth in the Tashkent Oasis, there is an ever-growing deficit of water for irrigation and hydropower generation.

CHATKAL RIVER

Kyrgyzstan (upstream) and Uzbekistan (downstream) share the catchment area of the Chatkal River (7,110 km^3).

Hydrology

The river has a length of 217 km. There are 106 tributaries to the Chatkal River with a total length of 1434.5 km. None of the three former gauging stations of the Hydrometeorological Service of Kyrgyzstan is currently operational. The gauging station at Khudajdodsaj, operated by the Hydrometeorological Service of Uzbekistan, is functioning properly.

Discharge characteristics of the Chatkal River (Gauging stations at the mouth of the Ters River)		
Q_{av}	66.2 m^3/s	1941–1990
Q_{max}	102.6 m^3/s	1978–1979
Q_{min}	40.7 m^3/s	1981–1982
$Q_{absolute\ max}$	450.0 m^3/s	24 June 1979
$Q_{absolute\ min}$	9.2 m^3/s	9 January 1974

Source: Ministry of Environment of Kyrgyzstan.

Discharge characteristics of the Chatkal River at the Khudajdodsaj gauging station		
Q_{av}	115 m^3/s	Average for 1968–2005
Mean monthly values (inflow into the reservoir):		
October – 54.0 m^3/s	November – 48.7 m^3/s	December – 41.1 m^3/s
January – 36.9 m^3/s	February – 35.6 m^3/s	March – 47.2 m^3/s
April – 134 m^3/s	May – 257 m^3/s	June – 322 m^3/s
July – 217 m^3/s	August – 112 m^3/s	September – 68.0 m^3/s

Source: Hydrometeorological Service of Uzbekistan.

Pressure factors, transboundary impact and trends

There are only eight villages in the basin, two of them with central water supply and only one of them with a wastewater treatment plant (Kanysh-Kiya).

The transboundary impact seems to be limited to organic pollution from the human settlements.

ARAL SEA[9]

The Aral Sea is the biggest lake in Central Asia; it lies between Kazakhstan in the north and Uzbekistan in the south. Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan share the lake basin, which is essentially made up of the basins of the Amu Darya, Zerevshan and Syr Darya.

The recharge basin is characterized by large variations in precipitation. Annual precipitation ranges from 1,500 to 2,500 mm in the glacier belts of the West Tien Shan and West Pamir ranges, 500–600 mm in the foothills, and 150 mm at the latitude of the Aral Sea.

Historically, the Aral Sea has risen and fallen considerably. During the Quaternary period, the lake's showed variations of as much as 36 metres due to natural factors. In the first half of the twentieth century, the variance did not exceed one metre, and the ecological situation was quite stable until the late 1950s. However, since then substantial variations have occurred mainly due to anthropogenic pressure: since the end of the 1950s, the level of the lake has fallen by more than 22 m.

Since the 1960s, the Aral Sea has been shrinking as the rivers that feed it have been intensively used for irrigation. This has created a number of ecological problems both for the lake and for the surrounding area. The lake is badly polluted, largely as a result of former weapons testing, industrial projects and fertilizer runoff before the 1990s.

Another major environmental problem facing the Aral Sea basin is the increasing salinization of irrigated areas, which is reducing their productivity. A significant proportion (about 33,000 km²) of the lake has dried up, and water mineralization has increased. The ecosystem of the Aral Sea has been nearly destroyed, and not least because of the salinization. The receding lake has left huge plains covered with salt and toxic chemicals, which are picked up and carried away by the wind as toxic dust, and thereby spread to the surrounding area. As a result, the land around the Aral Sea became heavily polluted, and the people living in the area are suffering from a lack of fresh water, as well as from a number of health problems, such as certain forms of cancer and lung disease.

[9] Source: Global International Waters Assessment; Aral Sea, GIWA Regional assessment 24, UNEP, 2005.

CHU-TALAS RIVER BASINS[10]

The Chu-Talas basins include the basins of three transboundary rivers: the Chu, the Talas and the Assa. The major part of their basins (73%) is located in desert and semi-desert zones. The Tien Shan Mountains occupy 14% of the basins' total area and the steppe-like hilly part covers 13%.

The Chu-Talas basins also encompass 204 smaller rivers (140 rivers in the Chu basin, 20 in the Talas basin and 64 in the Assa basin), as well as 35 lakes and three large water reservoirs.

Most of the runoff of the Chu, the Talas and the Kukureusu (Assa's main tributary) is formed in Kyrgyzstan. The water resources of the Chu River are estimated at 6.64 km^3 and those of the Talas River at 1.81 km^3. The Chu, Talas and Assa are ultimately regulated.

In Kyrgyzstan, the biggest reservoirs are the Orto-Tokoy reservoir (design capacity of 0.42 km^3) on the Chu and the Kirovsk water reservoir (design capacity of 0.55 km^3) on the Talas. In Kazakhstan, there are the Tasotkel reservoir (total volume 0.62 km^3) on the Chu and the Tersashchibulak reservoir on the Ters River, a tributary to the Talas, with a volume of 158 million m^3. The reservoirs of the Chu-Talas basins are used mainly to supply water for irrigation.

[10] Based on information provided by the Ministry of Environment Protection of Kazakhstan, and the State Agency for Environment Protection and Forestry of Kyrgyzstan.

CHU RIVER

The basin, shared by Kazakhstan (downstream) and Kyrgyzstan (upstream), covers an area of 62,500 km²; the mountainous part of the basin stretches over an area of 38,400 km² (60% of it in Kyrgyzstan).

Hydrology

The Chu River is 1,186 km long; 221 km of this length forms the border between Kyrgyzstan and Kazakhstan. The river is fed mainly by glaciers and melting snow. Rainfall is of secondary importance. Groundwater inflow, particularly in the foothills and lowlands, is particularly important for the formation of the basis flow and the spring flow.

In Kyrgyzstan, only one gauging station on the Chu River is still operational, and the number of groundwater observing wells has fallen by more than 50% since the 1980s. Consequently, the accuracy of runoff forecasts and water balance computations has decreased. Luckily, the number of measuring points for discharge regulation in the irrigation channels has been maintained.

In Kazakhstan, four gauging stations are operational, including one station downstream of the border with Kyrgyzstan at the village of Blagoveshshenskoye.

Pressure factors

The water quality of the Chu River depends on the degree of pollution of its tributaries, lakes in the basin and groundwaters as well as the pollution of glaciers, mainly due to human impact. Apart from irrigated agriculture in both countries, the main pressure factors in Kyrgyzstan arise from untreated municipal and industrial wastewaters, animal husbandry, mining in the mountainous parts and unaut horized storage of wastes next to human settlements. One of the pollution sources is the Gorvodocanal in Bishkek. In the lowlands, runoff regulation has decreased the occurrence of floods and/or their duration, which in turn has adverse effects on riparian vegetation and vegetation in the former flood-prone areas.

Transboundary impact

In Kazakhstan, water quality is measured at the village of Blagoveshshenskoye, downstream of the border with Kyrgyzstan. Water quality falls into classes 3 and 4. Nitrates, phenols and copper play a major role in pollution.

Water pollution characteristics of the Chu River in Kazakhstan (Blagoveshshenskoye village downstream of the border with Kyrgyzstan)					
Year	**Water pollution index**	**Determinands**	**Mean concentration in mg/l**	**Factor by which MAC is exceeded**	**Water quality**
2001	1.58	Sulphates	143.45	1.43	Class 3
		Ammonium-nitrogen	0.473	1.21	
		Nitrites-nitrogen	0.053	2.65	
		Iron, total	0.34	3.4	
		Iron (2+)	0.195	39.0	
		Copper	0.0012	11.73	
		Zinc	0.0245	2.45	
		Phenols	0.0013	1.33	
2002	2.87	Sulphates	265.95	2.66	Class 4
		Nitrites-nitrogen	0.043	2.17	
		Iron, total	0.255	2.5	
		Iron (2+)	0.08	16.0	
		Copper	0.0097	9.67	
		Zinc	0.0186	1.86	
		Phenols	0.002	2.0	
2003	1.73	Sulphates	128.95	1.29	Class 3
		Nitrites-nitrogen	0.024	1.19	
		Iron, total	0.36	3.6	
		Copper	0.0048	4.8	
		Phenols	0.0011	1.08	
		Oil products	0.06	1.2	
2004	2.24	Sulphates	129.25	1.29	Class 3
		Nitrites-nitrogen	0.035	1.73	
		Chromium	11.42	1.14	
		Iron, total	0.26	2.6	
		Iron (2+)	0.12	1.2	
		Copper	0.0035	3.48	
		Phenols	0.005	4.91	
		Oil products	0.058	1.15	
2005	1.85	Copper	0.0044	4.4	Class 3
		Nitrites-nitrogen	0.023	1.1	
		Phenols	0.002	2.0	
2006	2.13	Ammonium-nitrogen	0.45	1.2	Class 3
		Nitrites-nitrogen	0.032	1.6	
		Copper	0.0062	6.2	
		Iron, total	0.17	1.7	
		Phenols	0.0014	1.4	

Note: Class 3 – moderately polluted; class 4 – polluted.
Source: Ministry of Environment Protection of Kazakhstan.

Trends

According to an assessment by Kyrgyzstan, the technical status of water construction works, including irrigation channels, and the infrastructure for industrial and municipal water supply is deteriorating, which has adverse effects on the availability and quality of water resources. The pressure on water resources will also increase due to the worsening technical status of water supply and wastewater treatment systems. An additional adverse impact on groundwater quality will be created by increasing contamination caused by the worsening status of water protection zones.

TALAS RIVER

The basin, shared by Kazakhstan (downstream) and Kyrgyzstan (upstream), covers an area of 52,700 km^2 as shown in the following table.

Basin of the Talas River			
Area	**Country**	**Country's share**	
52,700 km^2	Kazakhstan	41,270 km^2	78.3%
	Kyrgyzstan	11, 430 km^2	21.7%

Source: Joint communication by the Ministries of Environment Protection of Kazakhstan and Kyrgyzstan.

Hydrology

The Talas River is formed by the confluence of the Karakol and Uchkosha rivers, which have their sources at the slopes of the Kyrgyz Ridge and the Talas Alatau. The river vanishes into the Moinkum sands without reaching Lake Aydyn. Of the river's total length of 661 km, 453 km flow through in Kazakhstan.

In Kyrgystan, only 13 of 21 former gauging stations are still operational, and the number of groundwater observing wells has decreased, (as it is the case for the Chu basin) by more than 50% compared to the 1980s. Consequently, the accuracy of runoff forecasts and water balance computations has decreased. Luckily, the number of measuring points for discharge regulation in the irrigation channels has been maintained.

Pressure factors

Water resources are used mainly to support grazing and animal husbandry in the mountainous parts of the basin, and irrigated agriculture and animal husbandry in the foothills and lowlands. In Kyrgyzstan some 137,600 ha are irrigated land, and in Kazakhstan 105,000 ha.

Apart from irrigated agriculture in both countries, the main pressure factors in Kyrgyzstan arise from untreated municipal and industrial wastewaters, discharges from livestock breeding, wastes from mining in the mountainous parts, and unauthorized storage of waste next to human settlements. In Kazakhstan, additional pressure on water quality arises from return water from wastewater infiltration fields used by the sugar and alcohol industries.

Transboundary impact

Water quality in the Talas River basin depends on polluting substances, which are discharged from Kyrgyzstan and Kazakhstan into the Talas, as well as on the extent of pollution of its tributaries, lakes in the basin and groundwaters. Major pollutants include ammonium-nitrogen and copper. In the vicinity of the city of Talas, water pollution is higher due to elevated concentrations of iron (total iron and iron-II).

Currently, Kazakhstan assesses the Talas's water quality as "good".

Water pollution characteristics of the Talas River in Kazakhstan (Pokrovka village downstream of the border with Kyrgyzstan)					
Year	**Water pollution index**	**Determinands**	**Mean concentration in mg/l**	**Factor by which MAC is exceeded**	**Water quality**
2001	1.19	Ammonium-nitrogen	0.492	1.29	Class 3
		Iron, total	0.137	1.37	
		Iron (2+)	0.046	9.2	
		Copper	0.0028	2.76	
2002	0.81	Iron, total	0.155	1.55	Class 2
		Iron (2+)	0.064	12.8	
		Copper	0.0019	1.96	
2003	0.79	Iron, total	0.164	1.64	Class 2
		Iron (2+)	0.071	14.2	
		Copper	0.0015	1.48	
2004	0.88	Iron, total	0.107	1.07	Class 2
		Iron (2+)	0.032	6.4	
		Copper	0.0016	1.57	

Note: Class 2 – slightly polluted; class 3 – moderately polluted.
Source: Ministry of Environment Protection of Kazakhstan.

Trends

As with the Chu basin, Kyrgyzstan finds that the technical status of water construction works, including irrigation channels, and the infrastructure for industrial and municipal water supply is deteriorating, which has adverse effects on the availability and quality of water resources. The pressure on water resources will also increase due to the worsening technical status of water supply and wastewater treatment systems. An additional adverse impact on groundwater quality will be created by increasing contamination caused by the worsening status of water protection zones.

ILI RIVER BASIN[11]

The basin of the Ili River, shared by China (upstream country) and Kazakhstan (downstream country), covers an area of 413,000 km².

Basin of the Ili River			
Area	**Country**	**Country's share**	
413,000 km²	Kazakhstan	353,000 km²	85.4%
	China	60,000 km²	14.6%

Source: Ministry of Environment Protection of Kazakhstan.

ILI RIVER

Hydrology

The Ili River is 1,439 km long, including 815 km in Kazakhstan. Its source is in the eastern Tien Shan at the confluence of the Tekes and Kunes rivers. Before flowing into Lake Balqash, it forms an immense delta with vast regions of lakes, marches and jungle-like vegetation.

In China, there are some 15 reservoirs on the tributaries to the Ili (Kash, Kunes, Tekes); some 40 small reservoirs are in the planning phase. The biggest reservoir in Kazakhstan is the Kapshagan hydropower station on the Ili; a number of smaller hydropower stations are operational on the Ili's tributaries.

Pressure factors

The main pressure factors include agriculture (animal farms and irrigated farming), mining, manufacturing and refinery enterprises, and urbanization.

In China, some 600 million ha are irrigated. The area of irrigated land in Kazakhstan is only 8.18 million ha; 6.53 million ha of this consists of grasslands for grazing of cattle, sheep, goats, horses and camels.

[11] Based on information provided by the Ministry of Environment Protection of Kazakhstan.

In the lowlands, flow regulation by the many reservoirs is another pressure factor and has a direct impact on flood plain vegetation: due to the decreasing number of flood events and a shortening of their duration, the vegetation is deteriorating, which adversely affects animal grazing. In the river delta itself, the opposite is happening in winter: high water discharges from the reservoirs to satisfy peak energy demand lead to complete flooding of the river delta, which adversely affects the riverine ecosystem.

Transboundary impact

The pressure factors described above are causing pollution in both China and Kazakhstan. The main industrial pollutants are copper and zinc (currently, out of 100 samples taken at the border station in Kazakhstan, 72 samples usually exceed the maximum allowable concentration values (MAC) and oil products.

Water pollution characteristics of the Ili River in Kazakhstan
(Dubunj measuring station downstream from the border with China)

Year	Water pollution index	Determinands	Mean concentration in mg/l	Factor by which MAC is exceeded	Water quality
2001	4.01	Iron, total	0.165	1.65	Class 4
		Iron (2+)	0.039	7.89	
		Copper	0.017	19.9	
		Zinc	0.017	1.75	
		Phenols	0.002	2.0	
		Oil products	0.085	1.70	
2002	2.48	Nitrate-nitrogen	0.035	1.74	Class 3
		Iron, total	0.24	2.4	
		Iron (2+)	0.099	19.84	
		Copper	0.009	8.95	
		Zinc	0.016	1.57	
		Oil products	0.056	1.12	
2003	2.46	Nitrate-nitrogen	0.029	1.45	Class 3
		Iron (2+)	0.061	12.21	
		Copper	0.0086	8.63	
		Zinc	0.021	2.06	
		Oil products	0.077	1.54	
2004	2.14	Iron (2+)	0.059	11.8	Class 3
		Copper	0.0072	7.28	
		Zinc	0.015	1.51	
		nganese	0.149	1.49	
		Phenols	0.0015	1.47	

Note: Class 3 – moderately polluted; class 4 – polluted.
Source: Ministry of Environment Protection of Kazakhstan.

Trends

The ever-growing water use, including for irrigation; the attempt to increase the volume of the Kapshagan reservoir to boost hydropower production; the sealing of areas next to reservoirs; and the pollution of water protection zones in mountain rivers will all continue to have adverse effects on the status of aquatic ecosystems.

In addition, there is the potential threat of growing pressure on water resources due to increasing economic activities in China. Of the available 18.1 km^3/year (long-term mean average flow into the Kapshagan reservoir), one third (12.3 km^3/year) is formed in China. With the expected decrease to 8.0 km^3/year, which is very likely due to increasing water use in China, Lake Balqash may – given the same amount of water use in Kazakhstan – share the fate of the Aral Sea.

LAKE BALQASH[12]

Lake Balqash, the largest moderately saline lake of Central Asia, is located in south-eastern Kazakhstan. The total area of the lake is 18,210 km^2. The western half of the lake consists of fresh water, while the eastern half is salt water. The average depth of the lake is only six metres. The lake is fed principally by the Ili River.

Water pollution of the Balqash is growing as agriculture, industrialization and urbanization in the area increase (see the assessment of the Ili River). The lake is also shrinking because of over-utilization of water. The extinction of species in the lake due to over-fishing is occurring at an alarming rate.

MURGAB RIVER BASIN[13]

The basin of the Murgab River, with a total area of 46,880 km^2, is shared by Afghanistan (upstream) and Turkmenistan (downstream). The 852 km long river (350 km in Turkmenistan) rises in Afghanistan at 2,600 m above sea level and ends up in a desert sink (actually, it feeds many irrigation channels in Turkmenistan). The Abikajsar River is its major transboundary tributary.

The long-term mean annual discharge of the river in Turkmenistan is 1,657 million m^3 usually with a clear-cut seasonal distribution: around 55% in summer, 16% in winter, 13% in spring and 17% in autumn.

Since ancient times, irrigated agriculture has been the predominant water user in the basin. Currently, the return waters (surface runoff and groundwater flow) from the irrigated land “do not significantly influence” the river’s water quality. According to the 2006 measurements (stations Iolontanj and Takhtabazar, Turkmenistan), the river’s mineral salt content was “moderate” and reached 500 mg/l and the maximum concentrations of nitrogen compounds exceeded the MAC values only by a factor of 3. The oxygen regime was “satisfactory”. However, water pollution by organic compounds increased over the last couple of years: in 2006, the COD was 65 mg O_2/l and its maximum was 154 mg O_2/l (station Iolotanj).

TEJEN RIVER BASIN[14]

Afghanistan, the Islamic Republic of Iran and Turkmenistan share the Tejen River basin with a total area of 70,260 km^2. The Tejen, also known as Tedshen and Gerirud, has a total lenght of 1,124 km.

Irrigational agriculture is the predominant water user in Afghanistan, the Islamic Republic of Iran and Turkmenistan. However, the river’s waters can only satisfy the water demand of 15% of the agricultural land suitable for irrigated agriculture.

To better satisfy agricultural water demand, the Islamic Republic of Iran and Turkmenistan completed in 2005 the construction of the Dostluk dam and reservoir on the Tejen (1,250 million m^3). Following a bilateral agreement between the two countries, the reservoir’s water resources are equally shared.

The return waters (surface runoff and groundwater flow) from the irrigated land heavily influence the river’s water quality: In 2006, the river’s mineral salt content was in the order of 1,900-2,000 mg/l and COD reached 277 mg O_2/l (measurements at Tedshen city).

[12] Based on information provided by the Ministry of Environment Protection of Kazakhstan.
[13] Based on information by the Ministry of Nature Protection of Turkmenistan.
[14] Based on information by Ministry of Nature Protection of Turkmenistan.