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Meeting of the Parties to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes

Working Group on Monitoring and Assessment

Twelfth meeting
Geneva, 2–4 May 2011
Items 5 (b) and 5 (d) of the provisional agenda
Assessment of the status of transboundary waters in the UNECE[1] region: Assessment of transboundary rivers, lakes and groundwaters in Central Asia

Assessment of the status of transboundary waters in the UNECE region: Assessment of transboundary rivers, lakes and groundwaters in the Caucasus

Assessment of transboundary rivers, lakes and groundwaters discharging into the Caspian Sea[2]

Note prepared by the secretariat*

Summary

This document was prepared pursuant to decisions taken by the Meeting of the Parties to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes at its fifth session (Geneva, 10–12 November 2009) (ECE/MP.WAT/29, para. 81 (e)), and by the Working Group on Monitoring and Assessment at its eleventh meeting (Geneva, 6–7 July 2010), requesting the secretariat to finalize the sub regional assessments of the Caucasus and Central Asia for the second Assessment of Transboundary Rivers, Lakes and Groundwaters in time for its submission to the Seventh "Environment for Europe" Ministerial Conference (Astana, 21–23

[1] United Nations Economic Commission for Europe.
[2] This document was submitted for publication without formal editing.
* The present document has been submitted on the present date due to late receipt of inputs by concerned countries and resource constraints in the secretariat.

September 2011).

This document contains the draft assessments of the different transboundary rivers, lakes and groundwaters which are located in the Basin of the Caspian Sea.

For background information and for the decisions that the Working Group on Monitoring and Assessment may wish to take, please refer to documents ECE/MP.WAT/WG.2/2011/4−ECE/MP.WAT/WG1/2011/4 and ECE/MP.WAT/WG.2/2011/5 –ECE/MP.WAT/WG1/2011/5.

Contents

I. Introduction

1. The present document contains the assessments of the different transboundary rivers, lakes and groundwaters which are located in the Basin of the Caspian Sea. The document has been prepared by the secretariat with the assistance of the International Water Assessment Centre (IWAC) on the basis of information provided by the countries in the Caucasus and Central Asia sub-regions.

2. For descriptions of the transboundary aquifer types and related illustrations, Annex V of document ECE/MP.WAT/2009/8 should be referred to.

3. For background information and for the decisions that the Working Group on Monitoring and Assessment may wish to take, please refer to documents ECE/MP.WAT/WG.2/2011/4−ECE/MP.WAT/WG1/2011/4 and ECE/MP.WAT/WG.2/2011/5 –ECE/MP.WAT/WG1/2011/5.

II. Ural River Basin

4. The basin of the 2,428-km long Ural River is shared by Kazakhstan and the Russian Federation. Geographically the basin is shaped by the Ural-Tau ridge (elevation commonly 700-900 m a.s.l.), the Zilairskoe plateau (elevation commonly 500-600 m a.s.l.) and the Obschiy Syrt (elevation mostly 200-300 m a.s.l.).

5. The Ilek, Or, Kigach, Bolshoy Yzeni, Malyi Uzeni, Khobda, Urta-Burtya, Emba, Uil, Sagiz and the Chagan are transboundary tributaries

Table 1
Area and population in the Ural Basin

Country	*Area in the country (km^2)*	*Country's share %*	*Population*	*Population density (persons/km^2)*
Russian Federation	160 300[a]			
Kazakhstan	*64 876*		2 091 530[b]	32
Total	**231 000**			

Sources: Scheme of complex use and protection of water resources, Kazakhstan 2006
[a] The figure includes the Uzeni Basin.
[b] Statistics Agency of Kazakhstan 2006

Hydrology and Hydrogeology

6. The right bank tributaries, which originate from the higher elevation part of the basin (the Ural-Tau), the Malyi and Bolshoy Kizil and Sakmara, have an important role in feeding the flow of the Ural. Towards the south, runoff significantly decreases with increased aridity.

7. Surface water resources in the Russian part of the basin are estimated to amount to some 10.6 km^3/year (based on observation during the period from 1958 to 2009)[3].

[3] *Source:* Committee on Water Resources of the Orenburg oblast, the Russian Federation

8. In Kazakhstan's part of the basin, surface water resources are estimated at 12.8 km^3/year (with 4.1 km^3 estimated generated within the borders of Kazakhstan and 8.7 km^3/year flowing from the Russian Federation.). Groundwater resources are estimated at 1.03 km^3/year. These add up to a total of 13.83 km^3/year which equals 6,612 m^3/year/capita.

Table 2
South-Pred-Ural aquifer: sand and gravel, intergranular/multilayered, partly confined and partly unconfined; Groundwater flow from the Russian Federation (north-east) to Kazakhstan (south-west). Weak links with surface waters.

	Kazakhstan	*Russian Federation*
Border length (km)	106	
Area (km^2):	9 512	
Renewable groundwater resource (m^3/d)		
Thickness in m (mean, max)	75, 200	
Groundwater uses and functions		
Pressure factors		
Groundwater management measures		
Other information	Stratigraphic horizons: aQ, K_{1-2}al-s, J, P-T	

Figure 1. Conceptual sketch of the South-Pred-Ural aquifer (provided by Kazakhstan)

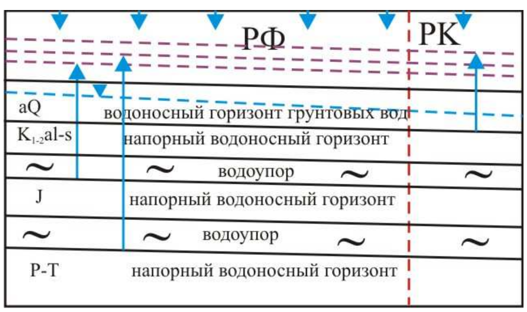


Table 3
Pre-Caspian aquifer: Medium- to fine-grained sands; Groundwater flow from the Russian Federation (north) to Kazakhstan (south) or along the border; Medium links with surface waters. The aquifer extends to the Malyi and Bolshoy Uzen Basins.

	Kazakhstan	*Russian Federation*
Border length (km)	1 680	
Area (km^2):	75 000	
Renewable groundwater resource (m^3/d)		
Thickness in m (mean, max)	21, 42	

Groundwater uses and functions		
Pressure factors		
Groundwater management measures		
Other information	Strategraphic horizons: $mQ_{III}hv$, $mQ_{II}hz$	

Figure 2. Conceptual sketch of the Pre-Caspian aquifer (provided by Kazakhstan)

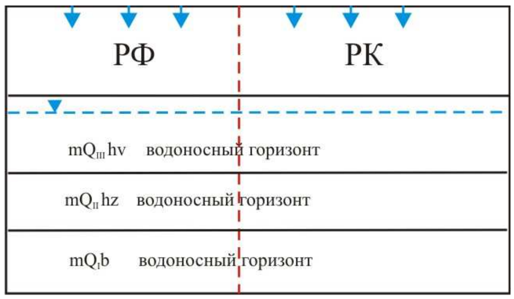
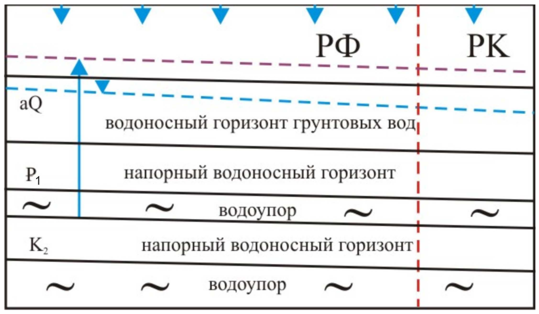


Table 4

Syrt aquifer: Quaternary gravel and pebbles, sand; Cretaceous chalk; Groundwater flow from the Russian Federation (north-east) to Kazakhstan (south-west); Medium links with surface waters

	Kazakhstan	*Russian Federation*
Border length (km)	212	
Area (km^2):	2 410	
Renewable groundwater resource (m^3/d)		
Thickness in m (mean, max)	50, 100	
Groundwater uses and functions		
Pressure factors		
Groundwater management measures		
Other information	Strategraphic horizons: aQ, P_1, K_2:	

Figure 3. Conceptual sketch of the Syrt aquifer (provided by Kazakhstan)



Pressure

Table 5
Total withdrawal and withdrawals by sectors

Country	*Year*	*Total withdrawal ×10⁶ m³/year*	*Agricultural %*	*Domestic %*	*Industry %*	*Energy %*	*Other %*
Russian Federation	2009	1 650[a]					
Kazakhstan	2006	1 429	49.9	14.9	33.8	-	1.4
	2020[b]	2 406	64.8	10.0	24.3	-	0.9

[a] For Orenburg oblast
[b] Forescast

9. The main pressure factors in the basin are industry (especially in Magnitogorsk and the Orenburg oblast), discharges of municipal wastewaters (the cities of Uralsk and Atyrau). Spring flooding and runoff in general mobilizes pollutants, among them oil products from oil extraction sites on the Caspian coast (Tengiz, Prorva, Martyshi, Kalamkas, Karazhmbas). In addition to oil products, phenols and heavy metals are principal pollutants in the Ural Basin.

Status

10. Oxygen content of the Ural River at the Yanvartsevo monitoring station was on average 8.43 mgO_2/l in 2009. The total concentration of dissolved solids was 848 mg/l and the pH was 7.80 on average. According to the water quality classification of Kazakhstan, water quality was classified as “moderately polluted” (class 3; see table 6 for details). At Uralsk, some 65 km downstream, the water pollution index was largely in the range 1.18–1.68 in the period from 1994 to 2004, even though the water quality appeared to deteriorate (classified as “polluted” i.e. class 4) in the late 1990 and in the beginning of the 2000s.

Table 6

Water quality classification in the Ural Basin

Location of observation in the Ural Basin	*Water pollution index[a] – water quality classification* 2008	2009	*Parameters exceeding MAC*	*Multiplier of MAC exceedence*
Zaiyk River (Ural), station Yanvartsevo (on the Russian-Kazakhstan border)	1.25; “moderately polluted” (class 3)	1.67; “moderately polluted” (class 3)	total iron	3.16
			ammonium nitrogen	2.25
			Chromium (+6)	1.75
			phenols	1.19
			BOD_5	2.25
Chagan tributary, station at the village of Kamennyi	1.35, “moderately polluted” (class 3)	1.26, “moderately polluted” (class 3)	phenols	1.40
			sulphates	1.27
			total iron	1.10

Source: Kazhydromet, Ministry of Environmental Protection of Kazakhstan

[a] 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.

Trends

11. Kazakhstan predicts water withdrawal from the Ural to increase significantly by 2020: by almost 70%, compared with the level in 2006. Relatively, withdrawal for agriculture is expected increase and the percentage share of withdrawals for other uses is expected to decrease.

III. Atrek River Basin

12. The basin of the 530-km long[4] Atrek River[5] is shared by the Islamic Republic of Iran and Turkmenistan. It has its source in the Islamic Republic of Iran, forms for some length the border between the riparian countries, and discharges to the Caspian Sea.

13. The Sombar is a transboundary tributary (length about 35 km).

Table 7

Area and population in the Atrek River Basin

Country	*Area in the country (km^2)*	*Country’s share %*	*Population*	*Population density (persons/km^2)*
The Islamic Republic of Iran	26 500	79.1	951 000	36
Turkmenistan	7 000	20.9		
Total**	**33 500**			

4 With its tributaries the river is 635 km long

5 The river is also known as the Atrak.

Sources: Ministry of Energy of Iran, I.R. The Islamic Republic of Iran's national institute of demography, 2006

Hydrology and hydrogeology

14. In the Iranian part of the river basin, all water resources generated internally are estimated to amount 1,263 × 10^6 m^3/year. Of this amount, the surface water resources make up an estimated 958 × 10^6 m^3/year and groundwater resources 306 × 10^6 m^3/year (both values are averages for the years 1972–2007). The total water resources per capita in the basin are 1,368 m^3/year.

15. The long-term mean annual discharge of the river in Turkmenistan is 100 million m^3.

16. There are some aquifers in the Iranian (upstream) part of the basin — used mainly for agriculture — which are recharged by precipitation and return flows and which feed the Atrek as baseflow. According to the Islamic Republic of Iran, there are no transboundary aquifers to speak of.

Pressures

Table 8
Land use/land cover in the Atrek Basin

Country	*Water bodies (%)*	*Forest (%)*	*Cropland (%)*	*Grassland (%)*	*Urban/industrial areas (%)*	*Surfaces with little or no vegetation (%)*	*Wetlands/ Peatlands (%)*	*Other forms of land use (%)*
The Islamic Republic of Iran	<1	5.6	31.7	25.0	5.0	29.7	<1.0	-
Turkmenistan								

Notes: Protected areas make up <1.0 % of the basin share of the Islamic Republic of Iran, including four wetlands out of which three are fed by the Atrek river and one is fed from the Caspian Sea directly (see the separate assessment of the Gomishan Lagoon).

Table 9
Total withdrawal and withdrawals by sectors

Country	*Year*	*Total withdrawal* $\times 10^6$ m^3*/year*	*Agricultural %*	*Domestic %*	*Industry %*	*Energy %*	*Other %*
The Islamic Republic of Iran	2009	1 264	90	5	5	N/A	N/A
	2020[a]	1 118	10	10	8	N/A	N/A
Turkmenistan							

[a] A forecast

17. In the Iranian part of the river basin, most of the water used (90 %) is for agriculture, but only 25 % of fertile land is irrigated, because of lack of water resources. Floods, high sediment load (especially in the Sombar tributary) and river bank alterations are the other main pressures in the basin, assessed as widespread and severe by the Islamic Republic of Iran. Wastewaters are treated only in some big cities and waste management despite being

controlled is also not sufficient, but in impact these factors are considered local and moderate. Some illegal groundwater abstraction occurs. Return flows from the irrigated land affect the river's water quality, resulting in high concentrations of mineral salts.

Status, transboundary impact and response

18. To the most significant factors affecting the surface water and groundwater resources quantity and/or quality are pollution from agriculture, flooding, drought as well as erosion and accumulation of sediments. The local problems include groundwater level decline, natural background pollution, municipal and industrial pollution, viruses and bacteria from inefficiently treated wastewater. Because of the poor water quality especially downstream, water for drinking has to be supplied from another basin.

19. Efforts are on-going in the Islamic Republic of Iran to improve irrigation efficiency by developing the irrigation network, develop wastewater treatment, limit groundwater abstraction and control pollution.

20. Following a bilateral agreement between from the time of the Soviet Union, the Atrek River's water resources are equally shared between the Islamic Republic of Iran and Turkmenistan. There is a need for a new agreement to provide an institutional framework for transboundary cooperation in the current situation. Related to river training, the Islamic Republic of Iran and Turkmenistan have had joint meetings and continue their projects. Some agreements have also been made about river management and dredging of the main Atrek River. The riparian countries have a joint hydrometrical monitoring programme. Monitoring of river discharges is carried out but water quality and sediment monitoring are gaps.

Trends

21. Some decreasing trends in precipitation and discharge have been observed in the Islamic Republic of Iran, but a lack of data limits assessing whether it is due to climate change or related to periodic events. For information on the strategies of the Islamic Republic of Iran in adapting to climate change, please refer to the assessment of the Tejen-Harirud.

22. The Islamic Republic of Iran reports that a comprehensive water management plan for Atrek river basin is under preparation.

23. A number of needs are indicated by the Islamic Republic of Iran related to transboundary cooperation: joint bodies should be created between the two countries, hydroclimatological monitoring stations and data exchange would need to be set up, mapping the Atrek main river at large scale, a joint study on river basin management and river engineering for improving these and implementation of erosion and sediment control in the upstream part of the basin.

IV. Gomishan Lagoon (Islamic Republic of Iran, Turkmenistan)[6]

General description of the wetland

24. Gomishan Lagoon is a natural coastal lagoon located at the south-eastern coast of the Caspian Sea in the province of Golestan in the Islamic Republic of Iran. It is part of two river basins, the Atrek and the Gorgan. However, these rivers do not play a major role in the lagoon's water supply. Essentially, the lagoon is made up of three different parts: The central part of the wetland is covered by saltmarsh vegetation as well as flats of glasswort (*Salicornia*) species, interspersed with pickle-weed (*Halostachys*) and sarsazan grasses (*Halocnemum*) which are seasonally flooded. To the East of the lagoon, the natural grasslands have mainly been converted into arable land for agriculture, namely wheat and cotton production, while the West of the lagoon features coastal dunes, including characteristic sand-dune vegetation. The size of the part of the lagoon which belongs to The Islamic Republic of Iran amounts to nearly 17,700 hectares. Additionally, the Northern part of the lagoon also borders the Western part of the Turkmen Steppe plains. The lagoon is a typical example of a «Coastal Permanent Brackish Lagoon» with an average depth of one meter. It is separated from the Sea only by a very narrow sandy barrier, which is too low in some points. Thus, the lagoon is partly connected to the Caspian Sea which directly influences its hydrological features. This also results in changes of the location of the lagoon`s shoreline due to the fluctuations in the level of the Caspian Sea. The average elevation of the wetland is the same as the Caspian Sea with nearly 27 m below sea level. It mainly consists of silty and sandy sediments, which are transported from the Caspian Sea. The lagoon's climate is semi arid while it gets gradually drier and warmer from South to North. Average annual rainfall in the area is 431 mm.

Main wetland ecosystem services

25. The lagoon contributes to the stabilization of the shoreline and plays a small role in terms of sediment trapping, coastal flood prevention and supports fish and great water birds. Further, it supports the local population (approximately 40,000 people) who use the lagoon for fishing and hunting, while the vast eastern flood plain of the wetland is mainly used for livestock grazing (mostly sheep and goats) as well as for wheat and cotton growing.

Cultural values of the wetland area

26. Due to the lack of fertile soil and sufficient fresh water in the region, people are dependent on fishing as well as shooting of waterfowls of the lagoon. The most important fish species being Caspian Roach (*Rutilus rutilus caspicus*) which migrates into the lagoon from the Caspian Sea during winter and spring seasons.

Biodiversity values of the wetland area

27. The Wetland supports 81 species of waterbirds including threatened species such as the Dalmatian Pelican (*Pelecanus crispus*) (Vulnerable) and the Sociable lapwing (Vanellus gregarius) (Critically Endangered) (according to IUCN`s Red List of threatened species). The Wetland regularly supports more than 20,000 water birds. Furthermore, the wetland regularly supports 1% of the global population of 20 species of waterbirds and is an important source of food for 15 fish species. The fish sub-species Common Roach (*Rutilus rutilus*) depends on the wetland as an important part of its migratory path. The wetland also

[6] Ramsar Information Sheet (http://www.wetlands.org/rsis/)
BirdLife International (2010) Important Bird Areas factsheet: Gomishan marshes and Turkoman steppes. (http://www.birdlife.org/datazone/sitefactsheet.php?id=8086)

supports a few mammal species including the Caspian Seal (*Phoca (Pusa) caspica*) which is listed as being endangered according to IUCN's Red List of threatened species. Reptile species are represented by turtles, lizards and snakes. In terms of flora, the wetland supports 17 species of macrophytes with the Common Reed (*Phragmites australis*), Wigeongrass (*Ruppia maritima*) and Fennel Pondweed (*Potamogeton pectinatus*) being the most dominant ones.

Pressure factors and transboundary impacts

28. The most important factor, which has the potential to have a detrimental effect on the natural ecological character of the wetland, is the Caspian Sea's fluctuation in water level. In 1978, when the Sea surface was at its lowest level, the large Gomishan Lagoon of today consisted only of a chain of narrow, small lagoons behind the Caspian Sea beach. Moreover, due to the Caspian Sea's connection to the lagoon all its introduced exotic species may affect the site. The most important adverse human activities in the area are excessive disturbance through hunting of waterfowl and fishing. Overgrazing and agriculture are additional pressure factors.

Transboundary wetland management

29. Most of the northern half of the wetland is a «no-hunting and no-fishing zone ». Up until now neither a management plan, nor any transboundary cooperation on the wetland exist. However, there has been some bilateral cooperation for determination of the border along the lagoon between the Islamic Republic of Iran and the Soviet Union as well as later between the Islamic Republic of Iran and Turkmenistan.

V. Kura River Basin[7]

30. The basin of the river Kura is shared by Armenia, Azerbaijan, Georgia, the Islamic Republic of Iran and Turkey.[8] The 1,515 km river has its source in Turkey on the North slope of the Allahuekber Mountains Range at the height of about 3,068 m a.s.l. and discharges to the Caspian Sea.

31. The basin has a pronounced mountainous and highland character in Turkey with an elevation between 1,300–3,068 m a.s.l. and an average elevation of about 2,184 m a.s.l.

32. Major transboundary tributaries include the following rivers: the Araks/Aras, Iori, Alazani, Debet, Agstev, Potskhovi/Posof and Ktsia-Khrami. Transboundary aquifers within the Kura Basin include the Alazan/Agrichay, Debet and Agstev-Akstafa/Tavush-Tovuz.[9]

[7] Based on information from Armenia, Azerbaijan, Georgia, the Islamic Republic of Iran, Turkey and the First Assessment of Transboundary Rivers, Lakes and Groundwaters (ECE/MP.WAT/25).

[8] The Russian Federation is usually not considered as a basin country, as its territory in the basin is far below 1% of the total basin area.

[9] These transboundary aquifers are described in the assessment of the Alazani, Debet and Agstev sub–basins, respectively.

Table 10

The largest protected areas located in the Kura-Aras River Basin[10]

Protected area	*Country*	*Coverage (ha)*
Sevan National Park including lake Sevan	Armenia	150 100
Marakan protected area	Islamic Republic of Iran	92 715
Agel National Park	Azerbaijan	17 924
Kiamaki protected area	Islamic Republic of Iran	84 400
Agri Mountain National Park	Turkey	87 380
Arasbaran Biosphere Reserve	Islamic Republic of Iran	72 460
Borjomi-Kharagauli National Park	Georgia	57 963
Shirvan National Park	Azerbaijan	54 373

Table 11

Area and population in the Kura basin

Country	*Area in the country (km^2)*	*Country's share %*	*Population*	*Population density (persons/km^2)*
Armenia	29 743	15.8		
Azerbaijan	57 831	30.7	6 900 000	145
Georgia	29 741	15.8	2 659 000	89
Islamic Republic of Iran	43 209	23.0		
Turkey	27 548[a]	14.6	112 242	24[b]
Total	**188 072**			

[a] The area in total within the whole Kura-Araks Basin which is Turkey's territory; the area within the Kura Basin only is 4,662 km^2. The population figures refer to the Kura Basin area only.

[b] Turkish Statistical Institute, 2008.

Sources: UNECE Environmental Performance Review (EPR) programme; Ministry of Nature Protection of Armenia; Ministry of Ecology and Natural Resources of Azerbaijan; Ministry of Environment Protection and Natural Resources of Georgia; Iranian Ministry of Energy/Deputy of Water and Wastewater Affairs; and Turkey's General Directorate of State Hydraulic Works.

[10] *Source*: Kura-Aras River Basin Transboundary Diagnostic Analysis. Project Reducing Trans–boundary Degradation of the Kura-Aras River Basin (Kura-Aras PDF B). January 2007.

Table 12
Renewable water resources in the Kura Basin per country

Country	*Renewable surface water resources (km³/year)*	*Renewable groundwater resources (km³/year)*	*Total renewable water resources (km³/year)*	*Renewable water resources per capita (m³/capita/year*	*Period of observations used for estimating water resources*
Armenia	4.858	4.311	7.769	2.778	1977-2001
Azerbaijan	8.0	5.2	13.2	1 913	Long term
Georgia	6.438	1.923	8.362	3 144	1935–1990
Islamic Republic of Iran					
Turkey	1.093	0.040	1.133	10 067	1969–1997

33. Spring floods cause damage in some parts of the basin. A number of reservoirs and dams on the Kura serve also for flood regulation. The Mingechevir Reservoir has improved the situation regarding flood control in the lowlands of the river.

Table 13
Most important water reservoirs in the Kura River Basin

River/tributary	*Reservoir, country*	*Year of construction*	*Full volume (mln m³)*	*Payload volume (mln m³)*	*Installed capacity (MW)*
Kura	Mingachevir (AZ)		15 730	8 210	
Kura	Shamkir (AZ)		2 677	N/A	
Aras	Aras (AZ)		1 350	1 150	
Aragvi	Jhinvali (GE)		520	370	
Iori	Sioni (GE)		325	315	
Khrami	Khrami (GE)		313	293	
	Samgori (Tbilisi) (GE)		308	155	
Agstafa	Agstafa AZ)		120	111	
Kura	Yenikend (AZ)		158	136	
Algeti	Algeti (GE)		65	60	

River/tributary	*Reservoir, country*	*Year of construction*	*Full volume (mln m^3)*	*Payload volume (mln m^3)*	*Installed capacity (MW)*
Kura	Barbarinsk (AZ)		62	10	
	Jandari (GE)		54.28	25.03	
Patara Liahvi	Zonkari (GE)		40.3	39	
	Iakublo (GE)		11	10.8	

Sources: Azerbaijan, Georgia and United Nations Development Programme/Sida project Reducing Trans–boundary Degradation of the Kura-Aras river basin, 2005.

Table 14

Kura aquifer: Type 2, volcanic rocks of Tertiary and Quaternary age: Tuff breccia, mergel, quartz porphury, albitophyre. Moderate links with surface water

	Georgia	*Azerbaijan*
Area (km^2)	70	
Renewable groundwater resource (m^3/d)		
Thickness in m (mean, max)	100, 250	
Groundwater uses and functions	Used for drinking water	
Other information	A common monitoring programme is indicated to be needed	

Pressures

34. The economy of the Turkish part of the Kura Basin relies on agriculture and animal production and, in Azerbaijan, extensive areas are under irrigated agriculture (some 745,000 ha in Azerbaijan, including 300,000 ha in the Azerbaijani part of the Araks/Aras sub-basin). In the part of the basin that is Turkey's territory, nearly one fifth of irrigable land is irrigated, but the area is increasing through land development projects. Upon completion of Turkey's Kura Master Plan, more than 38,000 ha of land will be irrigated. Where the groundwater table is high and there are problems with drainage, irrigation contributes to soil salinization. Water withdrawal from the Kura for irrigation occurs mainly downstream from Mingechevir.

35. In the Georgian part of the basin, agriculture is one of the main factors affecting groundwater as large amounts of water are abstracted for irrigation and via pollution from fertilizers. Animal stocks have also gradually increased in parallel with irrigation. There are also manure and fertilizer pollution problems related to agricultural activities in the basin. There is some limited manufacturing activity in Turkey based on agriculture and animal husbandry.

36. Logging has reduced forested areas and deforestation and overgrazing makes areas vulnerable to erosion, resulting in reduced stability of the ground and loose sediment making the river water turbid. Climatic, topographic and geological conditions also contribute to erosion. Land and soil degradation are a concern, e.g., in the upper part of the basin (Turkey). In addition to fertile soil wash-out, land degradation in the basin involves also salinization, especially in more arid parts of the basin. These are both reported to be a concern in Georgia and Azerbaijan. Some stone and aggregate quarries in Turkey have a

degrading effect on the landscape, but at local scale. Aggregate quarries add to erosion risk in the riverbed. Planned dam constructions are expected to influence the flow and hydromorphology.

37. Some 11 million people live in the catchment area of the Kura River[11] Wastewater discharges pose a risk of surface and groundwater pollution, because of a lack of wastewater treatment plants in urban settlements. In Georgia, municipal wastewater treatment plants are mostly not in functioning condition. In rural settlements, there is commonly no sewerage network. In the Turkish part, the influence of wastewater from municipalities and households is considered local, but severe.

38. There are similar risks from controlled and uncontrolled dumpsites, which are assessed by Turkey as local but severe in influence. In the Azerbaijani and Georgian parts of the basin, pollution from illegal dump sites is one of the main factors influencing the condition of waters. There are controlled dumpsites in municipalities in the Turkish part, but some, like Ardahan, may cause pollution of nearby agricultural land.

39. Polluting activities present in the basin include also mining (in Armenia, Georgia and the Islamic Republic of Iran), metallurgical and chemical industries. The major pollutants are heavy metals (copper (Cu), zinc (Zn), cadmium (Cd)) from mining and the leather industry, and ammonia and nitrates from the fertilizer industry. The waste rock dumps of Madneuli mine in the village of Kazreti, Georgia, are reported have an impact through rainfall flushing metals and other contaminants from the heaps to the river Mashavera.

40. Ceyhan-Tbilisi-Baku oil pipeline traversing the territory of Georgia in the basin is felt to pose a pollution risk.

Table 15
Water use in different sectors (per cent)

Country	*Total withdrawal ×10^6 m^3/year*	*Agricultural %*	*Domestic %*	*Industry %*	*Energy %*	*Other %*
Armenia	2.950	66	30	4		
Azerbaijan	11 785	63.4	N/A	20.8	[b]	N/A
Georgia	12 158	1	3	2	94	N/A
Islamic Republic of Iran						
Turkey	65	88	12	0[a]	0	N/A

[a] Considered negligible in Turkey as there are no substantial industrial facilities in the Turkish part of the basin and as the existing small factories generally use water from municipalities or from groundwater wells.

[b] Non-consumptive water use for energy purposes in Azerbaijan is 13.1 km^3/year.

41. The Kura River is the source of drinking water for almost 80% of the population of Azerbaijan.

42. The main water users in the Georgian part of the Kura River Basin are: agriculture, industry, municipalities and the energy sector (hydro- and thermal energy generation). In agriculture the water source for irrigation in Eastern Georgia is surface water. The efficiency of the irrigation network is quite low, with water losses estimated at 40–50%.

[11] Environmental Performance Review Azerbaijan, UNECE, 2004.

The main industry sectors using water are: chemical industry, building material industry, non-ferrous metallurgy and food processing industry. Groundwater makes up 80% of the drinking water distributed through centralized networks.

43. In the Turkish part, water for domestic use is commonly taken from springs and wells. Groundwater is also used locally for irrigation by farmers. Groundwater abstraction is not considered to be of concern. Surface water is withdrawn for irrigation locally also in Turkey, but its influence is considered insignificant.

Status

44. According to Turkish Inland Water Quality Standards, water quality in the Turkish part of the Kura River is in Class I and Class II, that is, unpolluted and/or less polluted water bodies, respectively.

45. According to measurements by Armenia from 2006 to 2009 along the Araks/Aras River, heavy metals such as aluminum (Al), iron (Fe), manganese (Mn), chrome (Cr) and vanadium (V) occur in water in moderate amounts. Some of these are part of the typical geochemical background of the Araks/Aras. Cr occurs at amounts exceeding the maximum allowable concentration (MAC) almost every year. Nitrate level did not exceed MAC during the same observation period.

46. According to the Ministry of Environment of Georgia, in the Kura River in 2008 (Tbilisi, Vakhushti Bagrationi bridge) the biochemical oxygen demand for five days (BOD_5) fluctuated between 1.79 (April) and 7.36 mg/l (September), and the concentrations of ammonium ion (NH_4^+) from 0.3 (January) to 1.4 mg/l (October). In 2009, the maximum concentration of ammonium ion was nine times higher than the corresponding MAC, ranging from 0.209 (November) to 3.616 (October). Other measured components within the respective MAC. To date, ecological and chemical status of the river is satisfactory in Georgia's view.

47. According to the Ministry of Ecology and Natural Resources of Azerbaijan, in 2009, the concentrations of BOD_5 ranged 2.45–5.02 mg/l, the concentration of NH_4^+-ion from 0.38 to 1.0 mg/l, the concentration of copper and zinc ranged from 0.69 to 1.01 mg/l in the Kura River at monitoring station Kura Shikhli-2. Phenols concentrations ranged from 0.003 to 0.007 mg/l. Other measured components were below the respective MAC. To date, in Azerbaijan's view, ecological and chemical status of the river is not satisfactory.

Trends

48. Turkey reports that no study has been carried out for historical climate change on Kura River Basin based on observation. However, according to national prediction and long-term scenarios, both precipitation and river run-off are expected to decrease by 10 to 20%, the former by 2030 and the latter by 2070–2100. Seasonal variability in precipitation and flood/drought risk are predicted to increase. Based on expert knowledge, groundwater level is predicted to decrease and groundwater quality to be affected negatively. Both consumptive and non-consumptive water uses are foreseen to increase.

49. To assess the future impact of predicted climate changes on the hydrological regime of the Alazani and Iori Rivers, crossing the territory of the East Georgia, a hydrological model — the Water Evaluation and Planning System (WEAP) — was applied. The water resources of these rivers are intensively used for the irrigation of crops and pastures.

Forecast of changes in climatic parameters (temperature, precipitation) has been performed applying two regional models.[12] Both rivers have been assessed starting from the upper part of their catchments, but limited by the Georgian territory. Climate change impacts on the upper parts of the Alazani and Iori Rivers and some segments on the territory of Georgia have been assessed for the time horizon 2070–2100. For that period, the annual mean temperature forecast is 8.9°C (current average 3.3°C) in the upper part of the Alazani and 11.9°C (current average 6.4°C) in the upper part of the Iori. The projected average for the annual sum of precipitation is 2,260 mm (current average 2,280 mm) for the Alazani and 1,351 mm (current average 1325 mm) for the Iori. The predicted decreases in flow are about 8.5% in the Alazani and 11% in the Iori.

50. In the Turkish part of the Kura Basin, water use is expected to increase substantially, to 0.331 km^3/year (presently 0.065 km^3/year) upon the completion of the projects in the Kura Master Plan. In particular, water use for hydropower is foreseen to increase. Georgia predicts increases in withdrawals in some tributaries, including the Alazani, Iori and Ktsia-Khrami Rivers, from a few% up to 10% by 2015.

VI. Iori/Gabyrry sub-basin[13]

51. The basin of the 320-km Iori River[14] is shared by Georgia and Azerbaijan. The river has its source in on the southern slope of the Main Caucasian Range at the height of 2,600 m and discharges into the Kura, as a left-hand side (northern) tributary. The upper part of the sub-basin is mountainous, located on the southern slope of the Kaveazskogo ridge, and the lower within Kakheti Kartlino plateau (lowland steppe).

52. In Georgia, the river system is made up of 509 smaller rivers with an overall length of 1,777 km. There are nine major tributaries to the Iori, ranging in length from 10 to 32 km: the Lapianhevi (10 km), the Ragolanttskali (12 km), the Hashrula (12 km), the Gombori (13 km), the Keno (16 km), the Adede (16 km), the Sagome (18 km), the Ole (29 km) and the Lakbe (32 km).

Table 16
Area and population in the Iori sub-basin

Country	*Area in the country (km^2)*	*Country's share %*	*Population*	*Population density (persons/km^2)*
Georgia	4 650	88.4	240 800	52
Azerbaijan	610	11.6	53 400	37
Total	**5 260**			

Sources: Ministry of Environment Protection and Natural Resources of Georgia for the area in Georgia; Ministry of Ecology and Natural Resources of Azerbaijan for the area in Azerbaijan.

Hydrology and hydrogeology

53. Surface water resources in the Georgian part of the basin are estimated at 0.366 km^3/year (average for the years 1963–1992) and groundwater resources at 0.155 km^3/year

[12] Regional climate models PRECIS and MAGICC/SCHENGEN.
[13] Based on information from Azerbaijan and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.
[14] The river is known as Gabyrry in Azerbaijan.

(based on year 2004), adding up to a total of 0.522 km^3/year (or 2,166 m^3/capita/year). The hydrological regime of the river is characterized by spring floods (from snowmelt and heavy rainfall that usually occurs during March), summer/autumn high waters and steady low-water levels in winter.

54. In Georgia, there are three large irrigation reservoirs on the Iori River: the Sioni Reservoir, used for irrigation, hydropower generation and water supply; the Tbilisi Reservoir, used for irrigation and water supply; and the Dalimta Reservoir, used for irrigation.

Table 17

Aquifer No. 61: Sandstones, conglomerates, marls, limestones, alluvial-proluvial pebbles and sands, Tertiary and Quaternary in age. Groundwater flow direction from Georgia to Azerbaijan. Medium links with surface water

	Georgia	*Azerbaijan*
Area (km^2)	100	
Border length (km)		
Thickness in m (mean, max)	100, 300	
Groundwater management measures		
Groundwater uses and functions	Used for drinking	
Other information	A common monitoring programme is indicated to be needed	

Pressures and status

55. The sub-basin is characterized by meadow and forest vegetation. Above 2,000 m, on the ridges, there is a narrow strip of alpine vegetation and, below it, a broad band of subalpine meadows. The rest of the sub-basin is covered by forests, including the so-called Bactrian woods along the river. Areas close to the river valley are covered by steppe vegetation. In Eldarskoy steppe, small patches of relict pine forest remain, unique in the Caucasus.

Table 18

Land use/land cover in the Iori/Gabyrry Basin

Country	*Water bodies (%)*	*Forest (%)*	*Cropland (%)*	*Grassland (%)*	*Urban/ industrial areas (%)*	*Surfaces with little or no vegetation (%)*	*Wetlands/ Peatlands (%)*	*Other forms of land use (%)*
Georgia	N/A	14.5	29.5	*55.1/0.491*	N/A	N/A	N/A	0.34
Azerbaijan	N/A	1.6	10.0	51.3	N/A	N/A	N/A	0.02

56. Diffuse pollution from agriculture (About 94,000 ha are used for irrigated agriculture) and municipal wastewater are the main anthropogenic pollution sources in Georgia. Georgia considers anthropogenic pollution as moderate and limited in extent. In Azerbaijan, 1,522 ha are used for irrigated agriculture.

57. One of the main factors influencing water quality negatively in the Georgian part is uncontrolled waste dumps on the river banks. Their influence is severe according to Georgia, but only local.

58. In the Georgian part, wastewater treatment facilities in municipalities are not operational and in rural settlements there is no wastewater collection system. Georgia ranks the influence of this pressure as severe and widespread.

59. According to Georgia, the withdrawal of surface water for different purposes is a pressure factor, with withdrawal for agriculture having the most widespread and severe influence. Withdrawals for households and industry are limited. Drinking water to a part of Tbilisi is supplied from Tbilisi Reservoir (a part of the Sioni-Zhinvali Reservoir complex), receiving water from the Iori River. A few years ago there were concerns about the capacity to meet the increasing drinking water demands of Tbilisi, together with agricultural water demands. Currently, the city of Tbilisi is improving its water supply — for example by reducing water losses.

60. Georgia considers groundwater resources within the sub-basin as not significant with regard to the total water demand, of which only 1.4% is met from groundwater. However, Iori Valley is mainly supplied with groundwater from the flood-plain and river terraces above the flood-plain. Furthermore, drilled wells tap artesian groundwater for use by the population and industry.

Table 19
Water use in different sectors in the Iori/Gabyrry sub-basin (percentage)

Country	*Total withdrawal* $\times 10^6$ *m*^{3}*/year*	*Agricultural %*	*Domestic %*	*Industry %*	*Energy %*	*Other %*
Azerbaijan	N/A	10	N/A	N/A	N/A	0.01
Georgia	291[a]	2.95	1.31	0.31	94.75	0.68

[a] 2008 figures.

61. Azerbaijan reported that there was little human impact on the river. Ministry of Environment of Azerbaijan evaluates ecological and chemical status of rivers moderately polluted. Pollution is mainly transboundary. The Ministry of Environment of Georgia assesses the river’s ecological and chemical status as “good”.

Trends

62. By 2015, Georgia predicts an increase of approximately 3% in water withdrawal from the Iori, to approximately 300×10^6 m^3/year. A slight relative decrease is expected in agricultural water withdrawal, but small increases are expected in withdrawals for households and industry.

VII. Alazani/Ganyh sub-basin[15]

63. The basin of the river Alazani[16] is shared by Georgia and Azerbaijan. The 391-km river (104 km in Georgia, 282 km along the common border between Georgia and Azerbaijan, and 5 km in Azerbaijan) has its source in the southern slopes of the Main Caucasus Mountain Range (elevation 2,600–2,800 m a.s.l) and is bound in the west by the Kahetsky Range and its southern extension, Gomborsky ridge. The Alazani flows for a substantial part of its length along the Georgia-Azerbaijan border and discharges into the Mingachevir Reservoir in Azerbaijan.

64. The most important tributaries (by length) are the following: the Kabala (48 km), the Chartlishevi (39 km), the Mazymchay (39 km), the Belokanchay (39 km), the Katehchay (59 km), the Talachay (40 km), the Kurmuhchay (55 km) and the Agrichay (134 km). In the basins of left bank tributaries of the Alazani, the base flow component to the river flow (from groundwater) is estimated to be 40–50%. There is currently some concern about worsening conditions for generating baseflow. The Alazan-Agrichay transboundary aquifer is linked to the Alazani River.

65. Melting of seasonal snow and rainfall causes spring flooding, but flooding resulting from rainy days in the summer can also result insignificant increases in water levels, especially in the lower reaches of the river.

Table 20
Area and population in the Alazani sub-basin

Country	*Area in the country (km²)*	*Country's share %*	*Population*	*Population density (persons/km²)*
Azerbaijan	4 755	41	564 900[a]	*119/63*
Georgia	6 962	59	342 400	49
Total	**11 717**			

[a] Figure for 2009.

66. Transboundary protected areas within the Alazani sub-basin include Lagodekhi-Zagatala-West Dagestan (between Georgia, Azerbaijan and the Russian Federation, the total area of 498,706 ha), and Alazani Ganikh (between Georgia and Azerbaijan; 51,230 ha).

Table 21
Renewable water resources in the parts of the Alazani sub-basin that are the territory of Azerbaijan and Georgia

Country	*Renewable surface water resources (km³/year)*	*Renewable groundwater resources (km³/year)*	*Total renewable water resources (km³/year)*	*Renewable water resources per capita (m³/capita/year)*	*Period of observations used for estimating water resources*
Azerbaijan	3.472	0.0007	3.473	6,150	1995–2008
Georgia	1.360[a]	1.24	2.60	7,600	1946–1992

[15] Based on information from Azerbaijan and the First Assessment of Transboundary Rivers, Lakes and Groundwaters

[16] The river is known as Alazani in Georgia and as Ganyh in Azerbaijan.

[a] Surface water resources in the Georgian part of the Alazani basin are estimated at 1.360 km^3/year at Shakriani gauging station and 3.001 km^3/year at Zemo-Kedi gauging station.

Table 22

Alazan-Agrichay aquifer (No. 62[17]): Type 3, Consists of an unconfined part (more vulnerable to, e.g., pollution) at the top part of an alluvial cone located at the foot of the mountains, underlain by confined aquifer where groundwater is artesian. Slate and clay shale, siltstone, sandstone, limestone, marl, sea and continental Molasse, sandstones, conglomerates, sands; Jurassic, Cretaceous, Tertiary and Quaternary in age. Groundwater flow direction from Greater Caucasus to the Alazani River, i.e., from Georgia to Azerbaijan. Medium links with surface water

	Georgia	*Azerbaijan*
Area (km^2)	980	3 050
Border length (km)	140	
Thickness in m (mean, max)	150, 320	
Groundwater management measures	Need to be improved: integrated management, abstraction management, efficiency of use, monitoring, agricultural practices, protection zones, mapping Need to be applied: treatment of urban and industrial wastewater, transboundary institutions, data exchange	Need to be improved: control of the use of groundwater resources. Need to be applied: treatment of urban and industrial wastewater, monitoring programmes both quantity and quality, data exchange
Groundwater uses and functions	Used for drinking water (e.g. towns of Telavi and Gurjaani are supplied from groundwater in the alluvium); agriculture	Irrigation (80–85%) Drinking water supply (10–15%) Industry (3–5%)
Other information	A common monitoring programme is indicated to be needed. A substantial problems related to groundwater quantity or quality. Water demand was expected to increase. There is no information about transboundary impacts.	

Pressures

67. Azerbaijan expresses concern about transboundary pollution from municipal wastewater (e.g. biochemical oxygen demand — BOD, chemical oxygen demand — COD, nitrogen, phosphorus) and pollution from agriculture (e.g., nitrogen, phosphorus, pesticides). Municipal wastewaters are among the main anthropogenic pollution sources in Georgia.

68. Georgia ranks diffuse pollution from agriculture, viniculture and animal husbandry in the Alazani basin as severe and widespread. As irrigation infrastructure involves a high share of open unlined channels, the water efficiency is low. More than 40,000 ha is

[17] In the First Assessment of Transboundary Rivers, Lakes and Groundwaters, the number of the aquifer was 5.

irrigated from the Upper Alazani irrigation system and the Lower Alazani system is expected to be renovated (20,000 ha), resulting in a decrease of water losses.

69. Flood-plain forests are still taken to cultivation to some extent. Erosion of river banks occurs, the influence of which Georgia assesses as severe, but local.

Table 23
Land use/land cover in the Alazani sub-basin

Country	*Water bodies*	*Forest*	*Cropland*	*Grassland*	*Urban/industrial areas*	*Surfaces with little or no vegetation*	*Wetlands/ peatlands*	*Other forms of land use*
Azerbaijan	N/A	15.6	44.5[a]	0.96	N/A	N/A	N/A	N/A
Georgia	N/A	26.9	26.8	*45.8/0.17*	N/A	N/A	N/A	0.2

[a] The reported cropland figure includes melon cultivations..

Table 24
Water use in different sectors (percentage) from the Alazani

Country	*Total withdrawal* $\times 10^6$ *m*^{3}*/year*	*Agricultural*	*Domestic*	*Industry*	*Energy*	*Other*
Azerbaijan		[b]	0.07	N/A	N/A	0.85
Georgia	632 378[a]	0.4	0.9	0.2	91.7	6.7

[a] 2008 figures
[b] Some 9 m^3/h is pumped from the river for irrigation.

Status

70. The Ministry of Environment of Georgia assesses the river's ecological and chemical status as "good".

71. According to the Ministry of Ecology and Natural Resources of Azerbaijan, in the Alazani in 2009 (Ganyhchay gauging station 1.7 km below confluence with the Agrichay) BOD_5 concentrations fluctuated between 1.95 and 3.02 mg/l, the concentration of NH4+-ion from 0.18 to 0.65 mg/l and the concentration of copper and zinc ranged from 0.03 to 0.08 mg/l. The concentration of phenols was measured at 0.002–0.004 mg/l. Other measured components were within the respective MAC. At present, the river is moderately polluted.

Trends

72. By 2015, Georgia predicts an increase of approximately 10% in water withdrawal from the Alazani, to approximately 700×10^6 m^3/year. The biggest relative increases are expected in agriculture and industry, followed by household water.

VIII. Debet sub-basin[18]

73. The basin of the river Debet[19] is shared by Armenia and Georgia. The 154-km Debet River rises at about 2,100 m a.s.l. and flows through a deep valley, joins with the Ktsia-Khrami and discharges into the Kura. The sub-basin has a pronounced mountain territory character with an average elevation of about 1,770 m a.s.l.

74. Major transboundary tributaries include Dzoraget (length 67 km, catchment area 1460 km^2) and Pambak (length 84 km, catchment area 1370 km^2).

75. A transboundary aquifer called Debet is linked to the surface waters in the basin.

Table 25
Area and population in the Debet sub-basin

Country	*Area in the country (km^2)*	*Population*	*Population density (persons/km^2)*
Armenia	3 790 (92.4%)	7 340[a]	89
Georgia	310 (7.6%)	20 632	66
Total	**4 100**		

Sources: Ministry of Environment Protection and Natural Resources of Georgia and L.A. Chilingarjan et al. “Hydrography of rivers and lakes in Armenia”, Institute of hydro-technology and water problems, Armenia.
[a] Statistical management, Armenia; http://www.armstat.am/.

Trends

76. Flow of the Debet River is not regulated. There is one reservoir on the Dzoraget River in the Armenian part of the catchment area of the Debet River-Mecavan with a volume of 5.40 million m^3. This facility for energy generation impacts moderately on natural flow.

77. Spring floods affect the lower part of the sub-basin, also causing damage.

78. Surface water resources the Debet sub-basin as flow generated in Armenia are estimated at 1.197 km^3/year (based on data from 1955 and 1961 to 2008) and groundwater resources at 0.180 km^3/year (average for the years from 1991 to 2008), making up a total of 1.377 km^3/year. This equals 188,000 m^3/year/capita.

Table 26
Debet aquifer (No. 64)[20]: Type 3 (Alluvial aquifer connected to the river, little transboundary impacts). Alluvial–proluvial formation of modern Quaternary age in the upper part of the basin. Volcanic–sedimentary rocks, limestones, tuffbreccia Consists of two main aquifers. Medium links with surface water

	Georgia	*Armenia*

[18] Based on information from Armenia and Georgia, and the First Assessment of Transboundary Rivers, Lakes and Groundwaters
[19] The river is known as Debed in Armenia and Debeda in Georgia.
[20] Based on information provided by Armenia and the first Assessment of Trasboundary Rivers, Lakes and Groundwaters. In the first Assessment, the aquifer was called “Pambak–Debet” (aquifer no. 10)

Area (km^2)		20
Thickness – mean, max (in m)		20–30, 50[21]
Groundwater resource (m^3/day)		39 000
Groundwater management measures	Effective: controlled water abstraction Need to be improved: urban and industrial wastewater treatment, Need to be applied: transboundary institutions to be set up, monitoring programme to be enhanced	It is important to make controlled water abstraction. Need to be improved: urban and industrial wastewater treatment, Need to be applied: transboundary institutions to be set up, monitoring programme to be enhanced and data exchange
Groundwater uses and functions	Drinking water supply 100%	Drinking water up to 90%, irrigation and mining industry
Pressure factors	Lack of data	Mining industry (assessed as severe in influence but local), agriculture and drainage water from dumps (widespread but moderate).
Additional information	1) There is a lack of data about problems related to groundwater quantity and quality; 2) Joint monitoring programme is felt to be needed; 3) Georgia predicts increased water use as a consequence of economic growth.	

Pressures

Table 27
Land use/land cover in the Debet sub-basin

Country	*Water bodies*	*Forest*	*Cropland*	*Grassland*	*Urban/ industrial areas*	*Surfaces with little or no vegetation*	*Wetlands/ peatlands*	*Protected areas*	*Other forms of land use*
Armenia	0.01	23.7	11.6[b]	33.4	5.6	2.4	0.1	1.2	21.8
Georgia[a]		*27 km²*	*327 km²* [c]	*336 km²*					

[a] The reported surface areas exceed the total surface area reported as the territory of Georgia within the sub-basin.
[b] From the cropland area, 27% is irrigated.
[c] From the cropland area, 40 km^2 or 13% is irrigated.

[21] There are two main aquifers: one at a depth of 71–120 m and with a thickness of stratum 48 m and a second one at a depth of 98–150 m and with a thickness of stratum of 25 m.

Table 28
Water use in different sectors (percentage) Debet sub-basin

Country	*Total withdrawal ×10^6 m^3/year*	*Agricultural*	*Domestic*	*Industry*	*Energy*	*Other*
Armenia	1358.8	7.5	0.8	0.3	90.6	0.7
Georgia	8.9	99		1		

79. In Georgia, the river water is mainly used for irrigation. Due to the poor technical condition of irrigation systems water losses occur. In addition, there is pollution of surface water from diffuse sources as a result of the use of fertilizers and pesticides

In the Armenian part of the basin, surface water withdrawal for irrigation is 101.695 ×10^6 m^3, which impacts on natural water flow locally.

80. In the Armenian part of the sub–basin, heavy metal (V, Mn, Cu, Fe) concentrations are naturally elevated, linked to the occurrence of ore deposits. Armenia ranks this influence as widespread and severe. Wastewater from the ore enrichment and processing industry are the main anthropogenic pollution sources. Improvements in ore processing facilities in recent years have decreased water pollution, but leakages from a tailings dam that stores wastes from the Achtalinsk ore processing factory are still a concern. There are also wastewater discharges from municipal sources (some 110 human settlements in the Armenian part). Armenia assesses the influence related to different wastewater as severe, but local in scope in the case of industry and more widespread from municipal sources.

81. Diffuse pollution from agriculture (51% of the Armenian agriculture uses water from the sub–basin of the Debet) is among the main pollution sources.

82. Due to the recent economic crisis, about 15% of all forest has been cut down, or some 14,000 ha. This deforestation impacts on the flow regime as well as water quality, but Armenia assesses the influence as local and moderate.

83. In Armenia, freight transport concentrates in the southern region and the Debet sub-basin in particular. There is wet and dry deposition of pollutants from the atmosphere, which get washed to surface waters increasing their content of suspended solids, COD, zinc, copper and lead. Shortcomings in solid waste handling can influence water quality negatively, but this is local and remains moderate.

Status and transboundary impact

84. The chemical and ecological status of the water system is not satisfactory for the maintenance of aquatic life, but meets the requirements for municipal, agricultural, industrial and other uses.

85. The most significant factors concerning impacts on surface water are untreated municipal wastewater (increased content of BOD, COD, nitrogen, phosphorus), pollution from agriculture (e.g., nitrogen, phosphorus, pesticides) and pollution from industrial wastewater (heavy metals). Erosion and accumulation of sediments also affect the status. In Armenia, the intensity of the before-mentioned factors is observed to be already reduced at the border between Armenia and Georgia and therefore inferred not to have transboundary impacts. In the period 2006–2009 the average mineral content at the border between Armenia and Georgia was 270 mg/l according to monitoring by Armenia.

Management response

86. Supported by the Municipal Development Fund of Georgia, projects for rehabilitation of irrigation systems are implemented. Bank protection activities carried out at selected sites.

So far, no particular measures have been taken in Armenia to address the pollution by municipal wastewaters.

87. In the framework of the EU Project: “Trans–Boundary River Management Phase II for the Kura River Basin — Armenia, Georgia, Azerbaijan”, joint monitoring is being carried out between Georgia, Azerbaijan and Armenia four times a year.

Trends

88. In terms of climate change, Armenia predicts by 2030 that the air temperature will rise by 1.1°C and that precipitation will decline by 3.1%. River discharge is predicted to decline by 3–5% and groundwater level to drop by 8–10% under the influence of climate change. Some moderate deterioration of groundwater quality is expected. It is considered that related indirect or secondary impacts (for example on land use and agriculture) will be appreciable in Armenia, but that water use will not be greatly influenced.

IX. Agstev/Agstafachai sub–basin[22]

89. The basin of the 121 km river Agstev[23] is shared by Armenia and Azerbaijan. The river has its source at about 3,000 m above sea level and discharges into the Kura River.

90. The sub-basin has a pronounced mountainous character with an average elevation of about 1,615 m a.s.l.

91. Major transboundary tributaries include the 58-km long Getik River (basin area 586 km^2) and the 58-km long Voskepar River (basin area 510 km^2). Lake Parz and Ijevan Reservoir are located within the sub-basin.

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[22] Based on information from Armenia and Azerbaijan, and the First Assessment of Transboundary Rivers, Lakes and Groundwaters

[23] The river is known as Agstafachai in Azerbaijan.

Table 29

Agslev–Akstafa/Tavush–Tovuz aquifer [24]: Volcanic and carbonate rocks of Middle Jurassic and Middle Eocene age. Consists of two main aquifers[25]. Groundwater flow from Armenia to Azerbaijan. Moderate connections with surface water

	Armenia	*Azerbaijan*
Area (km^2)	500	500
Thickness – mean, max (in m)	N/A	N/A
Groundwater resource (m^3/day)	279 000	N/A
Groundwater management measures	It is important to make controlled water abstraction Need to be improved: urban and industrial wastewater treatment, Need to be applied: transboundary institutions to be set up, monitoring programme to be enhanced and data exchange	
Groundwater uses and functions	Drinking water up to 75%, irrigation up to 25%	Irrigation 80%, drinking water 15%, industry 5%
Pressure factors	1) industrial waste products (wine and woodworking factories of Ijevan, food processing of Dilijan), which leads to increased concentrations of organic matter (e.g. BOD, COD, nitrogen and phosphorus; impact severe but local); 2) waste disposal	Mining industry (heavy metal pollution, with moderate transboundary impacts)
Additional information		Azerbaijan predicted increased water use as a consequence of economic growth.

Pressures

Table 30

Land use/land cover in the Agstev basin

Country	*Water bodies*	*Forest*	*Cropland*	*Grassland*	*Urban/industrial areas*	*Surfaces with little or no vegetation*	*Wetlands/ peatlands*	*Other forms of land use*
Armenia	0.3	14.2	21.5	45.1	10.1	0.3	0.1	8.4
Azerbaijan	N/A	2.5	10	7.6	3.8	56.7	N/A	6.8

[a] Includes protected areas (0.7%)

[a] Includes protected areas (6.7%)

92. Ranked as severe and widespread in influence in the Armenian part of the basin, the Ijevan and Dilidzhane landfills are close to the river and not protected from the effects of wind. Waste gets into the river by wind. Also, drainage water from the landfills, either directly or by seeping into groundwater, damages water quality. Furthermore, in many rural

[24] In the first Assessment, the aquifer was called “Agstev–Tabuch” (aquifer no. 11)

[25] At Margaovitsky groundwater system, there are two artesian aquifers: one with a depth of 46–57 m and a thickness of 11 m and another one with a depth of 98–150 m and a thickness of 52 m.

areas located in the Armenian part of the aquifer Agstev–Tavush, landfills are not controlled. Recreational visitors also leave trash in nature, which adds to the pollution of the river.

93. The high concentration of heavy metals (Fe, Cu, Mn) is mainly due to natural background pollution, and Armenia assesses its influence as severe and widespread.

94. Domestic and municipal wastewaters are one of the main sources of anthropogenic pollution of the river in the territory of Armenia, assessed as severe and widespread in impact.

95. Another one of the main factors of anthropogenic pollution of surface water — ranked as severe and widespread by Armenia — is diffuse pollution from agriculture.

96. In the post-Soviet period, because of the economic crisis, deforestation was not controlled and it affected the flow regime and water quality in rivers. In recent years, deforestation has decreased with improved energy supply. The influence of this factor is severe according to Armenia, but remains local.

Status and transboundary impact

97. According to Armenia, in the period 2006–2009 water quality in the Agstev was evaluated mainly as a “good”. In the Armenian part of the sub-basin, the Agstev is exposed to background contamination as a result of hydrochemical processes that leads to increased concentrations of heavy metals (V, Mn, Cu, Fe). These concentrations already exceed the MACs for the fish on top of the sub–basin. The main factors that have a negative impact on surface water resources are untreated urban wastewater (indicated by elevated levels of BOD and COD downstream from Ijevan, nitrogen, phosphorus and sulfate), contamination of agricultural products (e.g., nitrogen, phosphorus) and contamination by industrial wastewater (mostly with organic substances). The concentrations of several determinands such as Zn, Fe and sulphate decrease from their levels upstream by the monitoring station just upstream from the border of Armenia and Azerbaijan indicating reduced potential for transboundary impact. At three out or four reported monitoring stations[26] in the Armenian part of the sub-basin, the amount of suspended solids has increased from 2006 to 2009. In 2006–2009, the mineral content at the border of Armenia and Azerbaijan was on average of 330 mg/l. In the period 2004–2006, the average mineral content at the border was 559 mg/l and the maximum 600 mg/l. At least by this indicator, there seems to have been some reduction in the loading from the previous assessment period.

98. According to monitoring carried out by Azerbaijani specialists during the period from 2006 to 2009, the average content of total dissolved solids on the border between Armenia and Azerbaijan is 570 mg/l.

Trends

99. With the current trend of climate change, by 2030, according to the forecast, air temperature will rise by 1.1 ° C, while rainfall will decrease by 3.1%. Under the influence of climate change, rainfall is predicted to decrease by 3–4% and run-off to decrease by 5–10%. Groundwater levels are expected to decrease by 10–15%, with minor change in groundwater quality.

[26] Monitoring stations number 16 at Dilijan, 17 at Ijevan and 18 just upstream from the border with Azerbaijan.

X. Potskhovi/Posof sub–basin[27]

100. The sub–basin of the river Potskhovi/Posof[28] is shared by Turkey and Georgia. The 64-km river (35 km of the river length in Georgia) has its source in Turkey, from springs on the north-eastern slope of Goze Mountain (Göze Dağı) and discharges into the Kura River.

101. The sub-basin has a pronounced hilly, rough, and mountainous character on the Turkish side with an average elevation of about 2,100–2,200 m a.s.l. and is hilly on the Georgian side with an average elevation of about 1,700 m a.s.l., cut by deep and narrow gorges.

Table 31
Sub-basin of the Potskhovi/Posof

Country	*Area in the country (km^2)*	*Country's share %*	*Population*	*Population density (persons/km^2)*
Turkey	601	31.1	11 851[b]	20
Georgia	1 331[a]	68.9	46 650	35
Total	**1 932**			

[a] Ministry of Environment Protection and Natural Resources of Georgia.
[b] Posof Municipality, Turkey (2008).

Hydrology and hydrogeology

102. Floods mostly occur in the middle or end of March and reach their maximum in April, sometimes in May; the average increase of water levels is on the order of 0.8–1.2 m.

103. Surface water resources in the territory of Turkey are estimated to be approximately 0.217 km^3/year, which is 18,310 m^3/year/capita. In the part of the basin that is Georgia's territory, the surface water resources are estimated based on observations from 1936 to 1990 to be approximately 0.6716 km^3/year, which is 14,397 m^3/year/capita.

Pressures

Table 32
Land cover/use (percentage of the part of the sub-basin extending in each country)

Country	*Water bodies*	*Forest*	*Cropland*	*Grassland*	*Urban/industrial areas*	*Surfaces with little or no vegetation*	*Wetlands/ peatlands*	*Other forms of land use*
Turkey	~0.4	18	48.6	30	N/A	N/A	N/A	3
Georgia	N/A	19.2	7.4	28.4	N/A			N/A

[27] Based on information from Georgia, Turkey, and the First Assessment of Transboundary Rivers, Lakes and Groundwaters
[28] The river is known as Potskhovi in Georgia and as Posof in Turkey.

104. In the part of the basin that is Turkey's territory, human pressure on water resources is relatively low due to the small, rural population. In Georgia's part of the basin, water withdrawal is 9.156×10^6 m^3/year with 78% withdrawn for energy, 13% for agricultural purposes, 4% for domestic uses and 5% for industry.

105. Problems related to landslides and erosion are local and moderate. Animal husbandry and agriculture are the main source of income. Irrigation and animal production are on the increase, which is a general tendency in the Turkish part of the Kura basin. At present, there are no installed treatment plants for municipal wastewater, which results in a risk of surface and groundwater getting polluted by untreated wastewater from households. Turkey assesses the pressure from municipal wastewater as local and moderate in importance. The situation concerning the whole Turkish part of the Kura basin is elaborated in the section on the Kura.

106. Among activities affecting water quality in Georgia are diffuse pollution from fertilizers, which Georgia assesses as local and moderate. Both discharge of non–treated wastewater from settlements and illegal landfills on river banks, Georgia assesses as local but severe.

Response

107. In Turkish part of the basin, households are generally connected to sewerage systems and a drinking water distribution network. However, a wastewater treatment plant for Posof Municipality has not been planned yet.

108. Afforestation campaigns and activities have been also carried out by Turkish Ministry of Environment and Forestry.

109. A project to construct new landfills is under development in Georgia.

Status

110. According to the information of the Ministry of Environment Protection and Natural Resources of Georgia, the concentration of ammonium has increased in the period from 2007 to 2009 to be a few times higher than MAC: 1.5 times higher in 2008 and three times higher in 2009. In general, Georgia estimates the ecological and chemical status of the river as satisfactory.

Transboundary cooperation

111. The Posof wildlife development and management plan that was adopted by the Ministry of Environment and Forestry of Turkey was prepared within a Turkish-Georgian collaborative project titled "Enhancing Conservation in the West Lesser Caucasus through Trans-boundary Cooperation and Establishing a Training Program on Key Biodiversity Area Conservation".[29] The Project has supported establishment of cooperation between the two countries.

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[29] Critical Ecosystem Partnership Fund (CEPF) Final Project Completion Report, 2009: "Enhancing Conservation in the West Lesser Caucasus through Trans-boundary Cooperation and Establishing a Training Program on Key Biodiversity Area Conservation

112. There is no transboundary monitoring at present on the Potskhovi/Posof, but the possibility of starting such work in the framework of international projects is being looked into.

Trends

113. Turkey predicts that pressure on the sub-basin's water resources and water uses (both consumptive and non–consumptive) will likely increase due to economic development, population increase and climate change variability. According to long-term national prediction of climate change, a decrease in precipitation by between 10% and 20% by 2070–2100 and increased variability in seasonal precipitation will likely result in decreased average run–off. To address these issues, preparation of a river basin management plan is seen as essential for sustainable management of the Potskhovi/Posof sub-basin water resources.

XI. Ktsia-Khrami sub-basin[30]

114. The sub-basin of the Ktsia-Khrami River is shared by Armenia, Azerbaijan and Georgia. The 201-km long Ktsia-Khrami River has its source in a spring on the southern slope of the Trialeti range at the height of 2,422 m and discharges into the Kura. The Debet is a major transboundary tributary.

115. The basin of the Ktsia-Khrami has a pronounced mountainous character of rugged terrain with an average elevation of about 1,535 m a.s.l. The Ktsia-Khrami River is characterized by one significant spring flood. In other periods of the year the water level is mostly low, occasionally disrupted by summer-fall high waters.

116. An alluvial transboundary aquifer Ktsia-Khrami is linked to the surface waters of the sub-basin.

Table 33
Area and population in the Ktsia-Khrami sub-basin, including the Debet sub-basin

Country	*Area in the country (km^2)*	*Country's share %*	*Population*	*Population density (persons/km^2)*
Armenia	3 790	45.4	7 340	*2/89*[a]
Georgia	310		20 632	66
Subtotal Debet sub–basin	4 100			
Georgia	4 160	53.5	180 992	40
Azerbaijan	80	1.1		

Hydrology and hydrogeology

117. In the part of the Ktsia-Khrami sub-basin that is Georgia's territory, surface water resources are estimated at 1.631 km^3/year (based on data from 1928 to 1990) and

[30] Based on information from Armenia and Georgia, and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.

groundwater resources at 0.0815 km^3/year, making up a total of 1.713 km^3/year. This equals 9,465 m^3/year/capita.

Table 34
Ktsia-Khrami aquifer: Type 3, alluvial aquifer connected to river, little transboundary impacts. Gravel-Tertiary and Quaternary age conglomerates, tuffaceous sandstones, calcareous basalts, dolerites, quartz sandstone, marl, sand etc. Strong links with surface water

	Georgia	*Azerbaijan*
Area (km^2)	340	
Thickness: mean, max (in m)	120, 250	
Groundwater management measures	Used for drinking water	
Groundwater uses and functions		
Additional information	Joint monitoring programme is felt to be needed	

Pressures

More than 50% of the land is used for agriculture, some 20% is forest and about 30% grassland.

The total withdrawal in the Georgian part of the Ktsia-Khrami Basin is 853.3×10^6 m^3/year, with 94% for energy, 3% for domestic purposes, 2% for industry and 1% for agriculture.[31]

118. Municipal wastewater treatment plants in a number of cities in Georgia are not operational and in rural areas there is no sewage collection/network. The impact is considered serious, but remaining local according to Georgia. Pollution from illegal waste dumps is one of the main sources of pollution in the Georgian part of the sub-basin, and its impact is described as widespread and severe.

119. Copper-mining industry is reported to have a negative impact on the river in Georgia: acid mine drainage — leaching of metals from waste rock dumps when exposed to rainfall at JSC Madneuli in the village Kazreti — causes pollution of the Mashavera River (a tributary of Ktsia-Khrami).

120. The Ceyhan-Tbilisi-Baku oil pipeline traversing the basin is considered to pose a risk of accidental pollution in Georgia.

Status and management response

121. Georgia reports that during the period from 2007 to 2009, the concentration of ammonium ions in the Ktsia-Khrami exceeded the MAC three times in January 2008 and nine times in July 2009. Other measured components were within the respective MAC during the same observation period.

[31] Figures from the Yearbook of Water Use in Georgia 2008.

122. Regarding agricultural water use, drip irrigation techniques have been introduced through several projects in Georgia.

123. The mining company JSC Madneuli has developed a plan of water conservation measures, which is being implemented consistently. Georgia reports some measures to have been realized to protect river banks.

124. By ranking of factors affecting water resources by importance in the basin by Georgia, pollution from municipal non-treated or inefficiently treated wastewaters, including occurrence of viruses and bacteria, stands out as a priority issue to address.

125. In the framework of the European Union (EU) Project: "Trans-Boundary River Management Phase II for the Kura River Basin — Armenia, Georgia, Azerbaijan", joint monitoring is being carried out between Georgia, Azerbaijan and Armenia four times a year.

Trends

126. Georgia predicts water use for agriculture, domestic needs and for industry to increase relative to water use for energy by 2015. The total water withdrawal in 2015 is predicted to be 875 $\times 10^6$ m^3/year, which is more than in 2008.

127. In accordance with the procedures formulated in 2009 in draft strategic directions of the Ministry of Environment and Natural Resources of Georgia, a river basin management plan will be developed for the Ktsia-Khrami River in 2012.

XII. Lake Jandari[32]

128. Lake Jandari, which through construction of Gardaban Canal was turned into a reservoir, is shared by Georgia and Azerbaijan. The volume of water is 51.15 million m^3, with a maximum depth of 7.2 m and average depth of 4.8 m. Water comes mainly through the Gardaban Canal (maximum capacity 15 m^3/s) from the Kura River and another canal starting from the Tbilisi (Samgori) water reservoir. The lake is quite rich in fish (carp and catfish).

Table 35
Area and population in the Lake Jandari basin

Basin	*Country*	*Area in the country (km^2)*	*Country's share %*	*Population*	*Population density (persons/km^2)*
Lake Jandari basin	Georgia	68	67	14 000–15 000	140–150
	Azerbaijan	34	33		
	Sub–total	**102**			
Lake Jandari (lake surface)		12.5			

[32] Based on information from Georgia and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.

Pressures and status

129. Pollution originates from various anthropogenic sources. Wastes from industry, residential areas and agriculture pollute water coming into the reservoir from the Kura River.

130. A channel was dug from the south-eastern bank of the lake for irrigating land in the territory of Azerbaijan.

131. In Georgia, the water of the lake is not used for industrial purposes, and there are no industrial enterprises in the surroundings. There are no direct industrial or municipal wastewater discharges to the lake in Georgia. The lake is also an important area for commercial fisheries.

132. Lake Jandari does not have a good ecological or chemical status. Increased pollution from the Kura River and from reservoirs is affecting water quality in the lake. Moreover, expansion of irrigated land in both countries and uncoordinated use of water by various users have been decreasing the water level.

Transboundary cooperation

133. According to the agreement concluded in 1993 between the State Committee of Irrigation and Water Economy of the Azerbaijan Republic and Department of Management of Melioration Systems of Georgia, 70 million m^3 of water is delivered annually to Jandari water reservoir from Georgia. This includes 50 million m^3 for irrigation of 8,500 hectares of land of the Akstaphi region of Azerbaijan and 20 million m^3 for maintaining ecological balance of the water reservoirs.

134. According to Article 6 of the Agreement on Collaboration in Environmental Protection between the Governments of Georgia and Azerbaijan (1997), the Parties of the Agreement shall consolidate their efforts and take all appropriate measures to ensure that the Kura River and the Lake Jandari waters are used with the aim of ecologically sound and rational water management, conservation of water resources and environmental protection.

XIII. Kartsakhi Lake/Aktaş Gölü [33]

Table 36
Mean annual water withdrawal by sector

Country	*Area in the country (km²)*	*Country's share of the lake area %*	*Population*
Turkey	Lake area: 13	48	735
Georgia	Lake area: 14	52	5 925[a]
Total	Lake area: 27 (basin areas – 158 km²)		

Sources: Turkish Statistical Institute, 2008; Resource of Surface Water 1974, Georgia.
[a] Within a radius of 7 km from the lake.

[33] Based on information from Georgia, Turkey and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.

Hydrology and hydrogeology

135. The average and maximum depths are 1.5 and 3.5 m, respectively

136. The basin is characterized by a very weakly developed hydrographical network, consisting mainly of seasonal streams. On the South-Western side (Turkish territory), there are some springs.

Pressures and status

137. The lake is not designated as protected area but, being located in a military zone on the Turkish side, human activities are highly restricted. Therefore the quantity and quality of the lake water is preserved as in natural conditions. Only three villages are located near the lake in Turkish territory. There is no extraction of water from the lake in Turkey nor does Georgia use the lake water for industrial or household needs.

138. Lake water has naturally elevated salinity of 880 mg/litre, affected by volcanic rocks occurring in the area.

139. Lake Kartsakhi/Aktaş Gölü belongs to the Javakheti Wetlands of which Lake Arpi is included in the List of Wetlands of International Importance under the Ramsar Convention. The lake is a breeding site for White Pelican (*Pelicanus onocratus*) and the Dalmatian Pelican (*Pelicanus crispus*), as well as for a variety of other bird species.

XIV. Wetlands of Javakheti Region (Armenia, Georgia, Turkey) [34]

General description of the wetland area

140. The distinctive characteristic of the Javakheti region, which distinguishes it from the whole Caucasus, is the presence of numerous lakes. Most of them are connected by rivers, though groundwater interchange is also notable, so that all together they represent an ecological entity. Several lakes are of great importance for maintaining biodiversity of this region. These are, in particular, Lake Arpi in Armenia, which became a reservoir (2,120 ha) after building a dam in 1946–1950, Georgian high mountain shallow freshwater lakes Madatapa (870 ha), Khanchali (590 ha) and Bugdasheni (30 ha), and Lake Kartsakhi/Aktaş (2,660 ha) shared by Georgia and Turkey. Adjacent marshes and wet meadows as well as flood-plains also represent important wetland ecosystems.

[34] *Sources*:
Latest Information Sheet on Ramsar Wetlands (RIS), available at the Ramsar Sites Information Service: http://ramsar.wetlands.org/Database/Searchforsites/tabid/765/language/en–US/Default.aspx. Lake Arpi Ramsar site; Armenia (RIS updated in 1997).
Jenderedjian, K., Jenderedjian, A., Salathe ,T., Hakobyan, S. About Wetlands, and around Wetlands in Armenia. Zangak, Yerevan. 2004.
Jenderedjian, K. Transboundary management of Kura Basin wetlands as an important step towards waterbird conservation in the South Caucasus region // Boere, G.C., Galbraith, C.A. & Stroud, D.A. (eds). Waterbirds around the world. The Stationery Office, Edinburgh, UK. 2006. (www.jncc.gov.uk/worldwaterbirds)
Matcharashvili I. et al. Javakheti Wetlands: biodiversity and conservation, NACRES, Tbilisi. 2004.

Main wetland ecosystem services

141. Lake Arpi is considered to play a significant role in sediment trapping. The lakes in this area are valuable sources of freshwater. Lake Arpi also provides water for irrigation, while cattle watering and fishing are also of major importance for the local economy. Lake Khanchali and springs fed by the lake are important sources of drinking and irrigation water for local villages; in Georgia some lakes are also used by the local population for fishing. Around all the mentioned lakes, adjacent meadows are traditionally used for mowing and cattle and sheep grazing. Javakheti landscapes are of high aesthetic value, and the region has good potential for recreation and nature tourism development.

Biodiversity values of the wetland area

142. Javakheti wetland ecosystems support species-rich natural communities that include endemic species (e.g., reptiles, plants and Armenian Gulls *Larus armenicus*) as well as other threatened elements of biological diversity..

143. One of the main bird migration routes in the Caucasus crosses the Javakheti Plateau, with lakes Arpi, Madatapa, Bugdashen and Khanchali being the most important for migratory birds in this region. In Georgia alone, the lakes receive about 30,000–40,000 migratory birds each year. The lakes provide important feeding, resting and breeding habitats for grebes, pelicans, herons, geese, ducks, waders, gulls, terns and other waterfowl, as well as for birds of prey, including globally threatened species mentioned in the International Union for Conservation of Nature (IUCN) Red List: Dalmatian Pelican (*Pelecanus crispus*), Imperial Eagle (*Aquila heliacal*) and Greater Spotted Eagle (*Aquila clanga*). Many species are also covered by the African-Eurasian Waterbird Agreement and national Red Lists.

Pressure factors and transboundary impacts

144. After construction of the dam, the surface of the lake/reservoir Arpi increased around five times, the volume around 20 times, and seasonal water-level fluctuation started exceeding 3 m (in comparison with natural fluctuations less than 0.5 m). The average turnover period became one year (while the natural one is one month). This caused loss of submerged, floating and emergent vegetation and degradation of habitats for waterfowl and fish. In addition, droughts downstream cause serious deterioration of spawning and nesting conditions for fish and birds. Organic pollution from agriculture (mainly livestock) in the form of nitrogen and phosphorus represents another threat.

145. On the Georgian side, large-scale draining of wetlands for agricultural purposes or transforming them into fish farms began in 1960’s. Lake Khanchali was most affected of all the wetlands in the region: due to the drainage it lost two thirds of its surface area and later it was completely drained several times. The draining of Bugdasheni Lake began in 1998 due to draw-off for drinking water supply for the town Ninotsminda. The southern part of Lake Madatapa is dammed for fishing and agricultural needs; this prevents water exchange and facilitates eutrophication. Draining of lakes leads to the loss of habitats important for water-birds; another effect is decreasing humidity leading to changes in plant communities that may also affect agricultural production. Additional water loss occurs due to damaged irrigation systems. Disturbing factors for water-birds include illegal hunting in spring, as well as mowing on lakes shores and collecting eggs by locals in nesting period.

146. In Georgia, introduction of non–native fish species negatively affected local fish communities which used to be quite rich. In addition, Crucian Carp (*Carassius carassius*) which has minor economic value, has been accidentally introduced and has out-competed

all native fish species. However, one positive result of this invasion is that these fish provide a food source for fish-eating birds on those lakes where there was no fish before.

Transboundary wetland management

147. The “Eco-regional Nature Protection Programme for the South Caucasus Region”, part of the Caucasus Initiative launched by German Federal Ministry of Economic Cooperation and Development (BMZ), aims to promote cooperation on development of a coherent strategy to ensure biodiversity conservation in the region. A number of wetlands will be given the status of protected areas on both sides of Armenian-Georgian border. In Armenia, the Programme component “Establishment of Protected Areas in the Armenian Javakheti Region” is aimed at establishment of a National Park and its integration into the local context, as well as promotion of transboundary cooperation on biodiversity conservation in the Javakheti region. The National Park was established in 2009 and it includes Lake Arpi and its basin as well as flood-plains of the upper stream of the Akhuryan River. At present Ramsar Site Lake Arpi covers 3,149 ha and includes the whole reservoir and surrounding marshes.

148. The project “Establishment of Javakheti Protected Areas in Georgia” is implemented by the Agency of Protected Areas of Georgia and the World Wildlife Fund (WWF) Caucasus Programme Office with financial support of BMZ and German Credit Bank of Reconstruction (KFW). The project aims at establishment of Javakheti National Park and Kanchali, Madatapa and Bugdasheni Managed Reserves.

XV. Araks/Aras sub-basin[35]

149. The sub-basin of the 1,072-km river Araks/Aras[36] is shared by Armenia, Azerbaijan, the Islamic Republic of Iran and Turkey. The river has its source at 2,732 m a.s.l. and discharges into the Kura. The character of the basin ranges from mountain terrain in the upper part — with an elevation from 2,200 to 2,700 m a.s.l — to lowland.

150. Major transboundary tributaries to the Araks/Aras River include the rivers Akhuryan, Arpa, Sarisu, Kotur, Voghji/Ohchu and Vorotan/Bargushad.

151. The reservoirs in the Iranian part of the sub-basin include Aras storage dam, Mill-Moghan diversion dam, Khoda-Afarin storage dam, Ghiz-Gale si diversion dam.

152. The following wetlands/peatlands are located in the Iranian part of the basin: Arasbaran protected area; Marakan protected area; Kiamaki wildlife preserve; Yakarat no-hunting zone; Aghaghol wetland and no-hunting zone; and Yarim Ghijel wetland. Also the protected areas the Ghare Boulagh wetland, Sari Sou wetland, Eshgh Abad wetland and Siah Baz wetland are located in the Iranian part.

[35] Based on information from Armenia, the Islamic Republic of Iran, Turkey and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.

[36] The river is known as Aras in Azerbaijan, the Islamic Republic of Iran and Turkey.

Table 37
Araks/Aras sub-basin

Country	*Area in the country (km^2)*	*Population*	*Population density (persons/km^2)*
Armenia	22 560[a]	2 627 283	110
Azerbaijan	18 140		
Islamic Republic of Iran	43 209[b]	3 240 675	75
Turkey	22 285[c]	763 226	34

[a] L.A. Chilingaryan et al., "Hydrography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.
[b] Figure for the whole Kura-Araks sub-basin
[c] Total catchment area of the Kura-Araks sub-basin in Turkey is 27,548 km^2.

153. In the part of the Araks/Aras sub-basin that is Turkey's territory, surface water resources are estimated at 2.190 km^3/year and groundwater resources at 0.144 km^3/year, making up a total of 2.334 km^3/year. If divided by the number of inhabitants, this is 3,058 m^3/year/capita.

154. In the Iranian part of the basin, surface water resources are estimated at 1.327 km^3/year and groundwater resources at 0.730 km^3/year, making up a total of 2.057 km^3/year. This is almost 854 m^3/year/capita.

Pressures

155. There are pressures on water quality from mining, industrial and municipal wastewater, as well as natural geochemical processes. Agricultural pollution from return flows consisting of agrochemical waste, pesticides, nutrients and salts is a particular concern in both upstream and downstream sections of the Aras River.

156. Agriculture and animal husbandry are the main economic activities in the Turkish part of the basin, where there is need for development of irrigation and for efficient irrigation techniques. Tourism (for skiing and sightseeing in particular) is growing in Turkey. The region in the Turkish part of the basin is not industrialized and manufacturing industry is limited to small- and medium-size factories.

157. Municipalities of the urban areas are connected to a sewerage network, but in general no wastewater treatment plants have been set up yet. Concerning solid waste disposal, in the Turkish part, only Erzurum province has a sanitary landfill. Controlled dump sites of the municipalities cause pollution risk to surface water and groundwater. The pressures from wastewater and solid waste are both assessed by Turkey as widespread but moderate in influence. Wastewater discharges from small and medium industries are reported to cause pollution in Turkey, but it is considered local and moderate in influence, whereas in the Islamic Republic of Iran discharges from industries are viewed to have a widespread and severe influence.

158. Flooding of the plain areas in Iğdır province in Turkey is a longstanding issue. The lower part of the Araks/Aras River in Turkey is at a risk of flooding during high flows in winter and spring. Turkey reports that bank and riverbed protection works in the main river and its tributaries have been carried out since 1960s.

159. Invasion of the river, particularly in the plain regions, has resulted in intense bank erosion. Generally erosion of the land in the basin is assessed by Turkey as not severe but

in steep valleys and slopes the erosion rate is high, with sediments getting transported by snow and rain waters from tributaries into the main river course. Morphological changes and erosion in the riverbed and riverbanks have occurred due to aggregate mining, which is practiced for example in Armenia. Both Iran and Turkey assess the influence as severe, but Turkey views it rather as local than widespread like Iran. Soil degradation results from erosion. Medium- and small-scale quarrying in the Turkish part of the sub-basin result in morphological changes in landscape.

160. According to the Islamic Republic of Iran, heavy metals (Cu, Mn, Fe etc.) from mining waste in left-side tributaries from Armenia, rank among the main sources of transboundary pollution in the Aras River. However, investments into improving the facilities in recent years, also by international companies, have improved the situation. According to Armenia, the wastewater flow from mining on the Armenian side is small and their passage through a preliminary treatment should limit adding to heavy metals content in the Aras River. Heavy metals content in the Aras River at the Armenian-Iranian border according to the Armenian-Iranian monitoring data 2006-2009 is typical geochemical background.

Table 38

Heavy metal concentrations from monitoring locations on the Aras in Armenia before (IMS-1) and after (IMS-3) a mining wastewater discharge point.

Sites	*Copper (mg/l)*	*Manganese (mg/l)*	*Iron (mg/l)*	*Chrome (mg/l)*
IMS-1	0.0039	0.0130	0.1729	0.0045
IMS-3	0.0022	0.0106	0.2016	0.0040

161. Transfer of experience within the region could be beneficial, for example in controlling pollution from copper mines, in which the Islamic Republic of Iran has gained experience by developing closed water circulation in the processes. There is awareness that tailings dams are vulnerable to earthquakes.

Table 39

Land use/land cover in the Araks/Aras sub-basin

Country	*Water bodies*	*Forest*	*Cropland)*	*Grassland*	*Urban/indus trial areas*	*Surfaces with little or no vegetation*	*Wetlands/ peatlands*	*Protected areas*	*Other forms of land use*
Armenia	4.1	5.6	13.4	34.5	15.3	6.9	1.2	2.4	16.6
Azerbaijan	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Georgia	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Islamic republic of Iran	N/A	N/A	14.7[a]	N/A	N/A	N/A	N/A	N/A	N/A
Turkey	1.1	5	28[b]	29	N/A	N/A	2	4.7[c]	30.2[d]

[a] About 37% of cropland in Iran is irrigated.

[b] About 20% of cropland in Turkey is irrigated.

[c].Includes Lake Kuyucuk (Kuyucuk Gölü), 416 ha, Wetland of International Importance/Ramsar Site and designated natural park Mount Ararat (Ağrı Dağı), 1050 km^2.

[d] Including urban areas and surfaces with little or no vegetation.

Table 40
Water use in different sectors (percentage)

Country	*Total withdrawal ×10⁶ m³/year*	*Agricultural*	*Domestic*	*Industry*	*Energy*	*Other*
Armenia	N/A	N/A	N/A	N/A	N/A	N/A
Azerbaijan	N/A	N/A	N/A	N/A	N/A	N/A
Islamic Republic of Iran	3 000	93	5.5	0.76	0	0.5
Turkey[a]	507	89	11			

[a] It should be noted that there are probably withdrawals also by other sectors in the Turkish part of the basin, but no information was available on them. Therefore, agriculture and domestic are not the only water-user sectors, but they are the two main ones.

162. Water supply for villages and municipalities in Turkey is mainly provided from groundwater sources and groundwater is also used by farmers for local irrigation. Allocation of groundwater is made according to estimated renewable water resources. Surface water is withdrawn for irrigation in Turkey. There are hydropower projects under development in Turkey, which may influence water availability for other sectors.

163. The Islamic Republic of Iran expects its water use to increase from 3,000 × 106 m^3/year to 4,800 × 10^6 m^3/year.

Status

164. The ecological and chemical status is satisfactory for aquatic life, municipal and industrial uses, and other uses. As the largest tributary of the Kura River, the Aras is the second most important watercourse to the economy of Azerbaijan.

165. According to measurements by Armenia from 2006 to 2009 along the Araks/Aras, heavy metals such as Al, Fe, Mn, Cr and V occur in water in moderate amounts. Some of these are part of the typical geochemical background of the Araks/Aras. Iran rates the issue of naturally elevated metal concentrations as serious but local; Armenia, as widespread but moderate (considering the levels of the following elements: Al, Fe, Mn, V, Cr, cobalt (Co), nickel (Ni), Cu, Zn). Chrome (Cr) occurs at amounts exceeding MAC almost every year. Nitrate level did not exceed MAC during the same observation period.

166. Water quality monitoring results from the period 2006–2009 collected and analysed by Armenia downstream of river Araks/Aras indicate that there was a gradual increasing trend of BOD_5 (MAC: 3mg/l), especially during 2009. The concentration of total phosphorus was lower than MAC (MAC: 1–0.4 mg/l). The nitrite ion exceeded MAC (MAC: 0.024 mg N/l) during period 2006–2009 downstream of the Araks/Aras and the greatest influence of municipal wastewater on water quality in the river have been observed before and after mixing with waters of the tributary Razdan.

167. For many decades, the river is subject to severe pollution in Armenia through its left-bank tributaries (the Razdan, Agarak, Ohchuchay) which receive significant quantities of waste water discharges from mining, energy, chemical, machinery and other industries. The impact of the discharges can be observed of Azerbaijan as far as the confluence of the river Araz river Kura. In this section of the river Araz, the highest observed concentrations of phenols in river water (13 MPC), metals (9 MPC), sulphate (6 MPC) and petroleum (4

MAC), and the quantity of mineralization/total dissolved solids (1,130 mg / l) exceeds the sanitary norm by 25-35%.

168. According to Turkish Inland Water Quality Standards, water quality in the Turkish part of the Araks/Aras River is in Class I and Class II, that is, unpolluted and/or less polluted water bodies, respectively.

Management response

169. The monitoring network in the Turkish territory of the Aras River Basin includes some 55 monitoring stations distributed over the main course of the river and tributaries. Regular monitoring of water quantity and quality goes back to the 1960s. Some of the stored data are published in yearly statistical books but presently there is no database for the monitoring network in the Turkish part.

170. The Development of Water Resources Management Plan for the Aras River Basin is a part of Turkey's medium- to long-term national environmental strategies. Water and land development projects carried out in Turkish part of the Aras sub-basin are mainly oriented towards developing hydropower, irrigation and domestic water supply. There is at present time no river basin organization and council in the Turkish part of the Aras River Basin. In Turkey, conjunctive management of surface and ground waters is considered in determining water availability and allocation. A comprehensive integrated water resources management (IWRM) plan for the Aras Basin is under preparation according to Iran.

171. Wastewater treatment plants for municipalities will be installed in Turkey as a part of medium- and long-term national environment strategies (3–10 years). A wastewater treatment plant is required from new industrial facilities, and the existing small-medium industrial facilities are required to complete their wastewater treatment plants. Any direct discharges into groundwater bodies are not allowed.

172. Implemented measures in Turkey to tackle pollution from agriculture include introduction of efficient drainage systems for irrigated land, as well as limiting and controlling use of pesticides and fertilizers in agriculture. Efficient irrigation methods are one of the priorities of the Turkish Government in agricultural policy to be extended all over the country. Application of drip and sprinkle irrigation techniques has started in irrigation development projects in the Turkish part of the Aras sub-basin. Organic agricultural practices have been adopted for example in grain production, fruit growing and beekeeping by some local producers and farmers. The Organic Agriculture Law was adopted in 2004. The self-assessment in Iran is that irrigation is practised there with a high efficiency and productivity, and that the latest technology is in use. In most modern irrigation and drainage schemes — e.g., Moghan, Khodaafarin — wastewater reuse or managed aquifer recharge are applied. Demand management is seen as something that should be developed more.

173. Afforestation of land has been carried out on land with little or without vegetation by Turkey's Ministry of Environment and Forestry and on the drainage area of existing reservoirs. Erosion control measurements are made in the Turkish part of the catchment area of the Aras River and sediments are dredged in certain parts of the river as part of river protection works.

Transboundary cooperation

174. Bilateral transboundary collaborative projects on water quality monitoring are ongoing between the Islamic Republic of Iran and Armenia, as well as between Iran and Azerbaijan. A related database has also been established in cooperation.

175. Iran and Armenia and Iran and Azerbaijan have some river training[37] and flood control projects on the Aras River. Each country prepares its river training plan and delivers it to the other side. The other side then investigates the plan and gives its ideas about it (i.e., modifications or changes regarding border protocols or changes of river regime due to the execution of project).

176. The following are felt to be lacking in the current institutional frameworks in the Araks/Aras sub-basin:

- A regional strategy for integrated management and planning (for preventing and reducing pollution in particular):
- A multilateral agreement between the riparian countries;
- A transboundary basin council/

177. Strengthening cooperation in water quality control as well as risk and crisis management in man-made or natural disasters is called for.

Trends

178. In the sub-basin of the Araks/Aras, in the Iranian part, average annual temperature is predicted to increase by 1.5 to 2ºC by 2050. A reduction of 3% in precipitation is expected. More frequent floods and droughts are predicted. The impacts on land use and cropping patterns, as well as agricultural water requirements are expected to be considerable. Groundwater quality is expected to deteriorate.

179. Turkey reports that in the region in general, with results not specific to the Araks/Aras basin, precipitation is predicted to decrease from 10% to 20% by 2070–2100 and its seasonal variability is predicted to increase. By 2030, a decrease of 10% to 20% in run-off is predicted, with increased variability in both precipitation and run-off. Based on expert knowledge, groundwater level is predicted to decrease and groundwater quality affected negatively. Flood/drought risk is expected to increase. Both consumptive and non-consumptive water uses are foreseen to increase.

180. According to adaptation strategies identified in National Climate Change Strategy[38] of Turkey, the possible negative impacts of climate change on vulnerable ecosystems, urban biotopes and biological diversity will be identified and a vulnerability assessment will be carried out. Development and implementation of preventive and preparedness measures in Turkey will be made using scenarios and risk maps to be prepared.

181. In Turkey, the water resources of Aras sub-basin have been used mainly for irrigation, domestic supply and hydropower purposes. In recent years, particularly hydropower projects have been owned by private enterprises according to Turkish Electricity market law. Therefore involvement and investment of the private sector in water projects in the sub-basin has increased.

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[37] River training refers to engineering river-works that are built in order to direct the flow.

[38] Ministry of Environment and Forestry of Turkey, 2009: "National Climate Change Strategy", December 2009, Ankara, Turkey.

XVI. Akhuryan/Arpaçay sub-basin[39]

182. The sub-basin of the 186 km long river Akhuryan/Arpaçay[40] is shared by Armenia and Turkey. The river has its source in Armenia and discharges to the Araks/Aras. The Karkachun /Karahan, which is 55 km long and has a catchment area of 1020 km^2, is the biggest transboundary tributary. Gukasjan (length 26 km) and Illiget (length 16 km) are other transboundary tributaries.

183. The basin has a pronounced mountainous and highland character with an average elevation of about 2,010 m a.s.l. in the Armenian part and 1,500–1,600 m a.s.l. in the Turkish part.

Table 41
Akhuryan/Arpaçay sub-basin

Country	*Area in the country (km^2)*[a]	*Country's share %*	*Population*	*Population density (persons/km^2)*
Turkey	6 798	71	262 226[b]	39
Armenia	2 784	29	281 000	101
Total				

[a] L.A. Chilingaryan et al. "Hydrography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.
[b] Turkish Statistical Institute, 2008

184. In the part of the basin that is Turkey's territory, the surface water resources are estimated at 0.781 km^3/year and groundwater resources at 0.020 km^3/year, which make up a total of 0.801 km^3/year. If divided by inhabitant, the total is 3,055 m^3/capita/year. In the part of the sub-basin that is Armenia's territory, the surface water resources are estimated at 1.093 km^3/year (based on data from 1983 to 2008) and groundwater resources at 0.369 km^3/year (based on data from 1983 to 2008), which make up a total of 1.462 km^3/year. The total can also be expressed as 5,200 m^3/capita/year, approximately.

185. The river flow of the Akhuryan is heavily regulated by reservoirs: Akhuryan Reservoir (volume 525 million m^3) and Arpilits Reservoir (105 million m^3).

[39] Based on information from Armenia, Turkey and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.
[40] The river is known as Arpaçay in Turkey and as Akhuryan in Armenia.

Table 42

Leninak-Shiraks aquifer: None of the described aquifer types. Lavas, basalts and andesitic basalts of Upper Miocene, Quaternary and Upper Pliocene age. Two aquifer layers. Groundwater flow from Akhuryan basin to Ararat valley. Medium links with surface water

	Armenia	Turkey
Area	925	
Renewable groundwater resource (m^3/d)	612 000	
Thickness (mean, max)	18, 85	
Number of inhabitants	168 918	
Population density	182	
Groundwater uses and functions	Community water supply, (industrial) production, irrigation and fisheries	

[a] Based on information provided by Armenia. Turkey reports that it has not carried out any study regarding to transboundary aquifers in this region

Pressures

Table 43

Land cover/use in the Akhuryan/Arpaçay basin (per cent of the part of the basin extending in each country)

Country	*Water bodies*	*Forest*	*Cropland*	*Grassland*	*Urban/industrial areas*	*Surfaces with little or no vegetation*	*Wetlands/ peatlands*	*Other forms of land use*
Turkey	1.3	3.7	34.8[a]	39.1	4	–	N/A	17[b]
Armenia	2.0[c]	1.4	27.1	43.3	7.6	4.5	1.1	13.0[d]

[a] Of the cropland in Turkey, 10.4% is irrigated.
[b] Including protected areas (0.04%) and surfaces with little or no vegetation.
[c] The waterbodies include the rivers Karkazun, Illiget and Gukasjan, as well as reservoirs Akhurian, Arpa, Artik and Mantash.
[d] Of this, 0.7% is protected areas

186. Surface water is mainly used for irrigation purposes in the Turkish part of the sub-basin. In Iğdır Plain, 70,530 ha of land has been irrigated from Arpaçay reservoir. Water supply for municipalities is generally provided from groundwater sources and groundwater is also used for local irrigation by farmers.

187. Some 913 × 106 m3 of water was withdrawn in 2009 in the Turkish part of the basin, including withdrawal from storage water of Arpacay reservoir. Some 97% of the withdrawal was for agricultural and 3% for domestic purposes. The water use can considered insignificant as there are no substantial industrial facilities in the Turkish part of the sub-basin and the existing small factories are supplied generally with water from municipalities or with groundwater from wells.

188. The main pressure factors in the Akhuryan/Arpaçay basin include agriculture and animal husbandry, as well as discharge of untreated or insufficiently treated urban/ municipal wastewater. Municipalities of urban areas are generally connected to a sewerage network, but they mostly do not have wastewater treatment plants in place for the time being. Controlled dump sites of municipalities also cause a pollution risk for surface and groundwater resources in the basin. Morphological changes and erosion in the riverbed are also a concern. Geochemical processes are also a factor that affects water quality.

Pressures

189. According to predictions reported by Armenia, the air temperature is expected to increase by 1.1ºC, and precipitation to decrease by 3.1%, by 2030. The amount of precipitation (rain and snow) is predicted to decrease by 7 to 10%. As a result of climate change, groundwater level is expected to decrease by 15 to 20%. River discharges are predicted to decrease by 10–15%. The impact on water use is also expected to be significant.

190. Turkey reports that there is no existing study and research involving climate change modelling for the sub-basin of the Arpaçay River based on observations. However, according to national prediction and long-term scenarios, both precipitation and river run-off are expected to decrease by 10 to 20% — the former by 2070–2100 and the latter by 2030 — with increased seasonal variability in precipitation and flood/drought risk. Water use is foreseen to increase.

XV. Akhuryan/Arpaçay dam and reservoir[41]

191. The Akhuryan/Arpaçay dam[42] was jointly constructed by Turkey and the Soviet Union between the period from 1979 to 1983 along the boundary river Akhuryan/Arpaçay in accordance with the Cooperation Agreement of 1975 between the two countries (see ECE/MP.WAT/2010/WG.1/3−ECE/MP.WAT/2010/WG.2/4, Annex 3). Up until the 1990s the dam was operated jointly by Turkey and the Soviet Union and, since then, by Turkey and Armenia.

192. The dam was constructed mainly for irrigation and flood protection purposes and it has an active storage capacity of 525 hm^3/year.

Pressures

193. In Turkey, the water of Arpaçay Reservoir and the flow of the Aras River is used for irrigation of Iğdır Plain (70,530 ha). The Serdarabat Regulator for diverting irrigation water was constructed in 1937 downstream of the dam, on the main course of the Aras River, in accordance with an agreement of 1927 between Turkey and the Soviet Union.

194. Since 2004, there is an Interstate Commission of Armenia and Turkey on the Use of Akhuryan Water Reservoir.

[41] Based on information from Armenia, Turkey and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.

[42] The dam is called "Arpaçay Baraji" and the reservoir "Arpaçay Baraj Gölü" in Turkey.

XVI. Arpa sub-basin[43]

195. The sub-basin of the 92-km river Arpa is shared by Armenia and Azerbaijan. The river has its source at an elevation of 3,200 m a.s.l. and discharges into the Araks/Aras River. In the Armenian part, the rivers Elegis (47 km long, river basin area 516 km^2), Gerger (28 km long, river basin area 174 km^2) and Darb (22 km long, river basin area 164 km^2) are major transboundary tributaries of the Arpa.

196. The sub-basin has a pronounced mountainous character with an average elevation of about 2,090 m a.s.l.

Table 44
Area and population in the Arpa sub-basin

Country	*Area in the country (km^2)*	*Country's share %*	*Population*	*Population density (persons/km^2)*
Armenia	2 080	79	54 000[a]	26
Azerbaijan	550	21		
Total	2 630			

Sources: L.A. Chilingarjan et al. "Hydrography of rivers and lakes in Armenia", Institute of hydro-technology and water problems, Armenia.
[a] Statistical management, Armenia; http://www.armstat.am/

Hydrology and hydrogeology

197. Reservoirs on the Arpa include Gerger (volume 26.0 million m^3) and Kechoot (volume 25.0 million m^3). The flow is strongly regulated by the reservoirs and there are several hydroelectric power plants on the river.

198. Surface water resources in the Armenian part of the Arpa sub-basin, as run-off generated from precipitation within the area, are estimated at 0.751 km^3/year (based on data from 1931 to 2008) and groundwater resources at 0.084 km^3/year (average for the years from 1991 to 2008), making up a total of 0.835 km^3/year. This equals about 15,460 m^3/year/capita.

[43] Based on information from Armenia and the First Assessment of Transboundary Rivers, Lakes and Groundwaters under the UNECE Water Convention

Table 45

Herher, Malishkin and Jermuk aquifers[44]: Does not correspond with described aquifer types. volcanic rocks of Upper and Middle Eocene age. Weak links with surface water

	Armenia	*Azerbaijan*
Area (km^2)	N/A	
Thickness – mean, max (in m)	N/A	
Groundwater resource (m^3/day)		
Groundwater management measures		
Groundwater uses and functions	Domestic water supply and irrigation	
Pressure factors	Agriculture?	
Additional information	In the Armenian part of the aquifer, groundwater storage is estimated to be about 40 million m^3.	

Pressures

199. Untreated urban wastewater containing pollutants are discharged into the Arpa River from drainage systems, which is ranked by Armenia as both severe and widespread in influence on water resources. There are several towns and villages along the Arpa River in the Armenian part. There are several recreation areas in the river basin and trash is not necessarily properly disposed of by visitors, which impacts moderately on water quality.

200. Pressures related to agriculture, demonstrated as increased levels of nutrients (e.g., nitrate), are reported to be significant and widespread in the Armenian part, but at moderate level in impact. Some 7% of the land area in the Armenian part of the basin is cropland and 37% grassland.

201. According to monitoring by Armenia, V, Cr and Cu concentrations along the river remain almost constant, indicating naturally elevated background levels. Heavy metal concentrations except V and Cu were within the MAC (for fish life) level. The MAC levels were exceeded in the central part of the river basin.

Status and transboundary impact

202. The river has been assessed to be very clean. There was almost no human impact, and the ecological and chemical status has been viewed as “normal and close to natural conditions”. In the period from 2004 to 2006, the average mineral content on the border is 315 mg/l with a maximum of 439 mg/l.

203.. Increased anthropogenic impact can be observed in monitoring results from 2009 as nitrogen compound concentrations — nitrate (NO_3^-), nitrite (NO_2^-), ammonium (NH_4^+) — increasing up to three times in the Armenian part of the basin from above the Jermuk tributary down to the Areni monitoring station (upstream from the border with Azerbaijan).

[44] Based on information provided by Armenia.

This is reported to be due the influence of agriculture. The levels nevertheless remain lower than the MAC norms for fish life.

Trends

204. Armenia predicts that under the influence of climate change, precipitation will decrease 5–10% within the next 20 years. Surface flow is predicted to decrease by 7–10% and groundwater levels by 5–10%. Deterioration of groundwater quality is expected. Impact on water use is projected to be noticeable, and indirect impacts are projected to be evident in connection with reducing precipitation and increasing air temperature.

XVII. Vorotan/Bargushad sub-basin[45]

205. The sub-basin of the 111-km river Vorotan[46] is shared by Armenia and Azerbaijan. The river has its source at a height of 3,080 m a.s.l. and discharges into the Araks/Aras. Major transboundary tributaries to the Vorotan include the Gorisget (25 km, 146 km^2), the Sisian (length 33 km, basin area 395 km^2), the Tsghook, the Vagoodi and the Loradzor, among others. The sub-basin has a pronounced mountainous character with an average elevation of about 2,210 m a.s.l.

Table 46
Area and population in the Vorotan sub-basin

Country	*Area in the country (km^2)*	*Country share %*	*Population*	*Population density (persons/km^2)*
Armenia	2 575	41.6	72 800	28
Azerbaijan	3 620	58.4		
Total	**6 195**			

206. Surface water resources in the Armenian part of the Vorotan sub-basin are estimated at 0.748 km^3/year (based on the periods from 1988–1991 and 1999–2008). Groundwater resources are estimated at 0.218 km^3/year. Total water resources in the Armenian part of the Vorotan sub-basin are estimated at 0.966 km^3/year. This is about 13,270 m^3/year/capita.

207. The flow in the river is heavily regulated and there are several hydroelectric power stations on the river.

[45] Based on information from Armenia and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.
[46] The river is also known as Bargushad.

Table 47

Vorotan-Akora aquifer (No. 69)[47]: Type does not correspond with the described types. Volcanic rocks such as lava of Upper and Middle Eocene age. Two artesian aquifer horizons[48]. Groundwater flow direction is from Armenia to Azerbaijan. Weak links with surface water

	Armenia	*Azerbaijan*
Area (km^2)	1 100	
Renewable groundwater resource (m^3/d)	637 000	
Thickness in m		
Number of inhabitants		
Population density		
Groundwater uses and functions	Used for water supply, irrigation, power engineering and fisheries	
Other information		

Pressures

208. Agriculture is one of the main pressure factors in the Vorotan sub-basin, assessed as widespread but moderate in influence by Armenia. Cropland makes up almost 6% of Armenia's territory in the basin and grassland 45%. . Pollution from discharging untreated urban and rural wastewaters into the river is another severe pressure factor, but more local in the extent of influence. There are several villages in the Armenian part of the sub-basin.

209. Influence of hydropower generation and related infrastructure on the river are considered as local and moderate.

210. Natural hydro-geochemical processes cause elevated vanadium concentrations in the basin.

Status

211. At the time of the first Assessment (2007), there was almost no human impact on the river. Then, the ecological and chemical status was assessed as "normal and close to natural conditions". The average mineral content was at the time reported at the border to be 199 mg/l with a maximum of 260 mg/l during the period from 2004 to 2006.

212. The anthropogenic impact on the river water quality is manifested by the fact that the concentrations of NO_3^-, NO_2^-, NH_4^+, phosphate (PO_4^{3-}) ions and COD_{Cr} (dichromate as oxidizing agent) increased 1.5–2.5 times from source to river mouth, but remains lower than the MAC norms for fish life[49]. The increases in concentrations may be due to diffuse pollution from agriculture and/or point-source pollution from municipal wastewater. In the results of monitoring in Armenia in 2009, the concentrations of both nitrogen compounds

[47] Based on information provided by Armenia. The aquifer did not appear in the First Assessment of Transboundary Rivers, Lakes and Groundwaters.

[48] The first aquifer is located at the depth of 63–76 m and the second one at a depth of 151–177 m.

[49] In Armenia, water classification is based on MAC values for maintenance of aquatic life and which are more stringent than the MAC values for other uses.

and phosphate peak below the confluence of the Sisian tributary. BOD and dissolved oxygen remained approximately unchanged along the length of the river in the Armenian part.

213. Heavy metal concentrations except V and Cu were within the MAC (for fish life) level in the Armenian part of the basin. The MAC levels were exceeded in the central part of the river basin. The consistency of Cd, Cu, Fe and Cr along the course of the river seems to suggest that their concentrations may be influenced by the natural geochemical background. In 2009, V and arsenic (As) concentration were clearly more elevated on Sisian tributary and below its confluence. Mn, molybdenum (Mo) and lead (Pb) were highest on the main course of the river, below the confluence of Sisian, and Cu reached its highest concentration at the monitoring station of Tatev hydroelectric station, just upstream from the border with Azerbaijan.

Transboundary cooperation

214. An agreement was signed in 1974 between the Soviet Socialist Republic of Armenia and the Soviet Socialist Republic of Azerbaijan on the joint utilization of the waters of the river Vorotan (see document ECE/MP.WAT/2010/WG.1/3−ECE/MP.WAT/2010/WG.2/4, Annex 3).

Trends

215. According to predictions reported on by Armenia, precipitation is predicted to decrease in the area by 5–10% within the next 20 years due to climate change. Surface flow is predicted to decrease by 8–10%. Under the influence of climate change, groundwater level is expected to decrease by 5 to 10%. Some deterioration of groundwater quality is expected. Some indirect or secondary impacts, such as impacts on land use and agriculture, are expected in connection with reducing of precipitation and increasing of air temperature.

XVIII. Voghji/Ohchu sub-basin[50]

216. The sub-basin of the 82-km river Voghji[51] is shared by Armenia and Azerbaijan. The river has its source at a height of 3,650 m and discharges into the Araks/Aras. The Geghi is the most important tributary. Other major transboundary tributaries include the rivers Norashenik (length 29 km, river basin area 130 km^2), Vachagan (length 11 km, river basin area 35.5 km^2) and Geghanoosh (length 17 km, river basin area 51 km^2). The sub-basin has a pronounced mountainous character with an average elevation of about 2,337 m a.s.l. Lakes Gazana and Kaputan are located in the sub-basin.

217. At present, the river flow is not regulated. Geghi Reservoir in the Armenian part is unfinished.

[50] Based on information from Armenia and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.

[51] The river is known as Ohchu is Azerbaijan.

Table 48
Area and population in the Voghji sub-basin

Country	*Area in the country (km^2)*	*Population*	*Population density (persons/km^2)*
Armenia	880 (70%)	50 300	57
Azerbaijan	377 (30%)		
Total	**1 257**		

218. Surface water resources in the Armenian part of the Voghji sub-basin — estimated as run-off generated from precipitation within the Armenian territory in the basin — are approximately 0.472 km^3/year (based on the periods from 1965–1991 and 2000–2008). Groundwater resources are estimated at 0.036 km^3/year (average for years from 1991–2008). Total water resources in the Armenian part of the Voghji basin are estimated at 0.508 km^3/year. This is about 10,100 m^3/year/capita.

Pressures

219. In the Armenian part of the Voghji sub-basin, arable lands are mainly on slopes, especially in Kapan region, which limits mechanization of land cultivation and effective working of the land. Therefore, arable lands in high sloping parts are commonly turned into, for example, grasslands and pastures. Under these conditions, agriculture is not a significant pressure factor in the sub-basin. Some 18% of Armenian part of the basin is forest.

220. In the Voghji sub-basin, groundwater discharging from springs is used for domestic water supply and for irrigation. Groundwater occurs in intrusive rocks and metamorphic slates of Upper Jurassic and Middle Devonian age. Links with surface water systems are medium.

221. Pollution from discharges of untreated or insufficiently treated municipal wastewater into the river, in addition on industrial activities, is among the main pressure factors. Their influence is assessed as widespread and severe.

222. Water seeping from Artsvanik tailings dam in Kapan affects the river water quality, mainly by increasing heavy metal concentrations (V, Mn, Zn, Mo, Cd).

223. The influence of hydropower generation and related infrastructure on the river are considered as local and moderate in Armenia.

224. Visitors to the recreational area located upstream commonly do not dispose of their wastes properly, and this leads to moderate impacts on water quality locally.

Status

225. At the time of the first Assessment (2007), the ecological and chemical status of the Voghji River system was reported to be “not satisfactory for aquatic life”, but appropriate for other uses. The average mineral content was at the time reported to be 296 mg/l with a maximum of 456 mg/l during the period from 2004 to 2006.

226. Upon comparison of the average annual values measured in Armenia at the source of the Voghji River and at the downstream monitoring site located close to the border, it seems that the concentrations of NO_3, NO_2 and NH_4 increased from upstream to

downstream by 2.7–7.8 times. This demonstrates anthropogenic impact, mainly from pollution by municipal wastewater and/or agriculture. At the monitoring site located close to the border, NH_4^+ concentrations exceed the MAC norms (for fish life)[46]. 1.3 times, but NO_3^- and NO_2^- ion concentrations remain within the MAC norms. In particular at the monitoring station located at the mouth of the Norashenik tributary (No. 96), NO_2^- ion concentrations were clearly higher compared with the rest and NO_3^- also to some degree. PO_4^{3-} concentration in the boundary site was 100 times lower than MAC value.

227. Natural hydro-geochemical processes in the areas of ore deposits affect water quality, causing elevated metal concentrations, but this influence is rated as local and moderate by Armenia. Rather uniform levels of Pb, Fe and Cr observed (e.g., in 2009) seem to suggest that their occurrence is due to natural background. But as an increase in concentrations of heavy metals such as Zn, Cd, Mn and Cu has been observed in 2009 from upstream to downstream, increasing markedly below Kapan and staying at elevated levels down to the last monitoring station upstream from the border (No. 94), some influence of sewage and industrial effluents containing pollutants is inferred in the Armenian part of the Voghji sub-basin.

Trends

228. According to predictions reported on by Armenia, precipitation is predicted to decrease in the area by 3–5% within the next 20 years due to climate change. Surface water flow is predicted to decrease by 2–3%. Under the influence of climate change, groundwater level is predicted to decrease by 5–7%. It is expected that there will be a marked impact from climate change on water use. Some indirect or secondary impacts, such as impacts on land use and agriculture, are expected in connection with reducing of precipitation and increasing of temperature.

XIX. Sarisu sub-basin [52]

229. The basin of the river Sarısu /Sari Su[53] is shared by Turkey and the Islamic Republic of Iran. The river has its source from Tandurek mountains in Turkey and discharges into the Aras River in Iran.

230. The sub-basin has a pronounced volcanic mountainous and high plain land character with an average elevation of about 1,900–2,000 m a.s.l.

Table 49
Area and population in the Sarisu basin

Country	*Area in the country (km^2)*	*Population*	*Population density (persons/km^2)*
Islamic Republic of Iran	241	19 156	79
Turkey	2 230	113 048	47
Total	**2 471**	**132 204**	

[52] Based on information from Turkey, Iran and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.
[53] The river is known as Sarısu in Turkey and Sari Su in Iran.

Hydrology and hydrogeology

231. Water bodies cover 1% of the Turkish part of the Sarisu Basin. In the part of the Sarisu basin that is Turkey's territory, surface water resources are estimated at 0.054 km^3/year (based on data from 1988–1996) and groundwater resources at 0.028 km^3/year, making up a total of 0.082 km^3/year. This equals 725 m^3/year/capita.

Pressures, status and response

Some 7.8% of Turkey's part of the basin is cropland (with 23% of it being irrigated) and 73% grassland.

232. The riparian countries have signed a protocol entitled "Iranian-Turkish Protocol on the Use of the Waters of the Sari Su and Kara Su" in 1955. This protocol includes, for example, the basic principles of the water use in the border region, minimum water flow and water allocation.

XX. Flood-plain marshes and fishponds in the Araks/Aras River Valley (Armenia with parts of the ecosystem extending to Azerbaijan, Islamic Republic of Iran, Turkey)[54]

General description of the wetland area

233. The Araks/Aras River Valley harbours a big number of natural and man-made wetlands, including extensive permanent freshwater marshlands and brackish seasonally wet marshlands, lakes and fishponds. On the Armenian side, particularly noteworthy are Khor Virap Marsh occupying the ancient Araks/Aras riverbed and Armash fishponds to the south, as well as Metsamor wetland system that includes Lake Aighr and River Sevjur (one of the tributaries of the Araks/Aras), together with surrounding marshlands and fishponds. Other parts of this vast river valley ecosystem are located in Azerbaijan, the Islamic Republic of Iran and Turkey.

Main wetland ecosystem services

234. Over the past decades, fish farming in Armenia has become an important part of the economy. Armash fishponds used to be the biggest fish farming enterprise in the South Caucasus, with a total capacity of several thousand tons of fish per year. This complex contains 25 big ponds (1,700 ha of water surface area) and a number of smaller ponds surrounded by extensive reed stands and muddy areas. Other large enterprises are Aygherlich, Yeghegnut and Masis, with a total surface area of 1,000 ha. Fish species being farmed in wide and shallow "lacustrine" fishponds with emergent vegetation and soft bottom are carp (*cyprinus carpio*), silver carp (*hypophthalmichtys molitrix*) and grass carp (*ctenopharygodon idella*). In the narrow "riverine" fishponds with concrete walls and

[54] *Sources*:
Jenderedjian, K., Jenderedjian, A., Salathe ,T., Hakobyan, S., 2004. About Wetlands, and around Wetlands in Armenia. Zangak, Yerevan.
Jenderedjian, K.. Transboundary management of Kura Basin wetlands as an important step towards waterbird conservation in the South Caucasus region in Boere, G.C., Galbraith, C.A. & Stroud, D.A. (eds). Waterbirds around the world. The Stationery Office, Edinburgh, UK. 2006. (www.jncc.gov.uk/worldwaterbirds)

bottom, main commercial species are rainbow trout (*parasalmo mykiss*), brown trout (*salmo trutta m. fario*), sevan trout (*salmo ischchan*) and Siberian sturgeon (*acipenser baeri*).

235. Marshes of the Metsamor wetland system are used for cattle grazing, amateur hunting and fishing.

Cultural values of the wetland area

236. The Old Testament records that it was on Ararat Mountain that Noah's Ark came to rest after the Great Flood. On the opposite side of the River Araks/Aras, on top of a hill, sits the complex of Khor Virap Monastery (built in the ninth to twelfth centuries), which nowadays is one of the most popular tourism destinations in Armenia. The early Iron Age archaeological excavations and the museum of Metsamor are of considerable significance for historians.

Biodiversity values of the wetland area

237. Khor Virap Marsh and Armash fishponds are among the Caucasus's richest ornithological hotspots. Both sites provide important nesting areas for numerous cormorants, geese, ducks, ibises, waders and other water-birds, including globally threatened species such as the marbled teal (*Marmoronetta angustirostris*) and the white-headed duck (*Oxyura leucocephala*). Other man-made "lacustrine" fishponds and the Metsamor wetland system also play an important role for nesting waterfowl that lost their breeding habitats when the water level in lakes Sevan and Gilli dropped. The same wetlands provide stopover sites for migrating birds. Ornithofauna is especially rich during the fall migration, when more than 100 species can be registered here.

Pressure factors and transboundary impacts

238. Due to increasing demand for trout, many enterprises redesign existing earth ponds into concrete pools that are more effective for intensive trout breeding. This leads to loss of habitats for nesting and migrating waterfowl.

239. In the 1950's Khor Virap Marsh was drained and reclaimed as agricultural land. However, as early as the 1980's the uncared-for drainage system ceased to work properly and marsh habitats recovered; but traces of canals are still visible inside the marsh. On Armash fishponds the main threat to waterfowl is intensive poaching, while in Metsamor wetland system grazing represents a disturbance for birds.

Transboundary wetland management

240. There are several ongoing programmes initiated by the European Commission and the United Nations Development Programme to improve water management in the Kura-Araks sub-basin through the harmonization of legislation, monitoring and regional planning. The "Eco-regional Nature Protection Programme for the South Caucasus Region", part of the Caucasus Initiative launched by German Federal Ministry of Economic Cooperation and Development (BMZ), aims to promote cooperation in the development of a coherent strategy to ensure biodiversity conservation in the region.

241. The Critical Ecosystem Partnership Fund (CEPF) is developing a strategy based on the results of stakeholder workshops and background reports coordinated by the WWF Caucasus Programme Office. CEPF provides special attention to wetlands and international cooperation.

242. In 2007, the Government of Armenia designated part of Khor Virap Marsh (50.28 ha) as a sanctuary to be managed by the Khosrov Forest Reserve authorities and as a Wetland of International Importance (Ramsar site). Documentation is under preparation for formal submission to the Secretariat of the Ramsar Convention on Wetlands.

XXI. Samur River Basin[55]

243. The basin of the river Samur is shared by Azerbaijan and the Russian Federation. The river has its source in Dagestan, Russian Federation, and discharges into the Caspian Sea. The average elevation of the basin is 1,970 m a.s.l.

244. A transboundary aquifer called Samur is linked to the surface waters in the basin.

Table 50
Area and population in the Samur Basin

Country	*Area in the country (km^2)*	*Country's share %*
Azerbaijan	340	4.6
Russian Federation	6 990	95.4
Total[a]	**7 330**	

[a] Including the tributary Giolgerykhay.

Hydrology and hydrogeology

245. The common border on the river between the Russian Federation and Azerbaijan is 38 km long. Before flowing into the Caspian Sea, the river divides into several branches, located both in Azerbaijan and the Russian Federation. Some 96% of the river flow originates on Russian territory.

246. Spring floods cause damage in the Russian part of the basin.

247. The estimated renewable groundwater resources in the foothill plains of the Samur-Hussar amount to 3,471 m^3/day (about 0.00127 km^3/year). The depth of a typical well ranges from 150 to 200 m.

[55] Based on information from Azerbaijan, the Russian Federation and the First Assessment of Transboundary Rivers, Lakes and Groundwaters.

Table 51

Samur aquifer[56]: Type 3 (Alluvial aquifer connected to the river, little transboundary impacts). The upper, alluvial aquifer consists of gravel-pebble, sand and boulders of Neogene-Quaternary age (N-Q); the lower aquifer consists of fractured sandstones and siltstones of Jurassic and Cretaceous age (J-K). In the alluvial aquifer groundwater flow is from Azerbaijan and the Russian Federation to the Samur River. In the lower aquifer the flow direction is from Azerbaijan to the Russian Federation. Both aquifers have strong links with surface water

	Azerbaijan	*Russian Federation*
Area (km^2)	2 900	699
Thickness: mean, max (in m)	50, 100	N-Q: 50, 100 J-K: 40, 90
Groundwater resource (m^3/day)		
Groundwater management measures	Need to be improved: abstraction management, quantity and quality monitoring, protection zones, good agricultural practices, mapping Need to be applied: transboundary institutions, data exchange, integrated river basin management, treatment of urban and industrial wastewater	
Groundwater uses and functions	Drinking water (90–92%) Irrigation (5–8%) Industry (2–3%)	Drinking water (90%) Irrigation (7%) Industry (3%)
Pressure factors	No pressure factors, no problems related to groundwater quantity and no substantial problem related to groundwater quality	No pressure factors, no problems related groundwater quantity and no substantial problems related to groundwater quality
Additional information	Joint monitoring programme is felt to be needed. Azerbaijan predicts increased water use as a consequence of economic growth.	Groundwater management measures: Improvement of water management system, coordination of groundwater monitoring (observed parameters, monitoring network, procedures for information exchange)

248. Use of the water for irrigation (currently some 90,000 ha in Azerbaijan and 62,000 ha in the Russian Federation)[57] and to supply drinking water to the cities of Baku and Sumgait in Azerbaijan (up to 400 million m^3/a) and settlements in Dagestan (Russian Federation) has led to pressure on water resources.

56 Based on information provided by the Russian Federation and the first Assessment of Trasboundary Rivers, Lakes and Groundwaters. In the first Assessment, the number of the aquifer was 6.

57 The countries' irrigation inventory indicates 210,000 ha for Azerbaijan and 155,700 ha for the Russian Federation.

Status and transboundary impact

249. At the time of the first Assessment (2007), the river was classified as “moderately polluted”. Natural background concentrations of some heavy metals and trace elements are elevated, but the influence is assessed by the Russian Federation as local. In three areas in the Russian part of the basin groundwater pollution has been identified. Groundwater monitoring is carried out at nine points of observation in the Russian part of the basin at a frequency of three times per month.

250. The total water demand of both countries considerably exceeds the available resources, indicated by the considerable decrease of water flow from source to mouth and the drop in the groundwater table which has adverse ecological effect in the river valley and the delta. For about six months in a year, there is a more severe shortage with almost no water flow downstream from the hydrotechnical installation at Samursk. Otherwise, the impact of groundwater level decrease is assessed by the Russian Federation as widespread but moderate in influence.

Transboundary cooperation

251. An intergovernmental agreement on joint use and protection of the transboundary Samur River was signed between Azerbaijan and the Russian Federation 3 September 2010 (and entered into force 21 December 2010). However, the negotiations did not result in the signing of an agreement.[58]

252. At the present time there is no exchange of monitoring information, the agreement provides for it.

Trends

253. Concluding a bilateral agreement is of crucial importance for ensuring that the transboundary waters of the Samur are used in a reasonable and equitable way and for guaranteeing the ecological minimum flow in the delta region.

XXII. Sulak River Basin[59]

254. The basin of the river Sulak is shared by Georgia and the Russian Federation. The river has its source in the confluence of the Avarsk-Koisu (Russian Federation) and the Andis-Koisu (transboundary river shared by Georgia and the Russian Federation) and discharges into the Caspian Sea. The Sulak River itself flows entirely in the Russian Federation.

255. The Georgian part of the basin is traversed by very deep gorges and ravines. The difference between the depressions of the topography and ridges reaches 1,000 m. The lower part of the basin has a pronounced meandering lowland character. The average elevation of the basin is about 1,800 m a.s.l.

[58] UNECE (2009), River basin commissions and other institutions for transboundary water cooperation (ECE/MP.WAT/32).

[59] Based on information from Georgia, the Russian Federation and the First Assessment of Transboundary Rivers, Lakes and Groundwaters

Table 52
Area and population in the Andis-Koisu sub-basin

Basin	*Country*	*Area in the country (km²)*	*Country's share %*	*Popu-lation*	*Population density (persons/km²)*
Andis-Koisu tributary	Georgia	869	18	2 000	2
	Russian Federation	3 941	82		
Andis-Koisu subtotal		**4 810**			
Sulak basin, including tributaries, total		**15 200**			

Hydrology and hydrogeology

256. In the part of the Andis-Koisu sub-basin that is Georgia's territory, total water resources are estimated at 0.802 km^3/year (based on data from 1951–1977). This equals 400,827 m^3/year/capita. The surface water resources in the Russian part of the basin are estimated at some 2.26×10^6 m^3/year (equals 0.00226 km^3/year; based on data from 1929–1980), and groundwater resources at 0.26 km^3/year.

257. Andis-Koisu is a major transboundary tributary, shared by Georgia and the Russian Federation (basin area 4,810 km^2). Andis-Koisu River originates in the territory of Georgia at the confluence of the rivers Pirikita Alazani and Tushetskaya Alazani.

Table 53
Quaternary aquifer (No. 71)[60] Type 2. The upper aquifer consists of sand and gravel of Quaternary age (Q); the lower aquifer consists of sandstone, siltstone and limestone of Jurassic and Cretaceous age (J-K). In the upper aquifer groundwater flow is from Georgia and the Russian Federation to the Sulak River. In the lower aquifer the flow direction is from Georgia to the Russian Federation. Both aquifers have medium links with surface water

	Georgia	*Russian Federation*
Area (km^2)		
Thickness – mean, max (in m)		Q: 30, 50 J-K: 25, 50
Groundwater resource (m^3/day)		
Groundwater management measures		
Groundwater uses and functions		Some 20×10^6 m^3/year of groundwater is abstracted for drinking water and for irrigation.
Pressure factors		Six areas of groundwater contamination have been identified
Additional information		Transboundary groundwaters not seen to have specific uses and functions, because in the Russian

[60] Based on information provided by the Russian Federation.

Federation the resource is considered insignificant

Pressures and status

258. Irrigation and human settlements constitute the main pressure factors in the sub-basin of the Andis-Koisu River. Transboundary impact is assessed to be insignificant. The Andis-Koisu River has a good ecological and chemical status.

259. Increased pumping lifts or costs for groundwater abstraction are an issue in the Russian Federation, but this concerns a limited area. The State groundwater monitoring network in the Russian part of the basin consists of six monitoring points and the frequency of observations is 3–10 times per month.

260. There have been plans to construct a number of hydropower stations in the Russian part of the Andis-Koisu sub-basin.

Trends

261. Based on research studies and expert knowledge, a decrease in precipitation is expected in Georgia in the next 50 years: by 7% in eastern part of the country (where the Sulak basin is also located) during fall, winter and spring, and by 30% in the summer. Increase in drought frequency is expected in the eastern part of Georgia, but no data is available.[61]

XXIII. Terek River Basin[62]

262. The basin of the river Terek is shared by Georgia and the Russian Federation. The 623-km-long river has its source in the slopes of Mount Kazbek in Georgia and discharges into the Caspian Sea. The river flows through North Ossetia/Alania, Kabardino-Balkaria, the Stavropol Kraj, Chechnya and Dagestan (Russian Federation). In the Georgian part, the basin is characterized by mountainous, glacial topography.

263. The Assa (total basin area 2,060 km^2) and the Argun (total basin area 3,390 km^2) are transboundary tributaries to the Terek. Tributaries of the Terek within Georgia are the rivers Gamaradoni, Desikamidoni, Suatisi Doney, Mnasidoni, Snostskali, Chheri, Corot, Amalie and Hdistskali.

[61] *Sources*: Second National Communication of Georgia to the UNFCCC; UNECE and WHO (2008) Adaptation to Climate Change in Eastern Europe, Caucasus and Central Asia and South–Eastern Europe http://www.unece.org/env/water/meetings/Water.and.Climate/workshop/Report_survey_260608.doc

[62] Based on information from Georgia, the Russian Federation and the First Assessment of Transboundary Rivers, Lakes and Groundwaters

Table 54
Area and population in the Terek Basin

Country	*Area in the country (km^2)*	*Country's share %*	*Population*	*Population density (persons/km^2)*
Georgia	1 559	3.6	4 900	0.17
Russian Federation	41 641	96.4		
Total	**43 200**			

Sources: Ministry of Environment Protection and Natural Resources (Georgia) and Federal Agency for Water Resources (Russian Federation).

Hydrology and hydrogeology

264. The period of high water levels in spring-summer is very long (end of March to September). Spring floods cause damage, especially in the Russian part of the basin.

265. In the part of the Terek Basin that is Georgia's territory, surface water resources are estimated at 0.761 km^3/year (based on data from 1928–1990). This equals 155,223 m^3/year/capita. In the Russian Federation, water resources amount to 11.0 km^3/year in an average year (based on data from 1912–1980). The groundwater resources are estimated at 5.04 km^3/km in the Russian part of the basin.

Table 55
Quaternary aquifer (No. 72)[63]: Type 2/3. The aquifer consists of sand and gravel of Quaternary age (Q). Groundwater flow is from Georgia and the Russian Federation to the Terek. Strong links with surface water

	Georgia	*Russian Federation*
Area (km^2)		[length 12 km]
Thickness: mean, max (in m)		20, 50
Groundwater resource (m^3/day)		
Groundwater management measures		
Groundwater uses and functions		Some 409 × 10^6 m^3/year of groundwater is abstracted for drinking water and for irrigation.
Pressure factors		75 areas of groundwater contamination have been identified
Additional information		Transboundary groundwaters not seen to have specific uses and functions, because in Russia the resource is considered insignificant

63 Based on information provided by the Russian Federation.

Pressures and status

266. Irrigational water use and human settlements are the main pressure factors in the Georgian part of the basin. More than a half of the Georgian territory in the basin is grassland (53.6%) and only about 1% is cropland. In the Russian part of the basin, pressure arises from irrigation (>700,000 ha), industry, aquaculture/fisheries and human settlements.

267. At the time of the first Assessment of Transboundary Rivers, Lakes and Groundwaters (2007), the river had a good ecological and chemical status at the border. According to data provided by the Russian Federation, the Terek has been in the “polluted” category of the Russian water quality classification from 2005 to 2008 without significant variation.

XXIV. Malyi Uzen Basin

268. The 638-km long Malyi Uzen originates in the Syrt chain of hills in the Russian Federation (Saratov Oblast) and discharges into Lake Sorajdyn, which is one of the Kamysh-Samarsk lakes in Kazakhstan.

269. The (mean) elevation is in the range from 20 to 120 m a.s.l.

Table 56
Area and population in the Malyi Uzen Basin

Country	*Area in the country (km^2)*	*Country’s share %*	*Population*	*Population density (persons/km^2)*
Russian Federation	5 980	51.6		
Kazakhstan	5 620	48.4		
Total	**11 600**			

Hydrology and hydrogeology

270. Surface water resources in the Russian part of the basin are estimated at 88 × 10^6 m^3/year (based on observations from 1948 to 1987). [64]

271. According to the Russian Federation, the river practically does not have baseflow from groundwater due to the river bed consisting of clay. The Pre-Caspian aquifer extends to the Malyi Uzen Basin (see the assessment of the Ural, table 3).

272. Like in the basin of the Bolshoy Uzen, the lack of rain and short duration of rainfall events, dryness of the air and soil, as well as a high evaporation is typical of the area.

273. On the Russian side, the biggest reservoirs are the Upper Perekopnovsk (65.4 × 10^6 m^3), Molouzensk (18.0 × 10^6 m^3) and Varfolomejevsk (26.5 × 10^6 m^3) reservoirs and several artificial lakes (87.33 × 10^6 m^3). Reservoirs in Kazakhstan include: the Kaztalovsk-I (7.20 × 10^6 m^3), the Kaztalovsk-II (3.55 × 10^6 m^3) and the Mamajevsk (3.50 × 10^6 m^3) reservoirs and several artificial lakes (4.83 × 10^6 m^3).

[64] Source: Water management balance of the Malyi and Bolshoy Uzen River basins, TOO Uralvodproject 1998

Pressure and status

274. Water scarcity is severe in the basin. Irrigated agriculture is the main pressure factor. The land area requiring irrigation varies from 1,961 to 45,979 ha depending on the hydrometeorological conditions.

275. Wastewater discharges and surface runoff as well as sediments and riverbank erosion degrade water quality. Non-respect of water protection zones and unauthorized reconstruction works have affected water quality.

276. The status of the watercourses is assessed as “stable”.

Table 57
Total withdrawal and withdrawals by sectors

Country	*Year*	*Total withdrawal* $\times 10^6$ *m*^{3}*/year*	*Agricultural* %	*Domestic* %	*Industry* %	*Energy* %	*Other* %
Russian Federation	2009	56.85	95.9	4.1	0.1	-	-
Kazakhstan							

Response and transboundary cooperation

277. Monitoring of water resources of the Malyi and Bolshoy Uzen is carried out by the Regional Centre for Hydrometeorology and Environmental Monitoring of Saratov and also "Saratovmeliovodhoz" on reservoirs. Surface water quality is monitored on the Malyi Uzen (at monitoring station Malyi Uzen) with sampling during the main hydrological phases and on the Bolshoy Uzen (at the town of Novouzensk) with monthly sampling. A schedule for joint water sampling by specialized laboratories is approved annually.

278. In the regional program "Providing of the population of Saratov region with drinking water, 2004-2010", wastewater treatment plants are constructed in Krasnokutskaya, Fedorovskoye, Piterskaya and Algayskom rayons (districts) of Saratov oblast

279. Water transfer, including from the Volga basin, which is used to address with scarcity in the Malyi and Bolshoy Uzen basins, is subject to annual agreements between the riparian countries. The basis of the cooperation is the 1992 Agreement between the Russian Federation and Kazakhstan on the joint use and protection of transboundary waters. The minimum flow across the border that should be ensured is 19.2×10^6 m^3 since 2006. Issues of transboundary significance are discussed in the Kazakh-Russian joint commission, and monitoring data is shared in the intergovernmental working group on allocation of flow of the Bolshoy and Malyi Uzen.

280. As for the Bolshoy Uzen, the Lower Volga basin management administration and the Ural basin district deal with issues related to the Malyi Uzen in the Russian Federation. A scheme of complex use and protection of the water body is under development in the Russian Federation.

Future trends

281. The Russian Federation predicts the total withdrawals to decrease dramatically in 2011 compared with 2009. Withdrawals for agricultural purposes are expected to increase by about two percent and for household use to decrease respectively.

XXV. Bolshoy Uzen River Basin

282. The 650-km long Bolshoy Uzen River originates in the Syrt hills in the Russian Federation (Saratov oblast) and discharges into Lake Ajden which is a part of the Kamysh-Samarsk lakes in Kazakhstan. The lakes spread over a large area where the river flows on to the Caspian lowland.

Table 58
Area and population in the Bolshoy Uzen Basin

Country	*Area in the country (km^2)*	*Country's share %*	*Population*	*Population density (persons/km^2)*
Russian Federation	9 660	61.9		
Kazakhstan	5 940	38.1		
Total	**15 600**			**28**

Source: Water management balance of the Malyi and Bolshoy Uzen River basins, TOO Uralvodproject

283. Water resources in the Russian part of the basin are estimated at approximately 215.4×10^6 m^3/year (based on observations from 1948 to 2002).[65]

284. Groundwater is practically not contributing to the flow at all because of the river bottom consisting of clays. The Pre-Caspian aquifer extends to the Bolshoy Uzen Basin (table 3).

Table 59
Total withdrawal and withdrawals by sectors

Country	*Year*	*Total withdrawal $\times 10^6$ m^3/year*	*Agricultural %*	*Domestic %*	*Industry %*	*Energy %*	*Other %*
Russian Federation	2009	70.22	94.1	5.4	-	-	0.5
Kazakhstan							

On the Russian side, the biggest reservoirs are the Nepokojevsk (48.75×10^6 m^3) and Orlovogajsk (5.4×10^6 m^3) reservoirs and several artificial lakes (183.67×10^6 m^3). Three reservoirs in Kazakhstan are the Sarychganaksk (46.85×10^6 m^3), the Ajdarchansk (52.3×10^6 m^3) and the Rybnyj Sakryl (97×10^6 m^3) reservoirs.

Pressures

285. Irrigated agriculture is the main pressure on water resources, especially downstream from the border between the Russian Federation and Kazakhstan. Depending on the hydrometeorological conditions, the area requiring irrigation ranges from 1,200 ha to 27,000 ha.

286. The Russian Federation ranks as widespread and severe the problem of water scarcity.

[65] *Source:* Water management balance of the Malyi and Bolshoy Uzen River basins, TOO Uralvodproject 2003

287. Water quality is negatively affected by wastewater discharges, surface run-off, sediments and riverbank erosion.

Status, response and transboundary cooperation

288. The condition of the river is assessed as "stable".

289. In the regional program "Providing of the population of Saratov region with drinking water, 2004-2010", wastewater treatment plants are constructed in Krasnopartizansk and Ershovsky, Dergachevsky rayons (districts) of Saratov oblast.

290. Other response measures concerning also the Bolshoy Uzen are described in the assessment of the Malyi Uzen.

Future trends

291. The Russian Federation predicts the total withdrawal to increase in 2011 more than 50% compared with withdrawal in 2009 with the share of agricultural withdrawal increasing by about 2%.