SIC ICWC Policy brief

No.7 December, 2024

Analysis of Water Inflows into the Aidar-Arnasoy Lake System from the Shardara Reservoir (1990-2023)

Prepared by: Ikrom Ergashev

Introduction

The Aidar-Arnasoy Lake System (AALS) in Uzbekistan is a complex of inland lakes encompassing Aidarkul, Tuzkan, and East Arnasoy, covering a total area of 2,175 km².[1] Located in a desert basin on the eastern edge of the Kyzylkum desert, southeast of the Shardara Reservoir, the AALS spans Dzhizak and Navoi provinces. This lake system is crucial for both the environment and the economy.

The AALS formed due to catastrophic overflows from the Shardara Reservoir in 1969, exceeding 21 cubic kilometers of water. Subsequent winter releases caused by operational shifts at the Toktogul Reservoir further contributed to its development. However, the construction of the Koksarai Reservoir in Kazakhstan significantly reduced river inflows.

This policy brief analyzes data on water inflows into the AALS from the Shardara Reservoir between 1990 and 2023 to identify key trends, inflow peaks, and changes in river water discharge.

Key trends

1993-2003: Increased inflows as a result of operational shift at the Toktogul Reservoir

From 1990 to 1992, water was not released from the Shardara Reservoir into the AALS. Water inflows into the AALS occurred from 1993 onwards, with peak discharges in March 1993 (1,274.4 Mm³) and June 1993 (1,018.4 Mm³). Inflows increased dramatically in 1994, reaching a peak in February (3,231.4 Mm³) and March (2,574 Mm³). High discharges persisted from 1995 to 1999, particularly during winter and spring months. This period coincided with a shift in the operational regime of the Toktogul Reservoir. Before 1992, 3-4 km³ of water was typically released from the Toktogul Reservoir during autumn and winter, maintaining relatively stable water levels in downstream reservoirs. However, since 1992, water releases from the Toktogul Reservoir have increased by 2-2.5 times during the non-growing season, leading to increased inflows into in-stream reservoirs. As a result, the

[1] The Aidary-Arnasoy Lake System in Uzbekistan is protected under an international convention (http://www.regnum.ru/news/ecology/1078255, published on November 2, 2008

Scientific-Information Center
of the Interstate Commission for Water Coordination (SIC ICWC)

Karasu-4, B.11A, Tashkent, 100187, Republic of Uzbekistan

sic.icwc-aral.uz cawater-info.net

Bakhri-Tojik (former Kairakkum) Reservoir was filled rapidly by December-January. The Shardara Reservoir also experienced accelerated filling. However, the Bakhri-Tojik Reservoir was operated in a flow-non-regulation mode, releasing large volumes of water (900-1,000 m³/s and higher). Water releases from the Shardara Reservoir were constrained by ice conditions in the lower Syr Darya and the flow capacity of downstream hydroschemes. With the Shardara Reservoir at full capacity, excess water was inevitably discharged into the Arnasoy depression.

The period from 1993 to 1999 witnessed a significant volume of water, totaling 24.3 cubic kilometers, released from the Shardara Reservoir into the Arnasoy depression. In this context, the Interstate Commission for Water Coordination (ICWC) in Central Asia convened its 21st meeting on October 24, 1998 and signed a protocol aimed at optimizing the operational modes of in-stream reservoirs along the Syr Darya River. This protocol specifically sought to mitigate the volume of water discharged into the Arnasoy depression, particularly in anticipation of potential increases in river runoff. Since 1999, the ICWC has assumed a proactive role in establishing planned discharge volumes into the Arnasoy depression (Table 1).

In the early 2000s, significant discharges continued. 2003 marked a peak year, with 1,053 Mm³ discharged in February as planned and an unplanned 1,464.5 Mm³ released in April.

The period from 1993 to 2003 witnessed the highest growth in discharge. This surge is primarily attributed to a 2-2.5-fold increase in water releases from the Toktogul Reservoir during the growing season compared to pre-1992 levels (Figure 1). Notably, during this period, the Shardara Reservoir experienced seven instances of 3-month (January-March) inflows exceeding 7,000 Mm³.

Actual water discharges significantly exceeded planned volumes between 1999 and 2000, and again from 2003 to 2004. In contrast, 2006 and the period from 2009 to 2011 witnessed substantial decreases in actual discharge compared to planned levels. Notably, no discharge into the AALS was planned in 2006, 2009, 2013-2016, and 2020-2023.

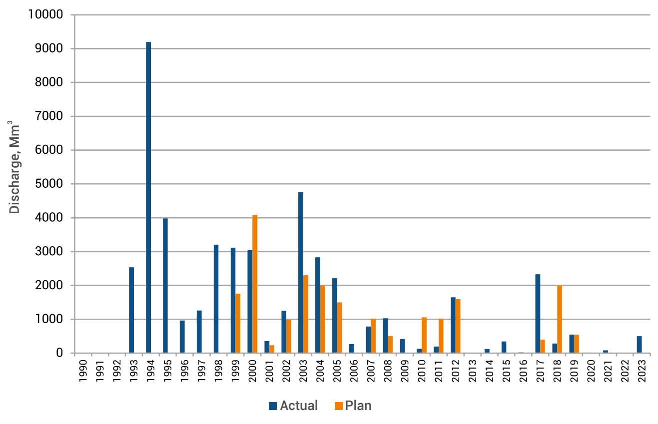

Figure 1. Annual discharge from the Shardara Reservoir

Peak discharges occurred between 1999 and 2004, culminating in 2003 when actual releases reached 4,755 Mm³, a 206% overshoot of the planned 2,305 Mm³. Subsequent years generally saw declining discharge volumes, although a minor upsurge was observed in 2008.

2004-2010: reduced discharge due to weather conditions

Between 2004 and 2010, water discharges into the AALS significantly decreased, averaging approximately 1.1 km³ annually, a threefold reduction compared to the 1993-2003 period (average 3 km³). Notably, six of the eleven years between 1993 and 2003 witnessed discharges exceeding 3 km³.

While 2004 (2.8 km³) and 2005 (2.2 km³) saw relatively high discharge volumes, subsequent years, with the exception of 2008, experienced actual discharges below planned levels. This reduction can be attributed to favorable ice conditions along the watercourses, enabling increased water releases into the North Aral Sea (NAS). Consequently, the average inflow into the NAS increased by 50% during this period compared to the 1993-2003 period.

Water was not discharged into the AALS in 2013 and 2022, following the commissioning of the Koksarai Reservoir. A total of 12 years witnessed discharges below 0.5 km³.

2011-2023: reduced discharge following Koksarai Reservoir completion

The construction of the Koksarai Reservoir in Turkistan province, Kazakhstan, from 2008 to 2011, introduced a counter-regulating structure for the Shardara Reservoir. Upon completion, the Koksarai Reservoir began receiving water that previously flowed into the AALS.

Between 2009 and 2011, actual discharge volumes into the AALS were minimal, indicating the commencement of water accumulation within the Koksarai Reservoir. In 2012, actual discharge (1,652 Mm³) closely mirrored the planned discharge (1,593 Mm³).

Subsequently, discharge volumes decreased to the 200-300 Mm³ range, with occasional surges during winter and spring attributed to ice formation significantly reducing flow capacity in watercourses. To mitigate flooding risks during these periods, operators were compelled to release water into the AALS. Despite a notable increase in discharge in 2017 (2,333 Mm³), subsequent years generally witnessed reduced water releases, with exceptions in 2019 and 2023.

Discharge from the Shardara Reservoir into the Aidar-Arnasoy lake system[2], *Mm^3*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Plan[3]
1990	0	0	0	0	0	0	0	0	0	0	0	0	**0**	-
1991	0	0	0	0	0	0	0	0	0	0	0	0	**0**	-
1992	0	0	0	0	0	0	0	0	0	0	0	0	**0**	-
1993	0	0	1,274	242	0	1,018	0	0	0	0	0	0	**2,535**	-
1994	2,252	3,231	2,574	980	156	0	0	0	0	0	0	0	**9,193**	-
1995	1,011	2,093	876	0	0	0	0	0	0	0	0	0	**3,979**	-
1996	0	0	967	0	0	0	0	0	0	0	0	0	**967**	-
1997	0	743	519	0	0	0	0	0	0	0	0	0	**1,262**	-
1998	0	147	2,030	178	0	850	0	0	0	0	0	0	**3,204**	-
1999	1,503	960	657	0	0	0	0	0	0	0	0	0	**3,120**	**1,757**
2000	1,311	1,680	51	0	0	0	0	0	0	0	0	0	**3,043**	**4,087**
2001	0	355	0	0	0	0	0	0	0	0	0	0	**355**	**236**
2002	0	0	0	651	200	60	24	297	17	0	0	0	**1,249**	**992**
2003	577	1,053	1,221	1,464	388	0	0	0	0	0	0	52	**4,755**	**2,305**
2004	917	982	461	472	0	0	0	0	0	0	0	0	**2,832**	**2,001**
2005	69	920	1,219	3	0	0	0	0	0	0	0	0	**2,212**	**1,501**
2006	0	52	214	0	0	0	0	0	0	0	0	0	**266**	**0**
2007	177	349	17	244	0	0	0	0	0	0	0	0	**788**	**1,022**
2008	0	537	459	0	0	0	0	0	0	0	5	29	**1,030**	**506**
2009	20	160	156	36	6	0	0	0	0	0	0	39	**417**	**0**
2010	0	0	0	0	0	67	61	0	0	0	0	0	**129**	**1,059**
2011	0	0	197	0	0	0	0	0	0	0	0	0	**197**	**1,020**
2012	372	622	599	59	0	0	0	0	0	0	0	0	**1,652**	**593**
2013	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**
2014	0	13	109	0	0	0	0	0	0	0	0	0	**122**	**0**
2015	0	89	255	0	0	0	0	0	0	0	0	0	**344**	**0**
2016	0	0	0	0	22	0	0	0	0	0	0	0	**22**	**0**
2017	0	481	465	314	833	240	0	0	0	0	0	0	**2,333**	**402**
2018	0	0	283	0	0	0	0	0	0	0	0	0	**283**	**2,004**
2019	0	0	135	376	37	0	0	0	0	0	0	0	**548**	**548**
2020	0	0	17	0	0	0	0	0	0	0	0	0	**17**	**0**
2021	0	0	0	82	0	0	0	0	0	0	0	0	**82**	**0**
2022	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0**
2023	438	61	0	0	0	0	0	0	0	0	0	0	**500**	**0**

Monthly trends

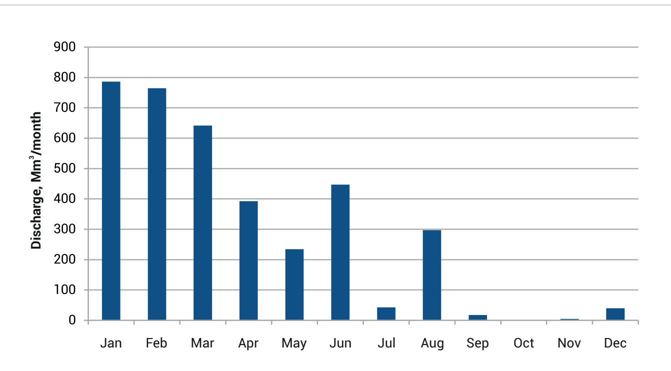

Figure 2. Average monthly discharge from the Shardara Reservoir

Analysis of monthly data reveals that the maximum discharge of water into the AALS typically occurs between January and March (Figure 2). Planned discharges primarily coincide with February and March (Figure 3). Conversely, the minimum volume of discharge is observed during summer months when reservoir water levels remain relatively stable. Notably, summer discharges ceased after the construction of the Koksarai reservoir in 2010.

2 Source: BWO Syr Darya

3 Planned discharge of water from the Shardara Reservoir as approved by ICWC meetings

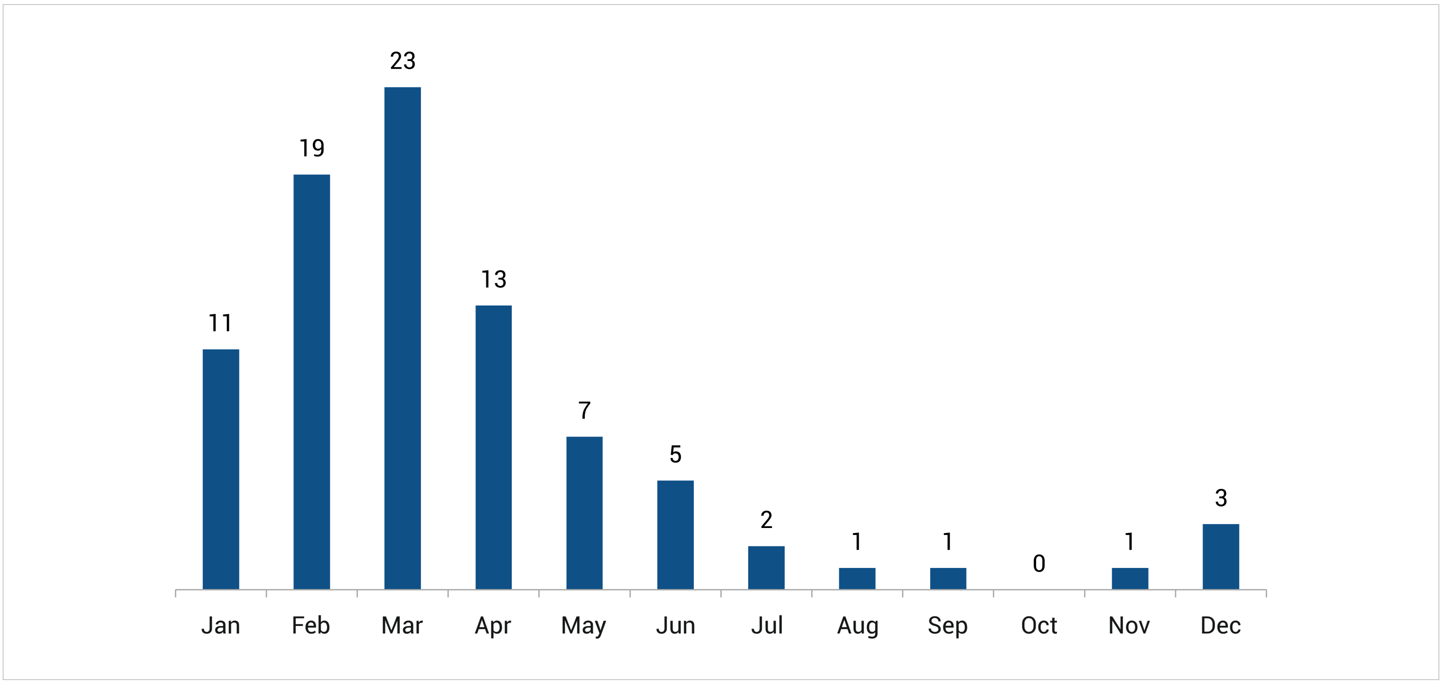

Figure 3. Instances of discharge in the course of 34 years (1990-2023)

Conclusion

During the period from 1994 to 2000, the lake system's water volume was 44.1 km³, with a surface area of 350,000 hectares (as detailed in Table 2 showing water area dynamics over the recent decade) and an extent of 250 km. However, between 2013 and 2021, due to the lack of water releases from the Shardara Reservoir into the lakes, the water volume dropped to 37.7 km³, the water level fell by 2 meters, and salinity increased from 5.1 g/l to 8.6 g/l, exceeding 12 g/l near the Baimurad locality. This decline led to shoreline recession by 15-50 meters and the formation of a 15-20 cm salt layer, further exacerbating lake water salinity.

Before the construction of the Koksarai reservoir, approximately 3.5 km³ of water, including 2 km³ of river water, was discharged annually into the AALS.[4] Analysis of water discharge data from the Shardara reservoir into the AALS over the period from 1990 to 2023 reveals significant variations in volumes (Table 1).

Regular monitoring and data analysis are essential for effective water resource management to ensure the stable functioning of the AALS ecosystem and mitigate potential adverse effects. Based on the balance method, it is recommended to restore an inflow of 1-1.5 km³ annually to the AALS.

[4] Aidar-Arnasoy lake system would suffer the fate of the Aral Sea // https://www.gazeta.uz/ru/2021/12/17/lakes/ Published 17.12.2021 (in Russian)

Table 2. Dynamics of the water area of the Aidar-Arnasoy lake system over 2014-2024[5]

#	Image date	System of lakes	Area, km^2	Total, km^2
1	May, 2014	Arnasoy	327.45	**3,218.11**
		Aidarkul, Tuzkan	2,890.66	
2	May, 2015	Arnasoy	240.82	**3,227.58**
		Aidarkul, Tuzkan	2,986.76	
3	August, 2016	Arnasoy	194.63	**2,996.33**
		Aidarkul, Tuzkan	2,801.70	
4	March, 2017	Arnasoy	275.33	**3,163.85**
		Aidarkul, Tuzkan	2,888.52	
5	September, 2018	Arnasoy	209.46	**2,949.56**
		Aidarkul, Tuzkan	2,740.10	
6	July, 2019	Arnasoy	229.58	**3,309.82**
		Aidarkul, Tuzkan	3,080.24	
7	September, 2020	Arnasoy	229.45	**3,270.34**
		Aidarkul, Tuzkan	3,040.89	
8	August, 2021	Arnasoy	202.27	**3,078.23**
		Aidarkul, Tuzkan	2,875.96	
9	September, 2022	Arnasoy	196.19	**3,072.15**
		Aidarkul, Tuzkan	2,875.96	
10	September, 2023	Arnasoy	206.33	**3,008.5**
		Aidarkul, Tuzkan	2,802.17	
11	May, 2024	Arnasoy	258.19	**3,020.17**
		Aidarkul, Tuzkan	2,761.98	

[5] Data of SIC ICWC