ANALYSIS OF HYDROLOGICAL CONDITIONS IN THE SYRDARYA AND AMUDARYA RIVER BASINS FOR THE NON-GROWING SEASON 2020-2021

Data source - BWO Syr Darya; BWO Amu Darya; analytical processing - SIC ICWC

1 Syr Darya River Basin

The actual inflow to the upstream reservoirs in the Syr Darya basin (Toktogul, Andijan, Charvak) was 4.8 km³ during the non-growing season (October 2021-March 2022). Inflow to the Toktogul reservoir was 2.82 km^3 or 101% of the forecast, and inflow to the Andijan reservoir was 15% higher than expected. The total water releases from the three upper reservoirs amounted to 9.44 km^3, which is 13% less than that in the forecast schedule of BWO Syr Darya.

Total lateral inflow in the reach from the Toktogul reservoir to the Shardara reservoir, including discharges from the Karadarya and Chirchiq rivers, was 8.96 km³. This is 1.8 times more than the total inflow to the upstream reservoirs but less than the total water releases from these reservoirs by 5%.

By the end of the non-growing season, the volume of water in the upstream reservoirs amounted to 9.56 km³, of which: Toktogul reservoir 0 7.85 km^3 or 124% of the BWO's schedule; Andijan reservoir - 1.06 km³ (110%); Charvak reservoir -0.64 km³ (90%). The Toktogul reservoir was drawn down for 4.45 km³; Charvak reservoir - for 0.61 km³. Andijan reservoir accumulated water in the amount of 0.56 km³.

Inflow to the Bakhri Tochik reservoir amounted to 9.81 km³, which is 1.42 km³ less than in the BWO Syr Darya schedule. Water releases from the reservoir into the river were 9.69 km³, which is 0.07 km³ less than in the the BWO Syr Darya schedule. The reservoir was filled up to 3.32 km³, and an unrecorded inflow to the reservoir in the amount of 1.37 km³ was revealed by the balance method (underestimated inflow to the reservoir).

The total water withdrawal from the Naryn and the Syr Darya rivers amounted to 4.03 km³, including: 0.02 km³ - Kyrgyz Republic; 0.05 km³ - Republic of Tajikistan -; 0.49 km³ - Republic of Kazakhstan (through Dustlik canal) -; 3.47 km³ - Republic of Uzbekistan - (Table 1.1).

For the non-growing season 2021-2022, the inflow to the Shardara reservoir made up 8.27 km³, which is 2.07 km³ less than scheduled by BWO Syr Darya. By the end of the season, the reservoir was filled up to 5.0 km³ (96%). Water losses (estimated from the negative discrepancy of the water balance) were insignificant - 0.15 km³. The discharge from the Shardara reservoir amounted to 3.79 km³ (62%), including: 3.52 km³ - discharge into the river; 0.27 km³ - water intake into Kizilkum canal. Water was not discharged into Arnasay.

The total discrepancy in the water balance of the Syr Darya basin up to Shardarya reservoir (rivers and reservoirs) is about - 2.5 km³ or 15% of regulated flow. The negative discrepancy can be partially attributed to river water losses (presumably about 1.5…1.6 km³) and partly on errors in flow recording at gauging stations. A positive discrepancy (see Table 1.3) indicates to the presence of an unaccounted inflow.

The amount of flow used in the lower reaches of the Syr Darya amounted to 3.29 km³ (Table 1.2) The water supply to the Aral Sea was 0.2 km³, according to Kazhydromet - and 0.24 km³ (21% of the expected amount), according to the Committee of Water Resources of Kazakhstan.

Table 1.2 shows the river water balance, and Table 1.3 shows the water balance of reservoirs.

Table 1.1

Water consumption of the countries in the Syr Darya river basin (reach up to the Shardara reservoir) for non-growing season 2021-2022

#	Water user	Water volume, km^3		Water availability, %
		Limit/ schedule	Actual	Season
1	Total water withdrawal	4.21	4.03	96
2	Water withdrawal by state:			
	Kyrgyz Republic	0.05	0.02	51
	Republic of Uzbekistan	3.35	3.47	104
	Republic of Tajikistan	0.37	0.05	13
	Republic of Kazakhstan	0.45	0.49	108
3	Water intake by river reaches			
3.1	Toktogul reservoir – Uchkurgan hydroscheme	1.38	1.35	98
	Including:			
	Kyrgyz Republic	0.04	0.02	51
	Republic of Tajikistan	0.08	0.04	52
	Republic of Uzbekistan	1.25	1.28	103
3.2	Uchkugran hydroscheme – Bakhri Tochik hydroscheme	0.25	0.18	72
	Including:			
	Kyrgyz Republic	0.01	0.003	46
	Republic of Tajikistan	0.07	0.00	
	Republic of Uzbekistan	0.17	0.17	101
3.3	Bakhri Tochik hydroscheme – Shardara reservoir	2.59	2.50	97
	Including:			
	Republic of Kazakhstan	0.45	0.49	108
	Republic of Tajikistan	0.212	0.004	0,208
	Republic of Uzbekistan	1.92	2.01	105

Table 1.2

Water balance of the Syr Darya River for the non-growing season 2021-2022

#	Balance item	Water volume, km^3		
		Forecast/plan	Actual	Deviation (actual–plan)
1	Inflow to Toktogul reservoir	2.80	2.82	0.03
2	Lateral inflow in the reach Toktogul reservoir (+)- Shardara reservoir (+)	9.12	8.96	-0.16
	Including:			
2.1	*Discharge from the Karadarya River*	1.18	1.84	0.66
2.2	*Discharge from the Chirchik River*	1.43	0.75	-0.68
2.3	*Lateral inflow from CDN and small rivers*	6.51	6.37	-0.14
3	Flow regulation by reservoirs: recharge (+) or diversion (-) of flow	4.29	4.32	0.03
	Including:			
3.1	*Toktogul reservoir*	5.95	4.44	-1.51
3.2	*Bakhri Tochik reservoir*	-1.65	-0.12	1.53
4	Regulated inflow (1+2+3)	16.21	16.11	-0.11
5	Water intake in the Toktogul - Shardara reach (-)	-4.21	-4.03	0.18
6	Water balance discrepancy	-1.66	-3.80	-2.15
7	Inflow to the Shardara reservoir	10.34	8.27	-2.07
8	Flow regulation by the Shardara reservoir recharge (+) or diversion (-) of flow	-5.80	-4.99	0.82
9	Water releases from Shardara reservoir into the river	5.65	3.52	
10	Water use in the Shardara – Aral Sea reach *	4.54	3.29	-1.25
11	Supply to the Aral Sea (Karateren g/s)**	1.12	0.24	-0.88

*Water withdrawal plus river water losses and minus lateral inflow

**According to the Committee of Water Resources of the Republic of Kazakhstan

Table 1.3

Reservoir water balance in the Syr Darya river basin for the non-growing season 2021-2022

#	Balance item	Water volume, km^3		Deviation (actual–plan)
		Forecast/plan	Actual	
1	**Toktogul reservoir**			
1.1	Water inflow to the reservoir	2.80	2.82	0.03
1.2	Water volume in reservoir:			
	- beginning of the season (October 1, 2021)	12.30	12.304	0.00
	- end of the season (April 1, 2022)	6.34	7.851	1.51
1.3	Water releases from the reservoir	8.75	7.26	-1.48
1.4	Water balance discrepancy	-0.02	-0.01	0.01
	Including % of inflow to the reservoir	1	0	0
1.5	Flow regulation: recharge (+) or diversion (-) of flow	5.95	4.44	-1.51
2	**Andijan reservoir**			
2.1	Water inflow to the reservoir	0.85	0.98	0.12
2.2	Water volume in the reservoir:			
	- beginning of the season (October 1, 2021)	0.50	0.50	0.00
	- end of the season (April 1, 2022)	0.97	1.06	0.10
2.3	Water releases from the reservoir	0.38	0.40	0.02
2.4	Water balance discrepancy	0.00	-0.02	-0.01
	Including % of inflow to the reservoir	0	2	1
2.5	Flow regulation: recharge (+) or diversion (-) of flow	-0.47	-0.58	-0.11
3	**Charvak reservoir**			
3.1	Water inflow to the reservoir	1.16	1.18	0.02
3.2	Water volume in reservoir:			
	- beginning of the season (October 1, 2021)	1.25	1.25	0.00
	- end of the season (April 1, 2022)	0.71	0.64	-0.07
3.3	Water releases from the reservoir	1.67	1.77	0.10
	Water balance discrepancy	-0.02	-0.01	0.01
	Including % of inflow to the reservoir	2	1	1
3.5	Flow regulation: recharge (+) or diversion (-) of flow	0.51	0.60	0.08
4	**Bakhri Tochik reservoir**			
4.1	Inflow to the reservoir from the river	11.23	9.81	-1.42
4.2	Lateral inflow	0.300	0.261	-0.04
4.3	Water volume in the reservoir:			
	- beginning of the season (October 1, 2021)	1.59	1.59	0.00
	- end of the season (April 1, 2022)	3.43	3.32	-0.11
4.4	Water releases from the reservoir	9.88	9.71	-0.17
	Including:			
	- releases into the river	9.77	9.69	-0.07
	- water intake from the reservoir	0.11	0.016	-0.09

4.5	Water balance discrepancy	0.19	1.37	1.18
4.6	Flow regulation: recharge (+) or diversion (-) of flow	-1.65	-0.12	1.53
5	**Shardara reservoir**			
5.1	Inflow to the reservoir	10.34	8.27	-2.07
5.2	Lateral inflow	0.0	0.0	0.00
5.3	Water volume in reservoir:			
	- beginning of the season (October 1, 2021)	0.67	0.67	0.00
	- end of the season (April 1, 2022)	5.20	5.00	-0.20
5.4	Water releases from the reservoir	5.74	3.79	-1.95
	Including:			
	- discharge into Arnasay	0.00	0.00	0.000
	- water releases into the river	5.65	3.52	-2.13
	- water intake from the reservoir	0.08	0.27	0.19
5.5	Water balance discrepancy	-0.07	-0.15	-0.07
	Including % of inflow to the reservoir	1	2	1
5.6	Flow regulation: recharge (+) or diversion (-) of flow	-4.60	-4.75	-0.15
	Total volume of flow regulation by reservoirs: recharge (+) or diversion (-) of flow	-0.27	-0.41	-0.14
	Total discrepancy: (+) unrecorded inflow	0.08	1.19	1.11

2 Amu Darya River Basin

The actual water content in the Amu Darya River at "nominal Kerki" section (upstream of the water intake to Garagumdarya) amounted to 11.7 km³, which is 8% more than the forecast according to the schedule of BWO Amu Darya (Table 2.1).

Inflow to the Nurek reservoir was 4.12 km³ (113% of the forecast), while water releases were 7.56 km³ (102% of that scheduled by BWO Amu Darya). The river flow increased due to the drawdown of the Nurek reservoir by 3.44 km³. By the end of the season, the reservoir was drawn down to 6.62 km³. The reservoir water balance discrepancy, showing water losses and (or) overestimated inflow to the reservoir, is negative - 0.48 km³ (Table 2.3)

In the reservoirs of Tuyamuyun hydroscheme (TMHS), the plan for water accumulation during the non-growing season was not fulfilled. By April 1, the actual volume of water turned out to be 0.34 km³ less than the planned one and amounted to 2.46 km³. The non-fulfillment of the plan can be explained by lower than expected inflow to the run-of-river reservoir - the flow at the Darganata section was 6.37 km³ (92% of the forecast). Water releases from TMHS was also less than the BWO schedule – 4.75 km³ (82%).

The established water withdrawal limit in the Amu Darya river basin was 86% used; the actual water withdrawal amounted to 13.50 km³ of water, including 10.72 km³ downstream of Kerki gauging station (starting from the water intake to Garagumdarya). Water supply by state has changed from 82% (Uzbekistan) to 89% (Turkmenistan) - Table 2.1. The water availability was 85% in the upper reaches (up to Garagumdarya water intake), 98% in the middle reaches (from "nominal Kerki" to TMHS), and 62% in the lower reaches (67% in Turkmenistan and 60% in Uzbekistan).

The river balance discrepancy was 1.97 km³ in the "nominal Kerki" - Darganata g/s reach and 1.47 km³ in the Tuyamuyun g/s - Samanbay g/s reach - I total, this is 3.45 km³ or 23% of river flow at "nominal Kerki" g/s. The discrepancy is negative. This indicates to river water losses and, possibly, to inaccuracies in river flow accounting at gauging stations.

The established limit of sanitary-environmental flow for the canals in the Amu Darya lower reaches was 82% used, the water supply amounted to 0.52 km³. According to UzHydromet, 0.34 km^3 reached in the Aral Sea region and the Aral Sea. This is 16% of the plan.

Table 2.2 gives the data on river water balance, while Table 2.3 shows the reservoir water balance.

Table 2.1

Indicators of water supply of the countries in the Amu Darya river basin for the non-growing season 2021-2022

#	Water user	Water volume, km^3		Water availability, %
		Limit/ schedule	Actual	Season
1	Total water withdrawal	15.73	13.50	86
2	Water intake by state:			
	Kyrgyz Republic	-	-	-
	Republic of Tajikistan	2.88	2.49	86
	Turkmenistan	6.50	5.79	89
	Republic of Uzbekistan	6.35	5.22	82
3	Downstream of “nominal Kerki” g/s	12.48	10.72	86
	Including:			
	Turkmenistan	6.50	5.79	89
	Republic of Uzbekistan	5.98	4.93	83
4	By river reach			
4.1	Upper reaches	3.25	2.77	85
	Including:			
	Kyrgyz Republic	-	-	-
	Republic of Tajikistan	2.88	2.49	86
	Republic of Uzbekistan, Syrkhandarya	0.37	0.29	77
4.2	Middle reaches	8.35	8.15	98
	Including:			
	Turkmenistan	5.10	4.85	95
	Republic of Uzbekistan	3.25	3.30	102
4.3	Lower reaches	4.14	2.58	62
	Including:			
	Turkmenistan	1.40	0.94	67
	Republic of Uzbekistan	2.74	1.63	60
5	Sanitary-environmental flow to canals in the lower reaches	0.80	0.52	65
	Including			
	Turkmenistan	0.15	0.14	94
	Republic of Uzbekistan	0.65	0.38	58
6	Supply to the Aral Sea region and the Aral Sea	2.1	0.34	16

Table 2.2

Water balance of the Amu Darya River for the non-growing season 2021-2022

Balance item	Water volume, km^3		Deviation (actual-plan)
	Forecast/ plan	Actual	
1.Water content in the Amu Darya River - unregulated flow at " nominal Kerki " section *	10.83	11.71	0.870
2.Flow regulation by Nurek reservoir: recharge(+), diversion (- of flow	3.76	3.44	-0.31
3. Water intake in the middle reaches (-)	-8.35	-8.15	0.20
4.Return flow in the middle reaches (+)	1.21	1.34	0.13
5. River balance discrepancy	-0.55	-1.97	-1.43
6. River flow at Darganata g/s	6.91	6.37	-0.54
7. Water releases from TMHS (including water intake from the reservoir)	5.78	4.75	-1.03
8. Water intake in the lower reaches, including water intake from TMHS (-)	-4.14	-2.58	1.56
9. Emergency-environmental water releases to canals (-)	-0.80	-0.52	0.28
10.River water balance discrepancy	-0.27	-1.47	-1.20
11.Flow of the Amu Darya River at Samanbay g/s	0.57	0.18	-0.39
TOTAL discrepancy	-0.82	-3.44	-2.62
% of flow at "nominal Kerki" g/s	6	23	17

* Excluding water intake in upper reaches (Tajikistan, Surkhandarya region)

Table 2.3

Reservoir water balance in the Amu Darya river basin for the non-growing season 2021-2022

Balance article	Water volume, km^3		Deviation (actual–plan)
	Forecast/ plan	Actual	
1 Nurek reservoir			
2.1 Water inflow to the reservoir	3.63	4.12	0.48
2.2 Water volume in the reservoir:			
- beginning of the season (October, 2021)	10.57	10.57	0.00
- end of the season (April, 2022)	6.21	6.62	0.41
2.3 Water releases from the reservoir	7.39	7.56	0.17
2.4 Water balance discrepancy	-0.60	-0.50	0.10
2.5 Flow regulation: recharge (+) or diversion (-) of flow	3.76	3.44	-0.31
2 Reservoirs of TMHS			
2.1 River flow Darganata g/s	6.91	6.37	-0.54
2.2 Water volume in the reservoirs:			
- beginning of the season (October, 2021)	2.37	2.37	0.00
- end of the season (April 1st 2022)	2.80	2.46	-0.34
2.3 Water releases from the hydroscheme	5.78	4.75	-1.03
Including:			
– water releases into the river	4.03	3.61	-0.42
– water intake	1.75	1.14	-0.61
2.4 Water balance discrepancy	-0.71	-1.53	-0.83
2.5 Flow regulation: recharge (+) or diversion (-) of flow	-1.13	-2.76	-1.63