

**ANALYSIS OF HYDROLOGICAL CONDITIONS IN THE SYRDARYA AND
AMUDARYA BASINS OVER THE GROWING SEASON
2016**

1. Syrdarya River Basin

The actual inflow to the upstream reservoirs in the Syrdarya basin (Toktogul, Andizhan, and Charvak reservoirs) was 20.52 km³ or 125% of the forecast for the growing season. The total lateral inflow to the Naryn and the Syrdarya (in the reaches up to the Shardara reservoir) was 11.96 km³. By the end of the growing season, the upstream reservoirs have accumulated 19.9 km³, including 17.49 km³ in the Toktogul reservoir, or 125% of the BWO Syrdarya scheduled amount. Water releases from the Toktogul reservoir were 3.57 km³ or 77% of the BWO Syrdarya scheduled volume.

During the growing season 2016, the total water diversion from the Naryn and Syrdarya rivers in the reaches up to Shardara reservoir was 8.82 km³ or 76% of the water limit. As compared to the BWO Syrdarya schedule, 2.84 km³ less water was withdrawn over the growing season 2016. The indicators of water shortage (against the water limit) were: for the Republic of Kazakhstan (along the Dustlik canal) – 262 km³; the Kyrgyz Republic – 54 km³; the Republic of Tajikistan – 357 km³; and, the Republic of Uzbekistan – 2165 km³. Water supply was uneven among the states and river reaches (Table 1.1). The water shortage was highest in the middle reaches from the Bakhri Tojik waterworks facility to the Shardara reservoir – 34 % on the average during the growing season. Minimum water supply recorded in summer was as follows:

- Uzbekistan – 36 % in the Bakhri Tojik-Shardara reach, in the 2nd ten-day period of June
- Kazakhstan – 29 % in the Bakhri Tojik-Shardara reach in the 1st ten-day period of July
- Tajikistan – 28 % in the Toktogul-Bakhri Tojik reach in the 1st ten-day period of June
- Kyrgyzstan – 52 % in the Toktogul-Bakhri Tojik reach in the 1st ten-day period of August

The inflow to the Bakhri Tojik reservoir was 5.7 km³ (5.2 km³ – BWO schedule); and water releases from the reservoir were 6.11 km³. The comparison of actual ten-day water releases from the reservoir with the BWO schedule demonstrates that the actual releases were lower than scheduled ones:

Month	April	May	June			July		
Ten-day period	3	1	1	2	3	1	2	3
Exceeding of BWO scheduled values over the actual data, %	35	50	15	35	8	19	14	13

The inflow to the Shardara reservoir was 6.14 km³, and water releases from the reservoir were 8.36 km³, including 7.59 km³ into the river. Shardara hydroscheme discharged 0.022 km³ into the Arnasay reservoir. According to Aralo-Syrdarya Basin water administration, the Koksarai reservoir accumulated water in the amount of 794 Mm³ in April

and May, while in other months it discharged the earlier accumulated flow in the amount of 2,476 Mm³.

Analysis of water balance in basin's reservoirs (Table 1.3) has detected unrecorded inflow of 30 Mm³ to the Toktogul reservoir and 90 Mm³ to the Andizhan reservoir and losses in the Bakhri Tojik and Shardara reservoirs in the total amount of 2.24 km³, including 1.55 km³ in the Shardara reservoir.

Water delivery to the Aral Sea and Prearalie (by Karateren gauging station) equaled 1.2 km³ during the growing season.

Table 1.1

Water availability in the Syrdarya River basin countries over the growing season 2016

Water user	Water volume, km ³		Water availability, %	Deficit (-), surplus (+), km ³
	BWO schedule/ Limit	Actual	Season	Season
1 Total water withdrawal up to Shardara reservoir	11.65	8.82	76	-2.84
2 By state:				
– <i>Kyrgyz Republic</i>	0.25	0.19	78	-0.05
– <i>Uzbekistan</i>	8.80	6.64	75	-2.16
– <i>Tajikistan</i>	1.91	1.55	81	-0.36
– <i>Kazakhstan</i>	0.70	0.44	63	-0.26
3 By river reach				
3.1 Toktogul reservoir – Uchkurgan hydroscheme	3.95	3.35	85	-0.60
<i>including:</i>				
– <i>Kyrgyz Republic</i>	0.16	0.12	76	-0.04
– <i>Tajikistan</i>	0.24	0.07	31	-0.16
– <i>Uzbekistan</i>	3.55	3.15	89	-0.40
3.2 Uchkugran hydroscheme – Bakhri Tojik reservoir	1.08	1.10	102	0.02
<i>including:</i>				
– <i>Kyrgyz Republic</i>	0.08	0.07	82	-0.01
– <i>Tajikistan</i>	0.45	0.52	115	0.07
– <i>Uzbekistan</i>	0.54	0.52	95	-0.03
3.3 Bakhri Tojik reservoir – Shardara reservoir	6.63	4.37	66	-2.26
<i>including:</i>				
– <i>Kazakhstan</i>	0.70	0.44	63	-0.26
– <i>Tajikistan</i>	1.22	0.96	79	-0.26
– <i>Uzbekistan</i>	4.71	2.97	63	-1.74
4 Additionally:				
– Inflow to Shardara reservoir	4.54	6.14	135	1.60
– Discharge into Arnasay	0.00	0.02		0.02
– Water supply to the Aral Sea and Prearalie	1.57	1.20	76	-0.37

Table 1.2**Syrdarya River channel water balance for the growing season 2016**

Balance item	Water volume, km ³		Difference (actual - plan)
	Forecast/plan	Actual	
1 Inflow to the Toktogul reservoir	8.64	12.10	3.45
2 Lateral inflow in the river reach of Toktogul reservoir – Shardara reservoir (+)	10.75	11.96	1.20
<i>including:</i>			
– Discharge from the Karadarya river	1.70	1.76	0.05
– Discharge from the Chirchik river	2.05	1.73	-0.33
– Lateral inflow from CDF and small rivers	7.00	8.48	1.48
3 Flow regulation in the reservoirs: inflow (+) or withdrawal (-)	-2.97	-8.02	-5.05
<i>including:</i>			
– Toktogul reservoir	-4.03	-8.52	-4.49
– Bakhri Tojik reservoir	1.06	0.50	-0.56
4 Regulated flow (1+2+3)	16.43	16.03	-0.40
5 Water withdrawal in the Toktogul – Shardara reach (-)	-11.65	-8.82	2.84
6 Water losses (-) or unrecorded inflow to the channel (+) in the Toktogul-Shardara reach	-0.23	-1.07	-0.84
<i>Including % of regulated flow</i>	1	7	
7 Inflow to the Shardara reservoir	4.54	6.14	1.60
8 Flow regulation in the Shardara reservoir: inflow (+) or withdrawal (-)	1.88	2.18	0.30
9 Water releases from the Shardara reservoir into the river	5.22	7.59	2.37
10 Water withdrawal into Kzylkum canal (-)	-1.21	-0.75	0.46
11 Discharge into Arnasay (-)	0.00	-0.02	-0.02
12 Water supply to the Aral Sea and Prearalie	1.57	1.20	-0.37

Table 1.3**Water balance of the Syrdarya River basin reservoirs for the growing season 2016**

Balance item	Water volume, km ³		Difference (actual - plan)
	Forecast/Plan	Actual	
1. Toktogul reservoir			
1.1 Inflow to the reservoir	8.64	12.10	3.45
1.2 Water volume in the reservoir:			
– beginning of the season (1 April 2016)	8.93	8.93	0.00
– end of the season (1 October 2016)	12.88	17.49	4.60
1.3 Water releases from the reservoir	4.61	3.57	-1.04
1.4 Unrecorded inflow (+) or losses (-)	-0.08	0.03	0.11
<i>% of inflow to the reservoir</i>	1	0	1
1.5 Flow regulation: inflow (+) or withdrawal (-)	-4.03	-8.52	-4.49

Balance item	Water volume, km ³		Difference (actual - plan)
	Forecast/Plan	Actual	
2. Andizhan reservoir			
2.1 Inflow to the reservoir	2.49	2.28	-0.21
2.2 Water volume in the reservoir:			
– beginning of the season (1 April 2016)	1.01	1.01	0.00
– end of the season (1 October 2016)	1.34	0.73	-0.61
2.3 Water releases from the reservoir	2.15	2.65	0.51
2.4 Unrecorded inflow (+) or losses (-)	-0.01	0.09	0.10
<i>% of inflow to the reservoir</i>	0	4	3
2.5 Flow regulation: inflow (+) or withdrawal (-)	-0.34	0.37	0.72
3. Charvak reservoir			
3.1 Inflow to the reservoir	5.30	6.14	0.84
3.2 Water volume in the reservoir:			
– beginning of the season (1 April 2016)	0.79	0.79	0.00
– end of the season (1 October 2016)	1.66	1.68	0.02
3.3 Water releases from the reservoir	4.41	5.18	0.77
3.4 Unrecorded inflow (+) or losses (-)	-0.03	-0.08	-0.05
<i>% of inflow to the reservoir</i>	1	1	1
3.5 Flow regulation: inflow (+) or withdrawal (-)	-0.90	-0.97	-0.07
4 Bakhri Tojik reservoir			
4.1 Inflow to the reservoir	5.21	5.73	0.52
4.2 Lateral inflow	0.30	0.22	-0.08
4.3 Water volume in the reservoir:			
– beginning of the season (1 April 2016)	3.38	3.38	0.00
– end of the season (1 October 2016)	1.72	2.27	0.55
4.4 Water releases from the reservoir	6.57	6.45	-0.12
including:			
– <i>Water releases into river</i>	6.09	6.11	0.02
– <i>Water withdrawal from reservoir</i>	0.48	0.34	-0.14
4.5 Unrecorded inflow (+) or losses (-)	-0.60	-0.61	-0.01
<i>% of inflow to the reservoir</i>	12	11	1
4.6 Flow regulation: inflow (+) or withdrawal (-)	1.06	0.50	-0.56
5 Shardara reservoir			
5.1 Inflow to the reservoir	4.54	6.14	1.60
5.2 Lateral inflow	0.00	0.00	0.00
5.3 Water volume in the reservoir:			
– beginning of the season (1 April 2016)	4.85	4.85	0.00
– end of the season (1 October 2016)	2.09	1.08	-1.01
5.4 Water releases from the reservoir	6.42	8.36	1.94
including:			
– <i>Discharge into Arnasay</i>	0.00	0.02	0.02
– <i>Water releases into river</i>	5.22	7.59	2.37
– <i>Water withdrawal from reservoir</i>	1.21	0.75	-0.46
5.5 Unrecorded inflow (+) or losses (-)	-0.87	-1.55	-0.67
<i>% of inflow to the reservoir</i>	19	25	6
5.6 Flow regulation: inflow (+) or withdrawal (-)	1.88	2.23	0.34

Balance item	Water volume, km ³		Difference (actual - plan)
	Forecast/Plan	Actual	
TOTAL Flow regulation: inflow (+) or withdrawal (-)	-2.32	-6.39	-4.07
TOTAL losses (-), unrecorded inflow (+)	-1.60	-2.12	-0.52

2. Amudarya River Basin

The actual water availability in the Amudarya River at the Atamyrat gauging station (upstream of the intake to Garagumdarya) was 39.76 km³, which is 0.29 km³ more than expected by the BWO Amudarya schedule (Table 2.2). The inflow to the Nurek HEPS was 17.21 km³ and was higher than the forecast by 2.57 km³; the water releases were 13.39 km³ or 2.07 km³ more than scheduled by BWO Amudarya. River runoff abstraction for accumulation of water in the Nurek reservoir amounted to 3.81 km³ (Table 2.3)

Given such hydrological conditions, the established limit of water withdrawal to canals in the basin was 89 % used (Table 2.1); the total water withdrawal was 35.38 km³, including 28.79 km³ downstream of Atamyrat gauging station (starting from the intake to Garagumdarya). During the growing season, the average water availability was 83% for the Republic of Tajikistan, 91% for Turkmenistan, and 89% for the Republic of Uzbekistan. In the lower reaches, the water availability was 77% in Turkmenistan, 89% in the Republic of Uzbekistan, and 65% in Surkhandarya province (Table 2.1).

Minimum water availability was recorded in the following ten-day periods:

- Uzbekistan – 71 % in Tuyamuyun-Samanbay reach in the 2nd ten-day period of May
- Turkmenistan – 55 % in Tuyamuyun-Samanbay reach in the 2nd ten-day period of May.

The channel losses from the Amudarya River in the Atamyrat g/s (conditional) to Bir-Ata g/s were calculated by the balance method and amounted to 2.64 km³ or about 7 % of runoff at Atamyrat g/s (conditional). Water losses in the Tuyamuyun-Samanbay reach were 3.48 km³ or 28 % of water releases from the Tuyamuyun hydroscheme.

An amount of 1.4 km³ (Amudarya runoff at Samanbay g/s plus collector-drainage flow) was supplied to the Priaralie and the Aral Sea during the growing season.

Table 2.1

Water availability in the Amudarya River Basin countries for the growing season 2016

Water user	Water volume, km ³		Water availability %	Deficit (-), surplus (+) km ³
	Limit/schedule	Actual	Season	Season
1. Total water withdrawal	39.7	35.4	89	-4.3
2. By state:				
Kyrgyz Republic	-	-	-	-
Republic of Tajikistan	7.0	5.8	83	-1.2
Turkmenistan	15.5	14.2	91	-1.3
Republic of Uzbekistan	17.2	15.4	89	-1.8
3. Downstream of Atamyrat g/s *)	31.5	28.8	91	-2.7
<i>of which:</i>				
<i>Turkmenistan</i>	15.5	14.2	91	-1.3
<i>Republic of Uzbekistan</i>	16.0	14.6	91	-1.4
4. By river reach:				
Upper reaches	8.2	6.6	81	-1.6
<i>of which:</i>				
<i>Kyrgyz Republic</i>	-	-	-	-
<i>Republic of Tajikistan</i>	7.0	5.8	83	-1.2
<i>Surkhandarya province, Uzbekistan</i>	1.2	0.8	65	-0.4
Middle reaches	16.2	15.8	98	-0.4
<i>of which:</i>				
<i>Turkmenistan</i>	10.5	10.3	98	-0.2
<i>Republic of Uzbekistan</i>	5.7	5.5	96	-0.2
Lower reaches	15.3	13.0	85	-2.3
<i>of which:</i>				
<i>Turkmenistan</i>	5.0	3.9	77	-1.2
<i>Republic of Uzbekistan</i>	10.3	9.1	89	-1.2
5. Besides:				
Environmental water releases to canals in the lower reaches	0.0	0.0		
<i>of which:</i>				
<i>Turkmenistan</i>	0.0	0.0		
<i>Republic of Uzbekistan</i>	0.0	0.0		
Supply to the Aral Sea and the Prearalie **	2.1	1.4	67	

*) Atamyrat g/s conditional – section of the Amudarya River upstream of water intake to Garagumdarya

***) include the discharged collector-drainage water

Table 2.2**The Amudarya River channel water balance for the growing season 2016**

Balance item	Water volume, km ³		Difference (actual-plan)
	Forecast/Plan	Actual	
1. Water content in the Amudarya River - non-regulated flow at conditional Atamyrat g/s	39.48	39.76	0.29
2. Flow regulation in the Nurek reservoir: accumulation (+) or withdrawal (-)	-3.31	-3.81	-0.50
3. Water withdrawal in the middle reaches (-)	-16.21	-15.81	0.40
4. Return flow (collector-drainage) in middle reaches (+)	1.98	1.75	-0.23
5. Water losses (-) or unrecorded inflow to the channel (+)	-1.96	-2.64	-0.68
<i>% of flow at conditional Atamyrat g/s</i>	5	7	2
6. River flow at Bir-Atal g/s	19.99	19.25	-0.74
7. Losses in Bir-Ata g/s – Tuyamuyun g/s (-)	-2.35	-2.64	-0.29
<i>% of flow at Bir-Ata g/s</i>	12	14	1.96
8. Flow regulation in Tuyamuyun hydroscheme: accumulation (+) or withdrawal (-)	-2.74	-2.06	0.69
9. Releases from Tuyamuyun hydroscheme (including withdrawal from reservoir)	17.24	17.19	-0.05
10. Withdrawal in lower reaches, including withdrawal from Tuyamuyun hydroscheme (-)	-15.31	-12.98	2.34
11. Return flow (collector-drainage) in lower reaches (+)	0.00	0.00	0.00
12. Emergency and environmental water releases to canals (-)	0.00	0.00	0.00
13. Flow losses (-) or unrecorded inflow to the channel (+)	-1.46	-3.48	-2.02
<i>% of flow at Tuyamuyun g/s</i>	12	28	16.02
14. Supply to the Prearalie and the Aral Sea (Samanbay g/s)	0.47	0.738	0.26
TOTAL losses:	-3.41	-6.12	-2.71
<i>% of river water content</i>	9	17	7.59

Table 2.3

**Water balance of the Amudarya River basin reservoirs for the growing season
2016**

Balance item	Water volume, km ³		Difference (actual-plan)
	Forecast / plan	Actual	
1 Nurek reservoir			
1.1 Inflow to the reservoir	14.631	17.21	2.57
1.2 Water volume in the reservoir:			
– beginning of the season (1 April 2016)	6.000	6.74	0.74
– end of the season (1 October 2016)	10.053	10.57	0.52
1.3 Water releases from the reservoir	11.322	13.39	2.07
1.4 Lateral inflow (+) or water losses (-)	0.74	0.01	-0.73
<i>% of inflow to the reservoir</i>	5	0	-5.01
1.5 Flow regulation: accumulation (+) or withdrawal (-)	-3.31	-3.81	-0.50
2 Tuyamuyun hydroscheme reservoirs			
2.1 Runoff at Bir-Ata g/s	19.99	19.25	-0.74
2.2 Water losses in Bir-Ata g/s – Tuyamuyun g/s reach (-)	-2.35	-2.64	-0.29
2.3 Water volume in the reservoirs:			
– beginning of the season (1 April 2016)	3.33	3.33	0.00
– end of the season (1 October 2016)	3.73	2.75	-0.98
2.4 Water releases from the hydroscheme	17.244	17.195	-0.05
of which:			
– releases to the river	11.83	12.29	0.46
– withdrawal	5.42	4.91	-0.51
2.5 Flow regulation: accumulation (+) or withdrawal (-)	-2.74	-2.06	0.69
TOTAL flow regulation by the reservoirs: accumulation (+) or withdrawal (-)	-6.05	-5.87	0.18
TOTAL losses (-),unrecorded inflow (+)	-1.60	-2.63	-1.02