

ANALYSIS OF WATER MANAGEMENT SITUATION WITHIN THE AMUDARYA AND SYRDARYA RIVER BASINS FOR VEGETATION PERIOD OF 2011

1 Syrdarya River Basin

The actual inflow to the upstream reservoirs of the Syrdarya River Basin (Toktogul, Andijan and Charvak without inflow from the Ugam river) for vegetation period was 16.99 km³ or 114% predicted inflow (the planned schedule of BWO "Syrdarya"). The upstream reservoirs took 3.82 km³ of the flow of Naryn, Karadarya and Chirchik rivers that less than the planned one by 0.14 km³. Owing to the increased inflow to the upstream reservoirs the actual release from them for vegetation period was 12.90 km³ that exceeds the planned one by 19%.

Before the beginning of vegetation period, 19.5 m³ of water was accumulated in the Toktogul reservoir owing to 4.14 m³ water withdrawn from the Naryn river, and the conditions for further over-year regulation have been created.

The total lateral inflow to Naryn and Syrdarya rivers (at the reach of the river before the Shardara reservoir) calculated by the balance method (data of BWO "Syrdarya") amounted 7.86 km³.

At the end of vegetation period 21.40 km³ of water or 99% of the planned one was accumulated in the upstream reservoirs including 1.18 km³ - in the Charvak reservoir and 0.67 km³ - in the Andijan reservoir.

The total water withdrawal from the Naryn and Syrdarya rivers up to the Shardara reservoir amounted 10.67 km³ including: to the Kyrgyz Republic - 0.18 km³; to the Republic of Tajikistan - 1.45 km³; to the Republic of Uzbekistan - 8.43 km³; to the Republic of Kazakhstan (through the Dustlik canal) - 0.61 km³.

The withdrawn water volume for vegetation period 2011 was less by 1.07 km³ (9%) than the planned limit in 2010. Water supply was unequal for the states as well for river sites (see Table 1.1, and also data on the website: www.cawater-info.net/analysis/water/).

Attention is needed to the fact that over the past 5 years (2006-2007 ... 2010-2011) the average annual inflow to the Toktogul reservoir amounted 13.5 km³, including 10.26 km³ for vegetation periods. The water inflow for vegetation period of 2011 amounted 9.9 km³ that less the average inflow over the past 5 years by 0.37 km³.

Over the past 5 years the average volume of releases from the Toktogul reservoir for vegetation period is estimated at 5.34 km³. During vegetation period of 2011 there was 5.71 km³ of released water, which is more than the scheduled release of BWO "Syrdarya" by 0.68 km³ (see Table 1.4).

According to our estimates, the releases from the Toktogul reservoir for vegetation period amounted 5.5...6.0 km³ in line with irrigation needs of the basin in the normal years and should allow (under stable operation of Naryn HPS cascade) to implement the stable water delivery to the canals in the Fergana Valley.

The obligations on water delivery to the Kairakkum reservoir was implemented on 135%; the water inflow to the reservoir amounted 6.78 km³ as compared with 5.0 km³ of the scheduled water inflow of BWO "Syrdarya".

Water availability of the middle stream of Syrdarya river depends on releases from the Kairakkum reservoir, which can limit water delivery into canals in the middle stream during even normal periods if it will operate under the power-producing mode. During vegetation period 2011 the lowest water availability, which was calculated using the limits of 2010, was observed in some ten-day periods in June-July 2011 (in Tajikistan - up to 70%; in Uzbekistan - up to 60%, in Kazakhstan - up to 30%).

The total release from the Kairakkum reservoir for vegetation period 2011 amounted 8.26 km³ including the release into the river amounted 7.87 km³.

Monthly the release from the Kairakkum reservoir was more than the scheduled one of BWO "Syrdarya"; and the total release for vegetation period amounted 3.3 km³! At the end of vegetation period the reservoir's water volume decreased to 1.5 km³. In spite of this, the total water availability of the river site "Kairakkum-Shardara" amounted 84%, what is 14% less than water availability of the Fergana Valley.

Water inflow to the Shardara reservoir amounted 2.73 km³ or 19% less than the scheduled one of BWO "Syrdarya". It is result of decreasing the lateral inflow and release in the Chirchik river as compared to the scheduled one. Water losses at the river section "Kairakkum-Shardara" was discovered on the basis of the water balance method; it amounted 1.2 km³ when the lateral inflow was 1.4 km³.

Water release from the Shardara reservoir amounted 6.35 km³ including 5.62 km³ into the river.

Analysis of reservoirs' water balances (Table 1.3) has revealed the nonregistered inflow to the Andijan reservoir amounted 0.02 km³. The total water losses of the Toktogul, Charvak, Kairakkum and Shardara reservoirs amounted 1.0 km³.

According to Kazhydromet (g/s Karateren) water delivery to the Aral Sea and Priaralie amounted 1.57 km³ what less than the scheduled one of BWO "Syrdarya" by 0.33 km³. Water volume used in the lower reaches (algebraic sum of withdrawal, lateral inflow, losses) amounted 4 km³.

Table 1.1

Water availability in the Syrdarya River basin countries for vegetation period 2011 r.

Water user	Water volume, km ³		Water availability, %		Deficit (-), surplus (+) km ³	
	limit/schedule*	actual	season	min value for the ten-day interval **)	season	total per ten-day interval ***)
1. Total water withdrawal	11,75	10,67	90,9	68,30	-1,07	-1,70
2. By countries:						
Republic of Kyrgyzstan	0,25	0,18	72	31,25	-0,07	-0,07
Republic of Uzbekistan	8,80	8,43	96	70,82	-0,37	-1,20
Republic of Tajikistan	1,90	1,45	76	22,67	-0,45	-0,47
Republic of Kazakhstan	0,79	0,61	77	23,00	-0,19	-0,24
3. By river reaches						
3.1 Toktogul reservoir – Uchkurgan	3,95	3,95	100,0	78,74	0,00	-0,30

Water user	Water volume, km ³		Water availability, %		Deficit (-), surplus (+) km ³	
	limit/schedule*	actual	season	min value for the ten-day interval (**)	season	total per ten-day interval (***)
hydroscheme						
<i>of which:</i>						
<i>Republic of Kyrgyzstan</i>	0,16	0,13	81	38,89	-0,03	-0,04
<i>Republic of Tajikistan</i>	0,24	0,10	42	26,56	-0,14	-0,14
<i>Republic of Uzbekistan</i>	3,55	3,72	105	79,73	0,17	-0,23
3.2 Uchkurgan hydroscheme – Kayrakkum hydroscheme	1,08	1,06	98,7	75,51	-0,01	-0,08
<i>of which:</i>						
<i>Republic of Kyrgyzstan</i>	0,08	0,05	62	13,57	-0,04	-0,04
<i>Republic of Tajikistan</i>	0,45	0,52	115	21,17	0,07	-0,03
<i>Republic of Uzbekistan</i>	0,54	0,50	92	71,63	-0,05	-0,06
3.3 Kayrakkum hydroscheme – Shardara reservoir	6,72	5,66	84,2	56,97	-1,06	-1,37
<i>of which:</i>						
<i>Republic of Kazakhstan</i>	0,79	0,61	77	23,00	-0,19	-0,24
<i>Republic of Tajikistan</i>	1,22	0,84	67	21,62	-0,38	-0,39
<i>Republic of Uzbekistan</i>	4,71	4,22	89	60,56	-0,49	-0,95
4. In addition:						
Inflow to the Shardara reservoir	3,36	2,73	81,3	22,6	-0,63	-1,69
Discharge to Arnasai	0,00	0,00	0,00	0,00	0,00	0,00
Water supply to the Aral Sea and Priaralie	1,802	1,57	87,3	0,00	-0,23	0,00

*) Limits for vegetation period 2010

**) Minimum value recorded in the ten-day period

***) Total water deficit by ten-day periods; covered by surplus water during the season

Table 1.2

Syrdarya River channel water balance for vegetation period 2011

Items	Water volume, km ³		Deviation (actual-plan)
	expected/plan	actual	
1 Inflow to the Toktogul reservoir	9,2	9,9	0,7
2 Lateral inflow to the river reach Toktogul reservoir – Shardara reservoir (+)	8,25	7,86	-0,39
<i>of which:</i>			
<i>Discharge along the Karadarya river</i>	0,79	2,02	1,23
<i>Discharge along the Chirchik river</i>	0,58	0,38	-0,20
<i>Lateral inflow by CDF¹ and small rivers</i>	6,88	5,46	-1,42

¹ CDF-collector-drainage flow

Items	Water volume, km ³		Deviation (actual- plan)
	expected/plan	actual	
3 Runoff regulation by reservoirs addition to runoff (+) or withdrawal (-)	-4,49	-3,26	1,24
<i>of which:</i>			
<i>Toktogul reservoir</i>	-4,16	-4,17	-0,02
<i>Kayrakkum reservoir</i>	-0,34	0,92	1,25
4 Regulated runoff (1+2+3)	12,94	14,49	1,54
5 Water withdrawal at the Toktogul – Shardara (-) site	-11,75	-10,67	1,07
6 Runoff losses (-) or unaccounted inflow to the channel (+) at the Toktogul – Shardara site	-2,16	1,08	3,25
<i>Including % of regulated runoff</i>	-16,7	7,5	24,18
7 Inflow to the Shardara reservoir	3,36	2,73	-0,63
8 Runoff regulation by the Shardara reservoir addition to runoff (+) or withdrawal (-)	3,36	3,62	0,259
9 Water release from the Shardara reservoir to the river	5,52	5,62	0,105
10 Diversion to Kyzylkum canal (-)	-1,21	-0,73	0,473
11 Discharge to Arnasai (-)	0,00	0,00	0,000
12 Amount of water used in the lower reaches: algebraic sum of withdrawal (-), lateral inflow (+), losses (-)	3,71	4,05	0,334
13 Water supply to the Aral Sea and Priaralie	1,80	1,57	-0,229

Table 1.3

Water balance of the Surdarya River basin's reservoirs for vegetation period 2011

Items	Water volume, km ³		Deviation (actual- plan)
	expected/plan	actual	
1. Toktogul reservoir			
1.1 Inflow to the reservoir	9,2	9,9	0,70
1.2 Water volume in the reservoir:			
- at the beginning of the season (April 1, 2010)	15,398	15,398	0,00
- at the end of the season (October 1, 2010)	19,500	19,541	0,04
1.3 Release from the reservoir	5,035	5,714	0,68
1.4 Unaccounted inflow (+) or water losses (-)	-0,05	-0,03	0,02
<i>% of inflow to the reservoir</i>	-0,01	0,00	0,00
1.5 Runoff regulation: addition to runoff (+) or withdrawal (-)	-4,102	-4,143	-0,04
2. Andijan reservoir			
2.1 Inflow to the reservoir	1,582	2,988	1,41
2.2 Water volume in the reservoir:			
- at the beginning of the season (April 1, 2010)	1,427	1,427	0,00
- at the end of the season (October 1, 2010)	1,016	0,672	-0,34
2.3 Release from the reservoir	1,982	3,763	1,78

Items	Water volume, km ³		Deviation (actual- plan)
	expected/plan	actual	
2.4 Unaccounted inflow (+) or water losses (-)	-0,01	0,02	0,03
<i>% of inflow to the reservoir</i>	-0,01	0,01	0,01
2.5 Runoff regulation: addition to runoff (+) or withdrawal (-)	0,411	0,755	0,34
3. Charvak reservoir			
3.1 Inflow to the reservoir	4,117	4,108	-0,01
3.2 Water volume in the reservoir:			
- at the beginning of the season (April 1, 2010)	0,747	0,747	0,00
- at the end of the season (October 1, 2010)	1,014	1,182	0,17
3.3 Release from the reservoir	3,83	3,42	-0,41
3.4 Unaccounted inflow (+) or water losses (-)	-0,02	-0,25	-0,23
<i>% of inflow to the reservoir</i>	0,00	-0,06	-0,06
3.5 Runoff regulation: addition to runoff (+) or withdrawal (-)	-0,267	-0,435	-0,17
4. Kayrakkum reservoir			
4.1 Inflow to the reservoir	5,005	6,782	1,78
4.2 Lateral inflow	0,295	0,173	-0,12
4.3 Water volume in the reservoir:			
- at the beginning of the season (April 1, 2010)	3,33	3,33	0,00
- at the end of the season (October 1, 2010)	3,08	1,53	-1,55
4.4 Release from the reservoir	5,00	8,26	3,27
of which:			
- release to the river	4,51	7,87	3,36
-water withdrawal from the reservoir	0,48	0,39	-0,09
4.5 Unaccounted inflow (+) or water losses (-)	-0,56	-0,50	0,06
<i>% of inflow to the reservoir</i>	-0,11	-0,07	0,04
4.6 Runoff regulation: addition to runoff (+) or withdrawal (-)	0,256	1,802	1,55
5. Shardara reservoir			
5.1 Inflow to the reservoir	3,361	2,734	-0,63
5.2 Lateral inflow	-	-	-
5.3 Water volume in the reservoir:			
- at the beginning of the season (April 1, 2010)	4,973	4,973	0,00
- at the end of the season (October 1, 2010)	1,071	1,118	0,05
5.4 Release from the reservoir	6,72	6,35	-0,37
of which:			
-discharge to Arnasai	0,00	0,00	0,00
- release to the river	5,52	5,62	0,10
- water withdrawal from the reservoir	1,205	0,732	-0,47
5.5 Unaccounted inflow (+) or water losses (-)	-0,54	-0,24	0,31
<i>% of inflow to the reservoir</i>	-0,16	-0,09	0,08
5.6 Runoff regulation: addition to runoff (+) or withdrawal (-)	3,902	3,855	-0,05
TOTAL runoff regulation: addition to runoff (+) or withdrawal (-)	0,20	1,83	1,63
TOTAL losses (-), unaccounted inflow (+)	9,2	9,9	0,70

Table 1.4**Inflow to and release from the Toktogul reservoir for 2006-2011**

n	Hydrologic year	Inflow, million m3			Release, million m3		
		Nonvegetation period	Vegetation period	Year	Nonvegetation period	Vegetation period	Year
1	2006-2007	3157	8911	12068	9538	5857	15395
2	2007-2008	2505	7371	9876	9726	4408	14134
3	2008-2009	2672	9876	12548	5884	5748	11632
4	2009-2010	3898	15244	19142	6965	5445	12410
5	2010-2011	3896	9888	13783	8000	5714	13714
	Average for 5 years	3226	10258	13483	8023	5434	13457

2 Amudarya River Basin

The actual water content of the Amudarya river at the Atamyrat conditional G/S (upstream to the water intake into Garagumdarya) amounted 32.3 km^3 or less the expected one (according to the BWO "Amudarya" schedule) by 2.3 km^3 and less the normal one by 30% (Table 2.2). At the same time water inflow to the Nurek HPS was more by 4.3 km^3 than the predicted one! Therefore the release from the reservoir amounted 12.4 km^3 or more than the planned one by 3.6 km^3 .

In the existing water management situation only 7.06% of water withdrawal limit for the canals in the Amu Darya River Basin was used; the total water withdrawal amounted 27.9 km^3 , including 28.72 km^3 down the Atamyrat GS (starting from the water intake into Garagumdarya). Water supplying was unequal for the states and river sites (see Table 2.1, and also data on the website: www.cawater-info.net/analysis/water/).

At the end of season the Nurek reservoir accumulated 10.54 km^3 of water, but the TMHS reservoir's water volume was decreased up to 2.36 km^3 (Table 2.3). The total river water withdrawal for filling in the Nurek and Tuyamuyun reservoirs amounted 6.57 km^3 .

Water losses assessed by water balance method (by using the CAREWIB river channel balance model) for the river section "G/S Atamyrat (conditional) – TMHS" amounted 4.2 km^3 or 13% of flow at G/S Atamyrat (conditional). Water losses for the river section "TMHS - up to boundary of water delivery to the Aral Sea and Priaralie" amounted 4.3 km^3 or 35% of inflow to TMHS.

There are no water losses in the Nurek reservoir; but they amounted 2.84 km^3 in the Tyuyamuyun reservoirs.

As a whole the water losses in the Amudarya river basin amounted 8.5 km^3 or 26% of water content (Atamyrat G/S) or less by 3.1 km^3 (10%) than the calculated (planned by the BWO "Amudarya") ones. At the beginning of nonvegetation period 2011-2012 the water situation is very complex: only the Nurek reservoir has the optimal water volume, the usable storage of the TMHS reservoirs is very low and amounted $0.1\text{-}0.2 \text{ km}^3$. The usable storage of the intersystem reservoirs (Talimardjan, Tudakul, Kuyumazar) amounted 0.53 km^3 at the beginning of nonvegetation period; the usable storage of these reservoirs could be increased by $0.7\text{-}1.5 \text{ km}^3$ during the high-water years.

The needed water volume wasn't delivered to the lakes in the Priaralie because of low water content and water losses (water availability 20-25%).

The flow at the Samanbay G/S amounted 0.207 km^3 ; if considering water release of the collector and drainage network, the Aral Sea and Priaralie received 0.523 km^3 of water.

Table 2.1

Water availability in the Amudarya River basin countries for vegetation period 2011

Water user	Water volume, km ³		Water availability, %		Deficit (-), surplus (+) km ³	
	limit/ schedule ****	actual	season	Min ten-day period)	season	Total ten-day period **)
1. Total water withdrawal	39,54	27,90	70,6	59,0	-11,64	-11,75
2. By countries:						
Republic of Kyrgyzstan	-	-	-	-	-	-
Republic of Tajikistan	6,82	6,08	89,2	55,7	-0,74	-0,80
Turkmenistan	15,50	10,55	68,1	52,7	-4,95	-4,95
Republic of Uzbekistan	17,22	11,27	65,4	47,3	-5,95	-6,16
3. Downstream from g/s Atamyrat ***)	31,52	20,96	66,5	53,3	-10,56	-10,66
of which:						
Turkmenistan	15,50	10,55	68,1	71,9	-4,95	-4,95
Republic of Uzbekistan	16,02	10,41	65,0	46,0	-5,61	-5,80
4. By river reaches:						
Upstream	8,02	6,94	86,5	60,9	-1,08	-1,11
of which:						
Republic of Kyrgyzstan	-	-	-	-	-	-
Republic of Tajikistan	6,82	6,08	89,2	55,7	-0,74	-0,80
Surkhandarya, Uzbekistan	1,20	0,86	71,7	60,0	-0,34	-0,36
Middle reach	16,21	12,94	79,9	60,3	-3,26	-3,26
of which:						
Turkmenistan	10,47	7,81	74,6	55,0	-2,66	-2,66
Republic of Uzbekistan	5,74	5,13	89,4	67,9	-0,61	-0,73
Downstream	15,31	8,02	52,4	27,4	-7,30	-7,52
of which:						
Turkmenistan	5,03	2,74	54,5	32,2	-2,29	-2,33
Republic of Uzbekistan	10,29	5,28	51,3	22,6	-5,01	-5,20
5. In addition:						
Emergency-environmental releases to downstream canals	0,0	0,0				
of which:						
Turkmenistan	0,0	0,0				
Republic of Uzbekistan	0,0	0,0				
Water supply to the Aral Sea and Priaralie (without CDF)	2,10	0,52	24,9			

*) Minimum value recorded in the ten-day period

**) Total water deficit by ten-day period \s; covered by surplus water during the season

***) gauging station Atamyrat (conditional) – Amudarya river section upstream of Garagumdarya

****) Limits are agreed but not adopted by ICWC

Table 2.2

The Amudarya River channel water balance for vegetation period 2011

Items	Water volume, km ³		Deviation (actual- plan))
	expected/plan	actual	
1 Water content of the Amudarya River – natural runoff in the section of g/s Atamyrat (tentative)	34,68	32,33	-2,35
2 Runoff regulation by the Nurek reservoir: addition to runoff (+) or withdrawal (-)	-3,85	-4,54	-0,69
3 Water withdrawal in the middle reach (-)	-13,7	-12,94	0,76
4 Return CDF in the middle reach (+)	1,37	1,44	0,07
5 Runoff losses (-) or unaccounted inflow to the channel (+)	-1.14	-4,20	-3,06
<i>% of runoff in the section of g/s Atamyrat (tentative)</i>	-3	-13,0	-10,0
6 Inflow to the Tuyamuyun hydroscheme (TMHS)	17,36	12,09	-5,27
7 Runoff regulation by TMHS reservoirs: addition to runoff (+) or withdrawal (-)	-0,15	-0,80	-0,65
8 Losses in TMHS reservoirs (-), lateral inflow (+)	-2,98	-2,84	0,14
<i>% of inflow</i>	-17	-23	-6,0
9 Releases from TMHS (including water withdrawal from reservoir)	14.53	10.02	4,51
10 Downstream water withdrawal, including withdrawal from the TMHS (-)	-13,02	-8,02	-5,0
11 Return CDF in the lower reach (+)	0,00	0,00	0,00
12. Sanitary-environmental water releases into downstream canals (-)	0,00	0,00	0,00
13 Runoff losses (-) or unaccounted inflow to the channel (+)	-1,31	-1,48	-0,17
<i>% of runoff in the section of g/s Tuyamuyun</i>	-13	-21	-8,0
14 Water supply to the Aral Sea and Priaralie (without CDF)	0.2	0,52	+0,32
TOTAL losses:	-5.43	-8,52	-3,09
<i>% of water content of the river</i>	-16	-26	-10,0

* after deduction of the upstream water withdrawal (Tajikistan, Surkhandarya province)

Table 2.3

Water balance of the Amudarya River basin's reservoirs for vegetation period 2011

Items	Water volume, km ³		Deviation (actual-plan)
	expected/plan	actual	
1. Nurek reservoir			
1.1 Inflow to the reservoir	12,65	16,97	4,32
1.2 Water volume in the reservoir:			
- at the beginning of the season (April 1, 2011)	6,00	6,00	0,00
- at the end of the season (October 1, 2011)	9,85	10,54	0,69
1.3 Release from the reservoir	8,80	12,44	3,64
1.4 Lateral inflow (+) or water losses (-)	0,00	0,00	0,00
<i>% of inflow to the reservoir</i>	0,00	0,00	0,00
1.5 Runoff regulation: addition to runoff (+) or withdrawal (-)	-3,85	-4,53	-0,68
2. TMHS reservoirs			
2.1 Inflow to the hydroscheme	17,36	12,09	5,27
2.2 Water volume in the reservoirs:			
- at the beginning of the season (April 1, 2011)	3,16	3,16	0,00
- at the end of the season (October 1, 2011)	3,01	2,36	0,65
2.3 Release from the hydroscheme	14,53	10,05	-4,48
of which:			
- release to the river	9,86	6,97	-2,89
- water withdrawal	4,67	3,08	1,59
2.4 Lateral inflow (+) or water losses (-)	-2,98	-2,84	0,14
<i>% of inflow to the reservoir</i>	-17	-23	-6
2.5 Runoff regulation: addition to runoff (+) or withdrawal (-)	-2,83	-2,04	0,79
TOTAL runoff regulation by reservoirs: addition to runoff (+) or withdrawal (-)	-6,68	-6,57	-0,11
TOTAL losses (-), unaccounted inflow (+)	-2,9	-2,84	-0,06