

ANALYSIS OF WATER MANAGEMENT SITUATION WITHIN THE AMUDARYA AND SYRDARYA RIVER BASINS FOR VEGETATION PERIOD OF 2009

1. Syrdarya river basin

Water content in rivers of the basin characterized by the aggregate of inflow to the upper water reservoirs and the channel inflow, was expected on the Hydrometeoservice forecast at 17.48-25,93 km³ or 59-87 % of the norm (29,62 km³), in average - 21,71 km³ (73%).

The cumulative inflow to the Toktogul, Andijan and Charvak reservoirs (without inflow from the Ugam river) the prognosis values are 11,22-16,44 km³ or 63-92% of the norm, the average value is 13,85 km³ (77% of the norm). The actual water content according to the inflow to these reservoirs is equal to 19,9 km³ or 112%.

Inflow to the Toktogul reservoir is 10,68 km³ or 111% of the norm or 108% of the average inflow during vegetation period for last 5 years (Table 1.1). It is more than the forecasted inflow by 2,8 km³ (35%).

Table 1.1

Inflow and release of the Toktogul reservoir for 2003-2009, million m³

№	Hydrological year	Inflow			Release		
		Non-vegetation period	Vegetation period	Year *	Non-vegetation period	Vegetation period	Year
1	2003-2004	3654	12045	15699	8478	6226	14704
2	2004-2005	3767	10692	14459	9045	6829	15874
3	2005-2006	3496	10362	13858	9082	5418	14500
4	2006-2007	3157	8911	12068	9538	5857	15395
5	2007-2008	2505	7371	9876	9726	4408	14134
	Average for 5 years	3316	9876	13192	9174	5748	14922
6	2008-2009	2672	10676	13348	5884	4440	10324

* Mean annual runoff (1911 - 2009) of the Naryn river at the Toktogul power site is estimated 11.8 km³.

Release from the Toktogul reservoir is 4.44 km³ and exceeds the planned power release (calculated by 25% down the water withdrawal limit) that is lower on 0.82 km³ (23%). It is close to the vegetation release of 2008 (Table 1.1) and is lower than the average vegetation

release from the Toktogul reservoir for last 5 years on 1.31 km³ (23%). The maximal reducing of releases was on June - 0.71 km³ (60%) - Table 1.2, Fig. 1.1.

Because of 6,19 km³ of accumulated water in the Toktogul reservoir, the water volume in the reservoir was 12,67 km³ at the end of vegetation period that is more than the planned volume on 1,85 km³. The water balance residual is 0.01 km³ that indicates the nonregistered inflow of 0.09% (Table 1.3).

Table 1.2

Releases from the Toktogul reservoir for 2004-2009, million m³

Year	April	May	June	July	August	September	Total
2004	893	725	1134	1163	1240	1070	6226
2005	936	560	2367	984	1045	937	6829
2006	1008	604	760	1027	1064	954	5418
2007	802	670	1056	1355	1208	766	5857
2008	775	588	601	894	967	584	4408
Mean for 5 years	883	629	1184	1085	1105	862	5748
2009	826	631	477	959	816	733	4440
Reduction compared with mean for 5 years	57	- 2	707	126	289	129	1308

As a whole, the release from the Toktogul reservoir was reduced up to 10.32 km³ (87% of the inflow norm to the reservoir) and the inflow to the reservoir was 13.35 km³ (113% of norm) for the hydrological year 2008-2009 (from 1 October 2008 till 1 October 2009).

Thereby the water volume as a result of Naryn river runoff over-year regulation by the Toktogul reservoir for 2008-2009 is: 13.35 - 10.32 = 3.03 km³, therefore the reservoir's water volume at the end of vegetation period of 2009 was exceeded more than 3 km³ as compared to the same date of 2008.

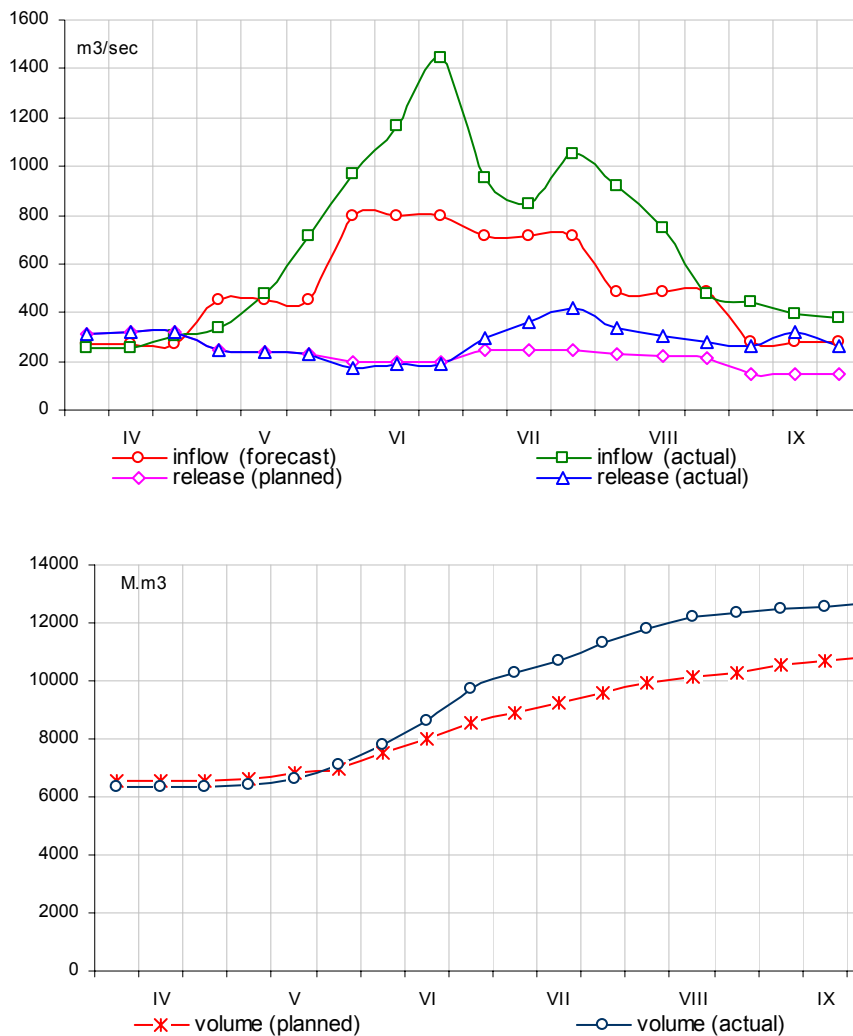


Fig. 1.1. Operation mode of the Toktogul reservoir for the vegetation period of 2009

Table 1.3

Water balance of the Toktogul reservoir for the vegetation period of 2009

Item of the water balance	Planned km ³	Actual km ³	Actual - Planned	
			km ³	%
1. Inflow	7.92	10.68	2.76	35
2. Release	3.62	4.44	0.82	23
3. Inflow - Release (1 - 2)	4.3	6.24		
Water volume in the reservoir:				
4. At the beginning of vegetation period	6.42	6.42	-	-
5. At the end of vegetation period	10.80	12.67	1.85	17
6. Volume change (5 - 4)	4.38	6.25		
Residual (6 - 3)		0.01		

The inflow to the Andijan reservoir (2.91 km³ - 96% of norm) was higher than the predicted one on 1.09 km³ (60%). Some part of inflow was directed to reservoir for accumulation and another part was released down stream (Fig. 1.2). The release from reservoir was 2.65 km³ that is higher the planned one on 43%.

The water balance residual of the Andijan reservoir is 0.04 km³ (1,3%), see Table 1.4.

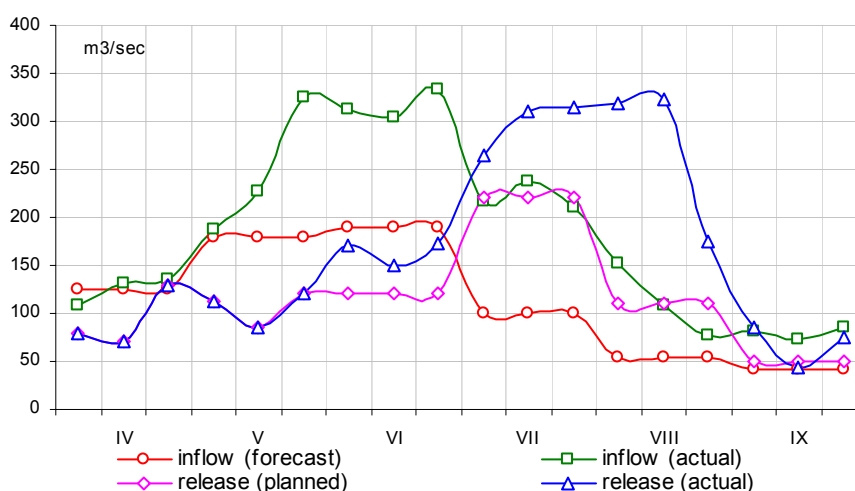
Table 1.4

Water balance of the Andijan reservoir for the vegetation period of 2009

Item of the water balance	Planned km ³	Actual km ³	Actual - Planned	
			km ³	km ³
1. Inflow	1.82	2.91	1.09	60
2. Release	1.85	2.65	0.8	43
3. Inflow - Release (1 – 2)	- 0.03	0.26		
Water volume in the reservoir:				
4. At the beginning of vegetation period	0.69	0.69	-	-
5. At the end of vegetation period	0.47	0.91	0.44	94
6. Volume change (5 - 4)	- 0.22	0.22		
Residual (6 – 3)		- 0.04		

Additional release (to the planned one) from the Andijan reservoir into BFC and BAC had compensated deficit of the irrigation release from the Toktogul reservoir.

Because of the increased water content and efficient activities to maintain the releases from the Andijan and Kayrakkum reservoirs the inflow schedule planned by BWO has been not only followed but also exceeded as a whole for the vegetation period and for some ten-days periods.



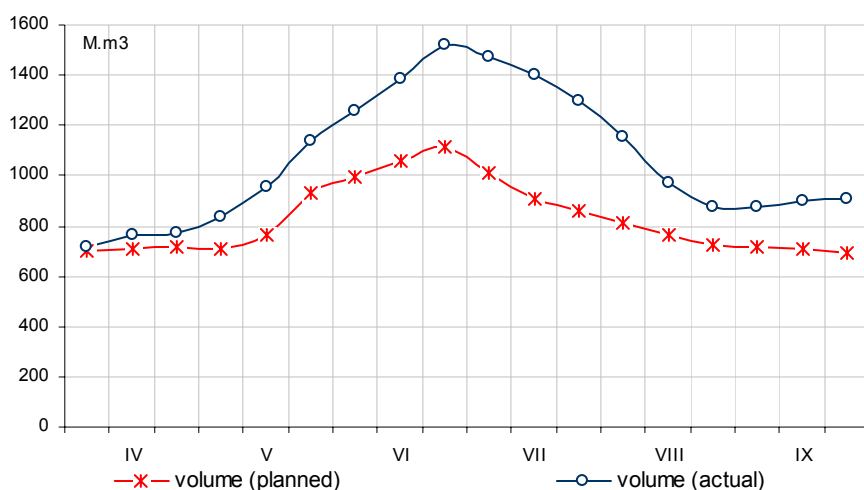


Fig. 1.2. Operation mode of the Andijan reservoir for the vegetation period of 2009

The expected water content as a result of the channel inflow was 3.52 km³ or 77% of norm at the Toktogul-Kayrakkum section, but the actual water content was 84% of norm (Table 1.5). The channel inflow for the vegetation period of 2009 correlates very well with probability of the water withdrawal for previous low-water management year (the vegetation period of 2008, the nonvegetation period of 2008-2009). At the Toktogul-Kayrakkum section the channel inflow of 2009 (% of norm) and the withdrawal probability of the water management year 20080-2009 have coincided and were 84% (Tables 1.5 and 1.6).

Table 1.5

Channel inflow within Syrdarya river basin for vegetation period of 2009, km³

Section	Norm	Prognosis	Actual	% of the norm	
				Prognosis	Actual
Toktogul - Uchkurgan	1,184	0,991	1,108	84	94
Andijan – HP Ychtepa	2,545	1,739	2,24	68	88
Uchkurgan, Ychtepa - Kayrakkum (except inflow of the Karadarya river)	3,378	2,53	2,71	75	80
HP Gazalkent - HP Chinaz-Chirchik	0,986	0,712	0,862	72	87
Kayrakkum - Shardara (except inflow of the Chirchik river)	3,178	1,423	2,693	45	85
TOTAL	11,271	7,395	9,613	66	85
Including:					
Toktogul - Kayrakkum	4,562	3,521	3,818	77	84

Table1.6

Water withdrawal from the Syrdarya river for 2008-2009 water management year, km³

	Toktogul - Uchkurgan	Uchkurgan - Kayrakkum	Kayrakkum - Shardara	Total:	Including: Toktogul - Kayrakkum
Vegetation period of 2008					
Limit	3,866	1,052	6,665	11,583	4,918
Actual	3,299	0,854	4,535	8,688	4,153
%	85,3	81,2	68,0	75,0	84
Non-vegetation period 2008-09					
Limit	1,379	0,172	1,537	3,088	1,551
Actual	1,608	0,301	2,425	4,334	1,909
%	116,6	175,0	157,8	140,3	123,1
Water management year 2008-2009					
Limit	5,245	1,224	8,202	14,671	6,469
Actual	4,907	1,155	6,96	13,022	6,062
%	93,6	94,4	84,9	88,8	93,7

Water availability at the section Toktogul reservoir - Uchkurgan waterworks is 82%; at the section Uchkurgan - Kayrakkum reservoir - 81%. Water deficit caused by the power releases from the Toktogul reservoir and as result of the decreased water withdrawals (as compared with the withdrawal limits) from the Naryn river was 0.71 km³ at the Toktogul-Uchkurgan section and was 0.2 km³ at the Uchkurgan-Kayrakkum section.

Water availability (% of limit) for states is as followings at different sections:

1) Toktogul - Uchkurgan:

- Kyrgyzstan - 83%
- Tajikistan - 60%
- Uzbekistan - 83%

2) Uchkurgan - Kayrakkum:

- Kyrgyzstan - 53%
- Tajikistan - 95%
- Uzbekistan - 74%

Water availability at the Toktogul-Kayrakkum section began fall sharply from the middle of April, and it ranged between 64 and 72% from the beginning of May till the middle of July. In September the actual water withdrawal excess above limits on 12-14% was observed.

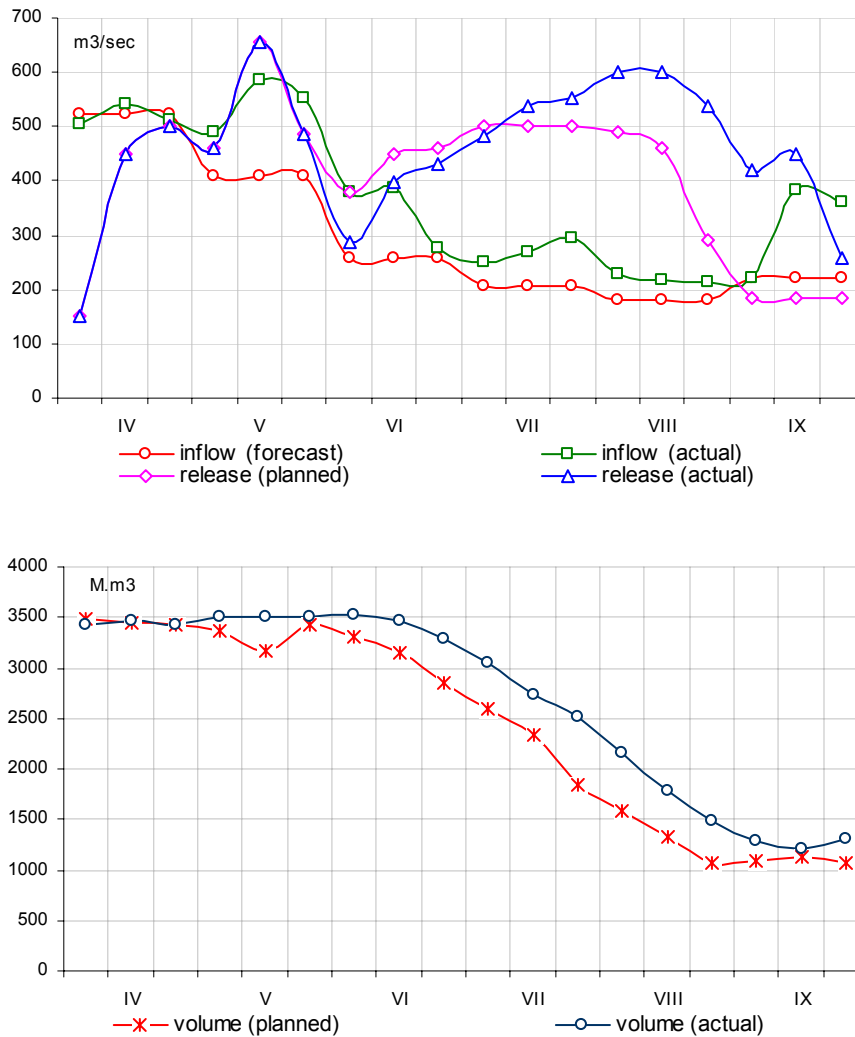


Fig 1.3. Operation mode of the Kayrakkum reservoir for the vegetation period 2009

Inflow to the Kayrakkum reservoir amounted 5.85 km³ under the planned one 4.7 km³. The total release from the Kayrakkum reservoir amounted 7.3 km³ that is more than releases planned by BWO on 0.86 km³ (13%) barely. Planned and actual inflows and releases from the reservoir Kayrakkum for some decades are shown in table 1.7. The releases from the reservoir in April, June and July were determined at the rate 400-500 m³/sec, but the actual releases were being varied within 150-600 m³/sec.

Thereby the Kayrakkum reservoir was operated in fact in the power mode, keeping the maximal water volumes (levels) in April - June within 3.5-3.3 km³. Only from July the step-by-step discharge of reservoir was started with maximal reservoir drawdown in August (1 km³). The reservoir has to be discharged on 0.57-1.0 km³ in June-July according to the plan. Actually it was discharged in those months only on 0.22-0.785 km³.

The actual inflow to the Charvak reservoir amounted 6.38 km³ that is more than the predicted one by 2.27 km³ (55%). The release from reservoir amounted 4.97 km³ that is more than the planned one by 0.84 km³ (20%) - Fig. 1.4.

In spite of sizable total release from the Charvak reservoir the water availability of upper zone of the Chirchik river basin (Parkent, Kelesky canal) in the vegetation period of 2009 was

lower than average value for last 10 years. One of the probable causes is the target water delivery for the maximal power production by HEPS of Chirchik-Bozsu tract (Table 1.8).

Table 1.7

Inflow and release from the Kayrakkum reservoir for some 10-days periods of the vegetation period 2009

	1 st 10-days period of April	1 st 10-days period of June	1 st 10-days period of July
1. Inflow			
Planned, m ³ /sec	400	260	200
Actual, m ³ /sec	506	381	250
Excess, m ³ /sec	106	121	50
Excess, %	27	47	25
2. Release			
Planned, m ³ /sec	400	400	500
Actual, m ³ /sec	150	285	480
Deficit, m ³ /sec	- 250	- 115	-20
Deficit, %	63	29	4

Table 1.8

Runoff volume for vegetation period on some waterworks facilities in the Chirchik river basin for 2000-2009

Year	Release from the Charvak reservoir		Release through HPS № 10		Total water withdrawal for the BKC ¹ and Parkentsky canal	
	km ³	%	km ³	%	km ³	%
2000	3,68	78	1,13	84	0,6	90
2001	4,01	86	1,29	96	0,69	103
2002	6,08	130	1,37	101	0,67	100
2003	5,55	119	1,45	107	0,65	97
2004	4,62	99	1,44	107	0,75	112
2005	5,45	116	1,44	107	0,84	125
2006	4,12	88	1,39	103	0,7	104

¹ Big Keles Canal

2007	5,39	115	1,45	107	0,73	109
2008	2,95	63	1,14	84	0,47	70
2009	4,97	106	1,40	104	0,59	88
Mean value for 2000-2009	4,68	100	1,35	100	0,67	100

To the end of vegetation period 2009 the actual release from the Charvak reservoir was less than the planned one. However there was a possibility to correct the initial operational plan of the Charvak reservoir, bearing in mind the increased (in excess of the plan) inflow to that reservoir.

The channel inflow at the Kayrakkum reservoir - Shardara reservoir section (excluding the Chirchik river flow) amounted 2.69 km³ and exceeded the predicted one on 1.27 km³ (89%). Because of that the inflow by Syrdarya river to the Shardara reservoir amounted 6.42 km³ that is more than the planned one on 0.80 km³.

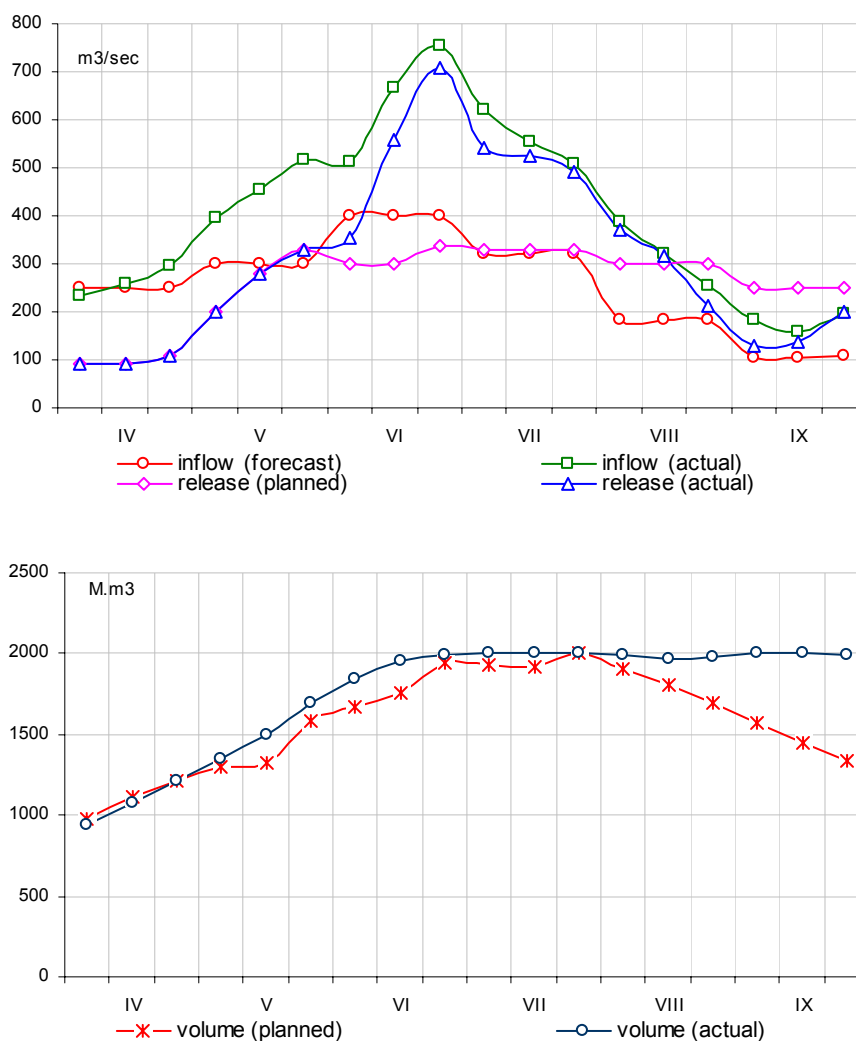


Fig. 1.4. Operation mode of the Charvak reservoir for vegetation period of 2009

The actual release from the Shardara reservoir amounted 10.89 km³ that is more than the planned one by the schedule on 1.42 km³ (15%). To the end of season the water volume 1.1 km³ in the Shardara reservoir was retained (Fig. 1.5).

The water release to the Arnasay (in April) had amounted 0.03 km³. The inflow to the Northern Aral Sea (HP Karateren) had amounted 2.4 km³ as compared with the planned one of 1.84 km³.

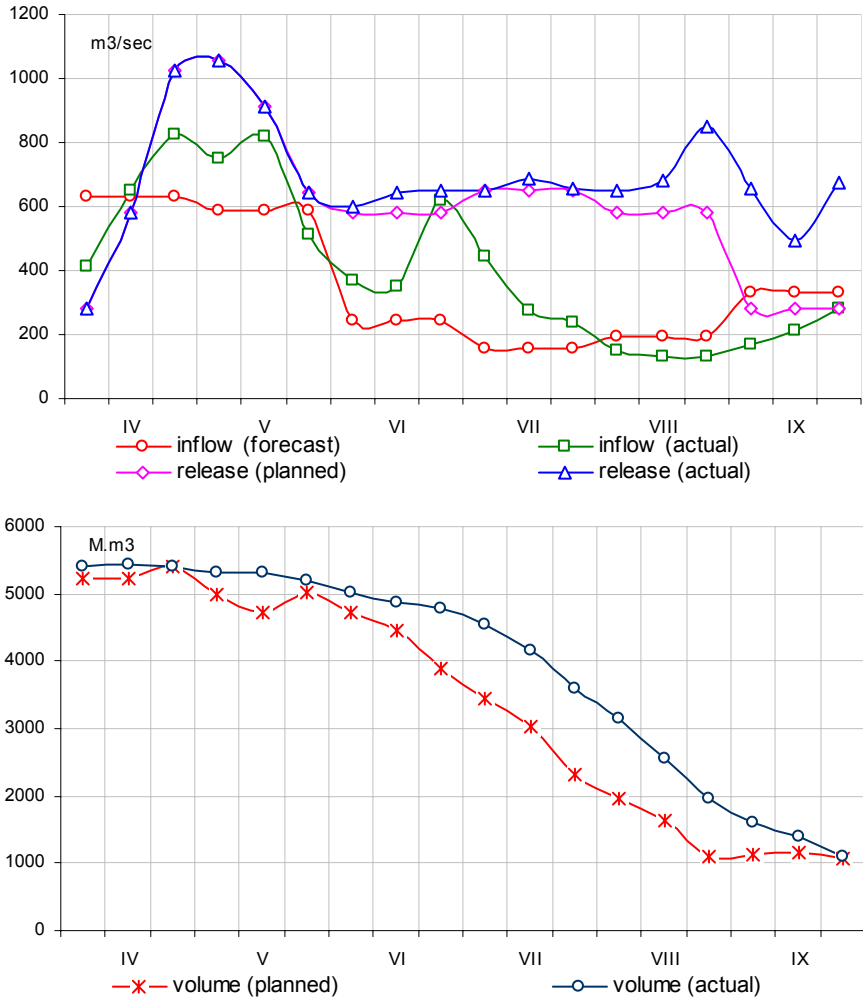


Fig.1.5. Operation mode of the Shardarinsky reservoir for vegetation period of 2009

The water availability (ratio of water withdrawal to the water withdrawal limit) at the Kayrakkum reservoir - Shardara reservoir section had amounted 74% when the total water deficit was 1.77 km³. The water deficit (% of limit) had amounted as followings: Tajikistan - 59%, Kazakhstan - 82%, Uzbekistan - 76%.

Conclusions

The analysis results of the water management situation in the vegetation period 2009 within the Syrdarya river basin are as follows:

1. The water withdrawal within the Syrdarya river basin (up to Shardara reservoir) had amounted 9.06 km³ or 77% of the limit, including: within Kyrgyzstan (despite of the increased water year) - 0.18 km³ (73% of the limit); Uzbekistan - 6.94 km³ (79%); Tajikistan - 1.29 km³ (68%); Kazakhstan - 0.65 km³ (82%). Water delivery was allocated between the states as follows: Kyrgyzstan - 2.0%, Uzbekistan - 76.7%, Tajikistan - 14.2%, Kazakhstan - 7.1%.

2. The total water deficit in the Syrdarya basin in the vegetation period (despite of the increased water year) had amounted 2.68 km³. Water availability from section to section is spread unevenly and is not stable across the time (see data on the website: www.cawater-info.net/analysis/water/).

3. The channel transmission losses were observed up to the Kayrakkum reservoir and had amounted 0.6 km³ (13%); and the nonregistered channel inflow had amounted 1.05 km³ (14%) and was observed at the Kayrakkum-Chardara section (see Table 1.9).

4. Though the Toktogul reservoir was operated in over-year regulation, the excessive water withdrawal from the Naryn river for the reservoir's filling (for the hydrological year 2008-2009) had led to less total annual release from the reservoir than the mean inflow on 1.43 km³ (during 2002-2008 the reverse result was observed: the annual release exceeded the mean inflow on 2.3-4.1 km³). This circumstance and nonregularity of releases from the Toktogul and Kayrakkum reservoirs were the main factors of the tense situation in the Syrdarya river basin.

Table 1.9

Water balance of Syrdarya river for the vegetation period of 2009

№	Section	Balance item	Unit	
1.1	Toktogul – Kayrakkum	Release from the Toktogul reservoir	km ³	4.44
1.2		Channel inflow (including inflow from the Karadarya river)	km ³	4.918
1.3		Water withdrawal	km ³	4.107
1.4		Inflow to the Kayrakkum reservoir	km ³	5.85
1.5		Balance residual (a difference between outflow and inflow): (+) nonregistered inflow, (-) losses	km ³ %	- 0.599 13
2.1	Kayrakkum - Shardara	Release from the Kayrakkum reservoir	km ³	7.27
2.2		Channel inflow (including inflow from the Chirchik river)	km ³	5.148
2.3		Water withdrawal	km ³	4.95
2.4		Inflow to the Shardara reservoir	km ³	6.42
2.5		Balance residual (a difference between outflow and inflow): (+) nonregistered inflow, (-) losses	km ³ %	1.05 14
	Toktogul - Shardara	Total residual (1.5 + 2.5)	km ³	0.45
			%	10
3.1	Shardara - Aral	Release from the Shardara reservoir	km ³	10.89
3.2		Inflow to the Aral Sea (HP Karateren)	km ³	2.4
3.3		Inflow used (sum of water withdrawal and losses excluding the channel inflow)	km ³ %	8.49 78

Thereby despite of the natural water content exceeded the mean annual runoff, during the vegetation period 2009 in the basin the tense situation was observed, which was characterized by low water availability and nonregular water delivery within some periods at some sections of Ferghana Valley and middle course of the Syrdarya river and also by not sufficient water delivery to the delta.

2 Amudarya river basin

The actual water content of the Amudarya river at the Atamyrat cross-section upstream Garagumdarya (water intake into the Karakumsky canal) calculated with consideration of natural discharges of the Vakhsh river (without streamflow regulation by the Nurek reservoir) and water intake to the Surkhandarya area of the Republic of Uzbekistan had amounted 46.26 km³ or 97% of the flow rate that is more than probable predicted ones (Table 2.1).

Table 2.1

Water content of the Amudarya river in vegetation period of 2009

№	Parameter	Runoff volume, km ³	% of norm
1	Water content according to the Hydrometeoservice forecast		
	- minimal	28.6	60
	- maximal	38.1	80
	- mean	33.35	
2	Actual water content (data of BWO)	46.26	97
3	Difference from the forecasting value (on the mean value)	12.91	27

The actual inflow to the Nurek reservoir had amounted 16.83 km³ that is more than the expected one on 3.35 km³ (25%). The release from the Nurek reservoir had amounted 12.31 km³ that is more than the planned one by the schedule on 1.72 km³ (16%). At the end of vegetation period in the reservoir was accumulated 10.53 km³ of water (the planned accumulation of water was amounted 8.89 km³) - Fig. 2.1.

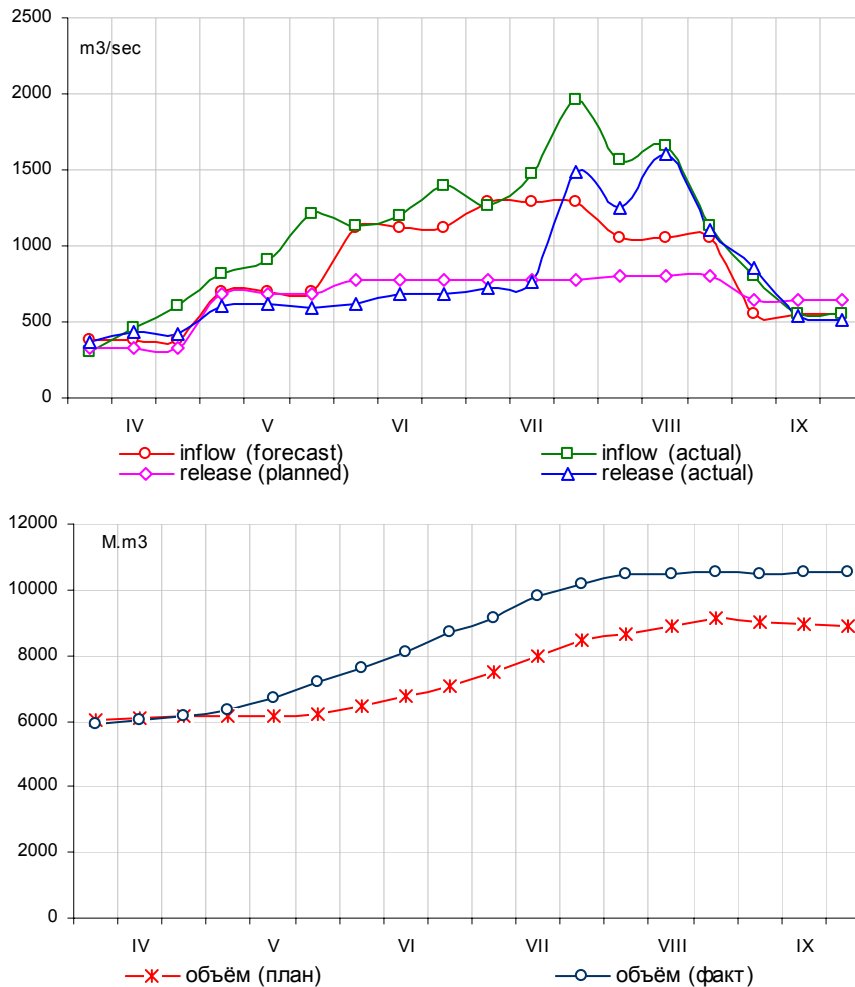


Fig. 2.1. Operation mode of the Nurek reservoir for the vegetation period of 2009

The water inflow to the Tuyamuyun waterworks facility (TWF) amounted 23.77 km³ that is more than the calculated one on 10.06 km³ (73%). Release from the TWF's reservoirs (including water withdrawals) amounted 19.91 km³ that is more than the planned schedule on 7.6 km³ (62%). The actual filling of reservoir at the end of vegetation period amounted 5.77 km³ (when the planned one was 2.13 km³) - Table 2.2 and Fig. 2.2.

Table 2.2

Water volume change in reservoirs in the vegetation period of 2009

	Nurek reservoir		TMHS reservoirs	
	On 1 April	On 1 October	On 1 April	On 1 October
According to the plan, km ³	6.00	8.89	2.10	2.13
Actual, km ³	6.00	10.53	2.10	5.77
On the same date of 2008,	5.96	9.62	2.73	2.12

km³

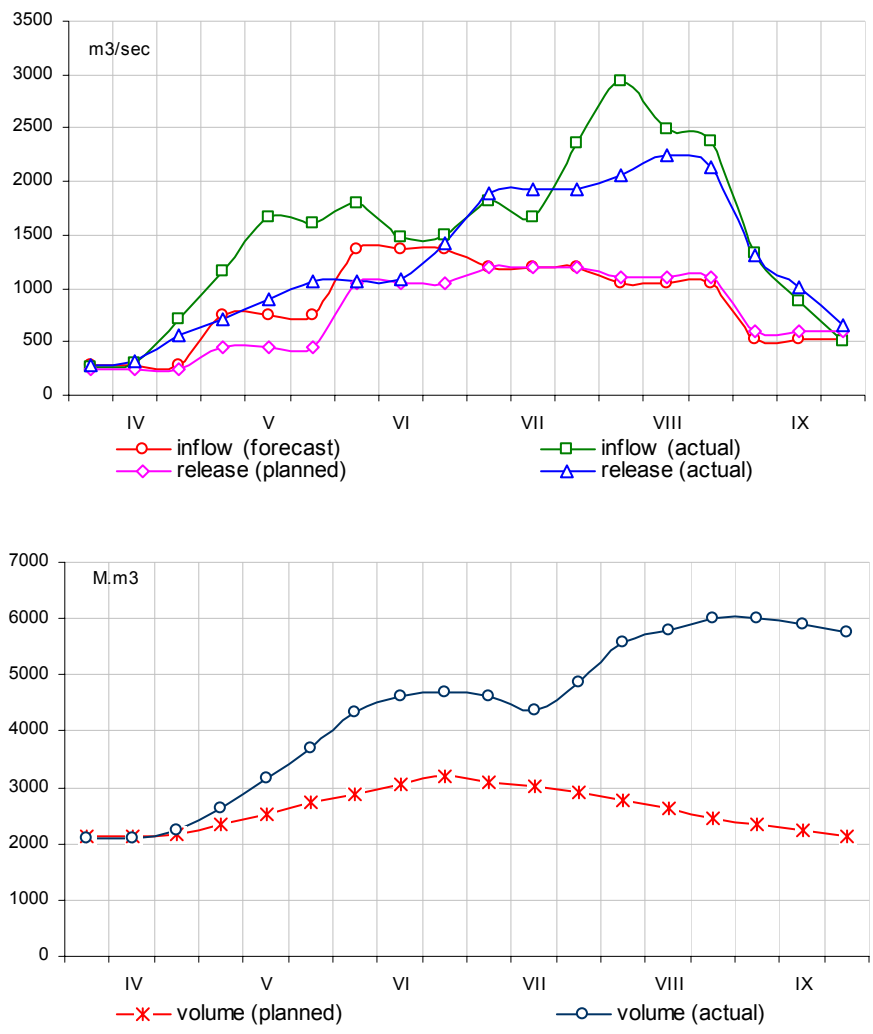


Fig. 2.2. Operation mode of the TMHS reservoirs during the vegetation period of 2009

As a whole the water availability within the basin amounted near 85%. Water withdrawal (33.94 km³) was allocated among the states as follows: Kyrgyzstan - 2%, Tajikistan - 79%, Turkmenistan - 85%, Uzbekistan - 89% (see Table 2.3).

Table 2.3

Withdrawal limit and actual distribution of the Amudarya river water during the vegetation period of 2009

№	State, river's section	Limit, km ³	Water withdrawal, km ³	Probability, %
1	Kyrgyzstan	0.41	0.01	2
2	Tajikistan	6.78	5.39	79

3	Turkmenistan	15.5	13.18	85
	Including:			
3.1	- middle course	10.46	8.66	83
3.2	- Dashoguz	5.04	4.52	90
4	Uzbekistan	17.23	15.36	89
	Including:			
4.1	- Surkhandariinskaya province	1.2	0.72	60
4.2	- middle course	5.74	5.27	92
4.3	- Khorezm	3.45	3.18	92
4.4	- Republic of Karakalpakstan	6.84	6.19	90
	Total in the basin:	39.92	33.94	85

Water delivery to Priaralie through the Amudarya river (cross-section Samanbay) for the vegetation period was 1.9 km³ (Table 2.4).

Table 2.4

Inflow to the Priaralie and to the Aral Sea in the vegetation period of 2009

№		Planned, km ³	Actual, km ³	Probability, %
1	Total inflow	2.1	2.7	128
2	Including by river	1.6	1.9	119
	For the same period of 2008	1.4	0.1	7

It is necessary to give attention that despite of the increased water content, the annual water delivery through the river to the Aral Sea and Priaralie was extremely low and the most of water bodies became empty.

The calculated water losses from the Amudarya river according to the water balance residual (Table 2.5) amounted 902 km³ at the Atamyrat-Samanbay section as a whole.

Table 2.5

Water balance of the Amudarya river for the vegetation period of 2009

№	Balance item	Water volume, km ³
1	Water content of the Amudarya (at the Atamyrat upper Garagumdarya)	46.26
2	Water volume change in the Nurek reservoir (filling)	4.52

3	Water withdrawal at the Atamyrat-Darganata section	14.65
4	Return flow	1.57
5	Runoff at the Darganata section – calculation (1-2-3+4)	28.66
6	Runoff at the Darganata section – actual	25.06
7	Residual (water losses) (6-5)	- 3.6
	- % of water content	8
8	Water volume change in the TMHS reservoirs (filling)	3.67
9	Water withdrawal at the Darganata - Samanbay section	13.89
10	Return flow	0.01
11	Runoff at the Samanbay section – calculation (6-8-9+10)	7.51
12	Runoff at the Samanbay section – actual	1.9
13	Residual (water losses) (12-11)	- 5.61
	- % of the runoff at the Darganata cross-section	22
14	Total losses (7+13)	- 9.21

Conclusions

Analysis of the water management situation during the vegetation period 2009 within the basin highlighted the followings:

1. Water withdrawal within the basin amounted 33.94 km³ or 85% of the water limit.
2. The total water deficit within the basin amounted approximately 6 km³. Supply with water is not proportional within sections and not regular with time (see data on the website www.cawater-info.net/analysis/water/).
3. The channel water losses amounted 3.6 km³ (8%) at the HP Atamyrat-HP Darganata section and 5.6 km³ (22%) at the Darganata-Samanbay section For comparison: the recommended calculated channel water losses from the Amudarya river (data of the ADB RETA 6163 project) for the low water year amounted 1.5 (minimal) - 4.0 (maximal) % at the Kerky-Darganata section and 12 (minimal) - 21 (maximal) % at the lower reaches of Amudarya river.