ANALYSIS OF WATER MANAGEMENT SITUATION WITHIN THE AMUDARYA AND SYRDARYA RIVER BASINS FOR THE NONVEGETATION PERIOD OF 2009/2010

1 Syrdarya River Basin

The actual inflow to the upstream reservoirs of the Syrdarya River Basin (Toktogul, Andijan and Charvak) for the nonvegetation period was 6.82 km3 or 122% predicted inflow. To this water volume additional releases from the upstream reservoirs accumulated during vegetation period were 3.72 km3 that is 0.94 km3 less the predicted one. So despite of increased inflow to the upstream reservoirs the actual release from them for the nonvegetation period was 10.54 km3 that is 3% less the predicted one.

The total channel inflow to Naryn, Karadarya and Chirchik rivers (including the Ugam River) was 11.64 km3 or 111% of predicted one; this allowed to increase the available regulated water resource of the basin up to 22.18 km3.

At the end of vegetation period 11.58 km3 of water was accumulated in the upstream reservoirs including 9.62 km3 or 116% of the predicted one - in the Toktogul reservoir. For comparison: at the end of nonvegetation period 2008-2009 there was only 6.42 km3 in the Toktogul reservoir that is 3.2 km3 less than at the beginning of vegetation period 2010.

At the 54th ICWC's meeting (14-15 January 2010, Shymkent) the proposals on the withdrawal limits and operational schedule for the Naryn-Syrdarya reservoirs cascade were accepted. Under these proposals the operation of reservoirs during three months (October- December) was being adopted de facto.

According to the proposed limits the water withdrawal from the Syrdarya River was 3.12 km3 including: 0.04 km3 - for the Kyrgyz Republic, 0.18 km3 - for Tajikistan, 2.5 km3 -for the Republic of Uzbekistan, 0.4 km3 - for the Republic of Kazakhstan (through the Dustlik canal). Moreover the proposed water releases to Arnasay were 1.0 km3 and water delivery to the Aral Sea and Priaralie was 2.2 km3.

Practically the water withdrawals from the river channel were being implemented according to the water users demand on the basis of actual water availability. For this reason the calculated water availability for some ten-days periods is less than its average for the season (Table 1.1). The planned water withdrawal from the Syrdarya River according to requirements (under the schedule) was 3.11 km3 that is practically the same as the proposed water withdrawal limits (3.12 km3); de facto the water withdrawal was greater - 3.69 km3 or 112% of the scheduled water amount.

However water supply was unequal for the states, river sites and was unsteady during the times (see Table 2.1, and also data on the website: www.cawater-info.net/analysis/water/).

The obligations on water delivery to the Shardarinsky reservoir was implemented on 99%; the actual water inflow to the reservoir for the nonvegetation period 2009-2010 was 12.47 km3 with the scheduled water inflow (planned) 12.55 km3.

Under the sufficient water inflow to the Shardarinsky reservoir the water release to the Arnasay was limited to 0.71 km3 (60% of scheduled one), and the plan on the water delivery to the Aral Sea and Piaralie was implemented on 103%.

Actual channel losses at the Toktogul-Shardara section calculated by the balance method, amounted 2.3 km3, or 12% of the regulated flow of the Syr Darya River (Table 1.2). Analysis of channel balances for previous nonvegetation periods indicates that the channel losses in this section do not exceed 10%. Possible cause of significant residual (losses) in the nonvegetation period of 2009-2010 is overestimation of lateral flow (on 10-15%).

Analysis of reservoirs' water balances in the Syrdarya basin (Table 1.3) has revealed the nonregistered inflow to the Toktogul, Kairakkum and Shardara within the total volume of 1.8 km3, while the expected losses was 0.36 km3 according to the schedule (plan). In the Andijan and Charvak reservoirs the total water losses were 0.28 km3.

Table 1.1

Indicators of state's water availability in the Syrdarya river basin
for the nonvegetation period 2009-2010

Water user	Water volume, km3		Water availability, %		Water deficit, km3	
	Limit/schedule	Actual	Season	Min, ten-days period *)	Season	Sum, ten-days period **)
1. Total withdrawal	3.101	3.688	119	48	0	0.804
2. By states:						
Kyrgyz Republic	0.037	0.032	86	37	0.005	0.014
Republic of Uzbekistan	2.484	3.263	131	38	0	0.418
Republic of Tajikistan	0.180	0.081	45	0	0.099	0.106
Republic of Kazakhstan	0.400	0.312	78	0	0.088	0.266
3. By sections:						
Toktogul reservoir - Uchkurgan waterworks facility	1.329	1.497	113	50	0	0.203
Including:						
Kyrgyz Republic	0.030	0.030	100	37	0	0.009
Republic of Uzbekistan	0.047	0.031	66	0	0.016	0.023
Republic of Tajikistan	1.252	1.436	115	52	0	0.171
Uchkurgan waterworks facility – Kairakkum waterworks facility	0.222	0.224	101	37	0	0.085
Including:						
Kyrgyz Republic	0.007	0.002	29	0	0.005	0.005
Republic of Uzbekistan	0.044	0.016	36	0	0.028	0.028
Republic of Tajikistan	0.171	0.206	120	37	0	0.052
Kairakkum waterworks facility – Shardara reservoir	1.550	1.967	127	43	0	0.516
Including:						
Republic of Kazakhstan	0.400	0.312	78	27	0.088	0.266
Republic of Tajikistan	0.089	0.034	38	0	0.055	0.055
Republic of Uzbekistan	1.061	1.621	153	4	0	0.195
4. Additionally:						
Inflow to the Shardara reservoir	12.554	12.465	99	68	0.089	0.469
Release to Arnasay	1.182	0.711	60	0	0.471	0.777
Water delivery to the Aral Sea and Priaralie	2.351	2.430	103	-	-	-

*) minimal registered water availability for ten-days period

**) Sum of minimal registered water deficits for ten-days periods; partially or fully covered by water surplus within the season up to "deficit for the season"

Table 1.2

The Syrdarya river channel balance for nonvegetation perid 2009-2010

Item	Water volume, km^3		Deviation (actual-plan)
	expected/plan	actual	
1 Inflow to the Toktogul reservoir	3.308	3.898	0.59
2 Lateral inflow at the Toktogul reservoir – Shardara reservoir section (+)	10.21	12.303	2.093
Including:			
Release along the Karadarya river	*1.439*	*1.923*	*0.484*
Release along the Chirchil river	*1.472*	*2.382*	*0.91*
Lateral inflow from CDF[1] and small rivers	*7.299*	*7.998*	*0.699*
treamflow regulation by reservoirs: adding to runoff (+) or removal from runoff (-)	2.394	2.259	- 0.135
Including:			
Toktogul reservoir	*4.358*	*3.067*	*- 1.291*
Kayrakkum reservoir	*- 1.964*	*- 0.808*	*1.156*
4 Regulated runoff (1+2+3)	15.912	18.460	2.548
5 Water withdrawal at the Toktogul – Shardara section (-)	- 3.101	- 3.688	0.587
6 Runoff losses (-) or unaccounted inflow to the channel (+) at the Toктogul – Shardara section	- 0.257	- 2.307	- 2.05
Including % of regulated runoff	*- 1.6%*	*- 12%*	
7 Inflow to the Shardara reservoir	12.554	12.465	- 0.089
8 Runoff regulation by the Shardara reservoir addition to runoff (+) or withdrawal (-)	- 4.399	- 3.986	0.413
9 Water release from the Shardara reservoir	8.155	8.479	0.324
10 Release to Arnasay (-)	- 1.182	- 0.711	0.471
11 Amount of water used in the lower reaches: algebraic sum of withdrawal (-), lateral inflow (+), water losses (-)	- 4.622	- 5.338	- 0.716
12 Water delivery to the Aral Sea and Priaralie	2.351	2.430	0.079

Table 1.3

Water balance of reservoirs in the Syrdarya river basin for nonvegetation perid 2009-2010

Water balance item	Water volume, km^3		Deviation (actual-plan)
	expected/plan	actual	
1. Toktogul reservoir			
1.1 Inflow to the reservoir	3.308	3.898	0.59
1.2 Water volume in the reservoir:			
- at the beginning of season (1 October 2009)	12.674	12.674	0
- at the end of season (31 March 2010)	8.303	9.617	1.314
1.3 Water release from the reservoir	7.666	6.965	- 0.701
1.4 Unaccounted inflow (+) or water losses (-)	- 0.013	0.010	0.023
Including % of inflow to the reservoir	*- 0.4%*	*0.3%*	
amflow regulation: ing to runoff (+) or removal from runoff (-)	4.358	3.067	- 1.291
2. Andijan reservoir			
2.1 Inflow to the reservoir	0.869	1.087	0.218
2.2 Water volume in the reservoir:			
- at the beginning of season (1 October 2009)	0.905	0.905	0
- at the end of season (31 March 2010)	1.263	1.147	- 0.116

[1] CDF-collector-drainage flow

Water balance item	Water volume, km^3		Deviation (actual-plan)
	expected/plan	actual	
2.3 Water release from the reservoir	0.510	0.816	0.306
2.4 Unaccounted inflow (+) or water losses (-)	- 0.001	- 0.029	- 0.028
Including % of inflow to the reservoir	*- 0.1%*	*- 3%*	
2.5 Streamflow regulation: adding to runoff (+) or removal from runoff (-)	- 0.359	- 0.271	0.088
3. Chsrvak reservoir			
3.1 1 Inflow to the reservoir	1.423	1.831	0.408
3.2 Water volume in the reservoir:			
- at the beginning of season (1 October 2009)	1.992	1.992	0
- at the end of season (31 March 2010)	1.332	0.820	- 0.512
3.3 Water release from the reservoir	2.080	2.755	0.675
3.4 Unaccounted inflow (+) or water losses (-)	- 0.003	- 0.248	- 0.245
Including % of inflow to the reservoir	*- 0.2%*	*- 13%*	
3.5 Streamflow regulation: adding to runoff (+) or removal from runoff (-)	0.567	0.924	0.357
4. Kairakkum reservoir			
4.1 Inflow to the reservoir	11.219	11.001	- 0.209
4.2 Lateral inflow	0.400	0.424	0.024
4.3 Water volume in the reservoir:			
- at the beginning of season (1 October 2009)	1.315	1.315	0
- at the end of season (31 March 2010)	3.418	3.418	0
4.4 Water release from the reservoir	9.255	10.193	0.938
Including:			
- release to the river	*9.225*	*10.163*	*0.938*
- waterwithdrawal from the reservoir	*0.030*	*0.030*	*0*
4.5 Unaccounted inflow (+) or water losses (-)	- 0.261	0.871	1.131
Including % of inflow to the reservoir	*- 2%*	*8%*	
4.6 Streamflow regulation: adding to runoff (+) or removal from runoff (-)	- 1.964	- 0.808	1.156
5. Shardara reservoir			
5.1 Inflow to the reservoir	12.554	12.465	- 0.089
5.2 Lateral inflow	-	-	-
5.3 Water volume in the reservoir:			
- at the beginning of season (1 October 2009)	1.091	1.091	0
- at the end of season (31 March 2010)	5.400	5.277	- 0.123
5.4 Water release from the reservoir	8.155	8.479	0.324
Including:			
- release to Arnasay	*1.182*	*0.711*	*- 0.471*
- release to the river	*6.890*	*7.416*	*0.526*
- waterwithdrawal from the reservoir	*0.083*	*0.352*	*0.269*
5.5 Unaccounted inflow (+) or water losses (-)	- 0.09	0.200	0.290
Including % of inflow to the reservoir	*- 0.7%*	*1.6%*	
5.6 Streamflow regulation: adding to runoff (+) or removal from runoff (-)	- 4.399	- 3.986	0.413
TOTAL: Streamflow regulation: adding to runoff (+) or removal from runoff (-)	- 1.797	- 1.074	0.723

Attention is needed to the fact that over the past 5 years (2004-2005 ... 2008-2009) the average annual inflow to the Toktogul reservoir was 12.56 km3, including 12.3 km3 for the nonvegetation period. The water inflow for nonvegetation period of 2009-2010 amounted to 3.9 km3 that exceeds the average inflow over the past 5 years by 0.78 km3.

Over the past 5 years the average volume of releases from the Toktogul reservoir for the nonvegetation period is estimated at 8.66 km3. During the nonvegetation period of 2009-2010 there was 6.97 km3 of released water, which is less than the average volume of releases over the past 5 years by 1.69 km3 (see Table 1.4). Compared with the period 2006-2008, the nonvegetation releases for 2009-2010 have decreased by 2.5 ... 2.8 km3.

According to our estimates, the releases from the Toktogul reservoir for the nonvegetation period 2009-2010 are totally in line with own energy needs of Kyrgyzstan and should allow (owing to saving certain volume of water in the reservoir to the beginning of vegetation period) to implement the releases during the vegetation period about 5 km3 of water.

Table 1.4

Inflow to and release from the Toktogul reservoir for 2004-2009

n	Hydrologic year	Inflow, million m3			Release, million m3		
		Nonvegetation period	Vegetation period	Year	Nonvegetation period	Vegetation period	Year
1	2004-2005	3767	10692	14459	9045	6829	15874
2	2005-2006	3496	10362	13858	9082	5418	14500
3	2006-2007	3157	8911	12068	9538	5857	15395
4	2007-2008	2505	7371	9876	9726	4408	14134
5	2008-2009	2672	9876	12548	5884	5748	11632
	Average for 5 years	3119	9442	12561	8655	5652	14307

2 Amudarya River Basin

The actual water content of the Amudarya river at the Atamyrat gauging station (GS) conditional (upstream to the water intake into Garagumdarya), which was calculated on the basis of natural discharges of the Vaksh river (without runoff regulation by the Nurek reservoir), given with water withdrawal to the Republic of Tajikistan and Surkhandarya region was 11.93 km3 or 84% of the rate.

Additionally 4.85 km3 of water was released from the Nurek reservoir and the actual flow at the Atamyrat GS (upstream to the water intake into Garagumdarya) amounted 16.78 km3 that exceeds the expected one (planned) by 13%.

In the existing water management situation the defined water withdrawal limit in the Amu Darya River Basin was used by 98%, and total water withdrawal amounted to 15.4 km3, including 12.75 km3 down the Atamyrat GS (starting from the water intake into Garagumdarya).

However water supplying was unequal for the states, river sites and was unsteady during the time (see Table 2.1, and also data on the website: www.cawater-info.net/analysis/water/).

The defined limit of sanitary-environmental water releases into the Amudarya downstream canals was used by 95%; water delivery amounted 0.76 km3. Water delivery to the Aral Sea and Priaralie amounted 1.92 km3 or 91% of planned flow (see Table 2.2).

At the end of season only 6.17 km3 of water was stored in the Nurek reservoir or less the planned volume by 0.23 km3, and in the TMHS reservoirs - 4.56 km3 or more than the planned one by 0.92 km3 (see Table 2.3). The total additional water volume to the river flow due to Nurek and Tuyamuyun reservoirs drawdown amounted 5.64 km3.

The water losses of the Amudarya river at the Atamyrat-Darganata section, which were calculated by the balance method (as the water balance residual) amounted 1.35 km3 or 8% of water flow at the Atamyrat GS. The water losses in the TMHS reservoirs amounted 0.42 km3 (5% of water inflow) and in the Tuyamuyun-Samanbay section - 1.52 km3 or 23% of water flow at the Tuyamuyun hydropost. For comparison: the recommended calculated limits of Amudarya river channel losses at

the Atamyrat-Darganata section (according to the ADB RETA 6163 project) amounted 5, and at the Tuyamuyun-Samanbay- section - 21%. Thereby the actual losses exceeded the recommended (calculated) ones for the middle Amudarya by 3%, and for lower Amudarya - 2%.

There are no losses in the Nurek reservoir, the nonregistered inflow of 0.49 km3 is discovered by means of the balance method (13% of the inflow to the reservoir through the Vaksh river).

In spite of relatively low water content of the river, which was calculated in % as the ratio of actual water content to the average long-term flow (84% of the average long-term flow), the probability of waterwithdrawal (98%) and probability of water delivery to the Aral Sea and Priaralie (91%) were higher than relative water content of the river owing to reservoirs' drawdown.

The total water deficit amounted 2% only, including within the Republic of Tajikistan - 8%, the Republic of Uzbekistan - 2%. Turkmenistan exceeded water limit by 5%.

The total actual water losses from the river channels and reservoirs amounted 2.29 km3 or about 14% of river flow at the Atamyrat GS what is near the recommended ones.

At the same time the usable storage of the Nurek reservoir at the beginning of vegetation period was extremely low (approximately 0.2 km3).

Table 2.1

Indicators of state's water availability in the Amudarya river basin
for nonvegetation period 2009-2010

Water user	**Water volume, km^3**		**Water avaialability, %**		**Deficit, km^3**	
	limit/ schedule	**actual**	**season**	**min value for the ten-day interval *)**	**season**	**total per ten-day interval **)**
1. Total withdrawal	15.70	15.40	98	66	0.30	2.52
2. By countries:						
Republic of Kyrgyzstan	-	-	-	-	-	-
Republic of Tajikistan	2.85	2.35	82	52	0.50	0.58
Turkmenistan	6.50	6.80	105	76	0	0.48
Republic of Uzbekistan	6.35	6.25	98	53	0.10	1.46
3. down the Atamyrat GS ***)	12.48	12.75	102	69	0	1.8
Including:						
Turkmenistan	6.50	6.80	105	76	0	0.48
Republic of Uzbekistan	5.98	5.95	99	51	0.03	1.32
4. By sections:						
Upstream	3.22	2.65	82	48	0.57	0.72
Including:						
Republic of Kyrgyzstan	-	-	-	-	-	-
Republic of Tajikistan	2.85	2.35	82	52	0.50	0.58
Surkhandarya,Uzbekistan	0.37	0.30	81	0	0.07	0.14
Middle course	8.35	8.23	99	74	0.12	0.64
Including:						
Turkmenistan	5.10	5.05	100	76	0.05	0.36
Republic of Uzbekistan	3.25	3.15	97	71	0.10	0.28
Downstream	4.13	4.52	109	7	0	1.16
Including:						
Turkmenistan	1.40	1.72	123	65	0	0.12
Republic of Uzbekistan	2.73	2.80	103	7	0	1.04
5. Additionally:						
Sanitary-environmental	0.80	0.76	95	0	0.04	0.24

Water user	Water volume, km^3		Water avaialability, %		Deficit, km^3	
	limit/ schedule	actual	season	min value for the ten-day interval *)	season	total per ten-day interval **)
water releases into downstream canals						
Including:						
Turkmenistan	0.15	0.15	100	0	0	0.09
Republic of Uzbekistan	0.65	0.61	94	0	0.04	0.15
Water delivery to the Aral Sea and Priaralie	2.10	1.92	91	62	0.18	0.18

*) minimal registered water availability for ten-days period

**) Sum of minimal registered water deficits for ten-days periods; partially or fully covered by water surplus within the season up to "deficit for the season"

***) Atamyrat hydropost conditional (upstream to the water intake into Garagumdarya)

Table 2.2

The Amudarya river channel balance for nonvegetation perid 2009-2010

Item	Item		Water volume, km^3
	expected/plan	actual	
1 Water content of the Amudarya river at the g/s Atamyrat conditional	10.59	11.93	1.34
2 Runoff regulation by the Nurek reservoir: addition to runoff (+) or withdrawal (-)	4.13	4.85	0.72
3 Water withdrawal of middle course (-)	- 8.35	- 8.23	0.12
4 Return CDF in the middle course (+)	0.93	0.70	- 0.23
5 Runoff losses (-) or unaccounted inflow to the channel (+)	0	- 1.35	- 1.35
% of runoff in the section of g/s Atamyrat conditional	*0*	*- 8 %*	*- 8 %*
6 Inflow to the Tuyamuyun hydroscheme (TMHS)	7.30	7.90	0.6
7 Runoff regulation by TMHS reservoirs: addition to runoff (+) or withdrawal (-)	0.70	0.79	0.09
8 Downstream water withdrawal, including withdrawal from the TMHS (-)	- 4.13	- 4.52	- 0.39
9 Return CDF in the downstream (+)	0.02	0.03	0.01
10 Sanitary-environmental water releases into downstream canals (-)	- 0.80	- 0.76	0.04
11 Runoff losses (-) or unaccounted inflow to the channel (+)	- 0.99	- 1.52	- 0.53
% of runoff in the section of g/s Tuyamuyun	*- 17%*	*- 23%*	*- 6%*
12 Water delivery to the Aral Sea and Priaralie	2.10	1.92	- 0.18

Table 2.3

Water balance of reservoirs in the Amudarya river basin for nonvegetation perid 2009-2010

Items	Water volume, km^3		Deviation (actual-plan)
	expected/plan	actual	
1. Nurek reservoir			
1.1 Inflow to the reservoir	3.52	3.68	0.16
1.2 Water volume in the reservoir:			
- at the beginning of the season (1 October 2009)	10.53	10.53	0
- at the end of the season (31 March 2010)	6.40	6.17	- 0.23
1.3 Release from the reservoir	7.65	8.53	0.88
1.4 unaccounted inflow (+) or water losses (-)	0	0.49	0.49
% of inflow to the reservoir	*0%*	*13%*	*13%*
1.5 Runoff regulation:	4.13	4.85	0.72

Items	Water volume, km^3		Deviation (actual-plan)
	expected/plan	actual	
addition to runoff (+) or withdrawal (-)			
2. TMHS reservoirs			
2.1 Inflow to **TMHS**	7.30	7.90	0.60
2.2 Water volume in the reservoirs:			
- at the beginning of the season (1 October 2009)	5.77	5.77	0
- at the end of the season (31 March 2010)	3.64	4.56	0.92
2.3 Release from **TMHS**	8.00	8.69	0.69
Including:			
- release to the river	5.90	6.60	0.7
- water withdrawal	2.10	2.09	- 0.01
2.4 unaccounted inflow (+) or water losses (-)	- 1.43	- 0.42	1.01
Including: % of inflow to the reservoir	*19%*	*5%*	*-14%*
Runoff regulation: addition to runoff (+) or withdrawal (-)	0.70	0.79	0.09
TOTAL runoff regulation by reservoirs: addition to runoff (+) or withdrawal (-)	4.83	5.64	0.81