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Long-term objectives of water resources management in Chirchik-Ahangaran basin (Central Asia)

Introduction

Concerning biogeographic taxonomic units, Chirchik-Ahangaran basin (CAB) is located in Western Tyan-Shan between Kyzyl-Kum and Muyun-Kum desert. It is characterized by biodiversity and is a source of fresh water. Basin is characterized by low freezing, high precipitation (in low mountain 800mm/yr), moderate climate (average long-term air temperature is -5^{o}C in January and 10-15 ^{o}C in July. Total area of the basin amounts for 90 th.sq.km and is distributed between Kyrgyzstan (more than 60%), Kazakhstan (near 20%), Uzbekistan (more than 15%) and Tajikistan (about 4%).

CAB is located within three republics: Uzbekistan (Tashkent region), Kazakhsta (Shimkent region taking water from Chirchik river – Keles massif), Kyrgyzstan (Jalalabad region in Chatkal upper reaches).

Long-term objectives of water resources management are considered in context of sustainable development both national economy and water sector as well as their compliance with principles of integrated water resources management. In the countries under consideration[1] near 90% of available water resources are used for irrigation.

According to statistical data[2], in national economies of CAB countries production of irrigated agriculture is very important part of GNP. For instance, in 2000 irrigated agriculture product amounted for: in South Kazakhstan – 29,0%, Kyrgyzstan – 27,0%, Uzbekistan – more than 30% from GNP. In agricultural sector employment percentage is as follow: Kazakhstan - 22%, Kyrgyzstan - 53%, Uzbekistan – 36%. Rural population amounts for 60-70% (in Tashkent region – 30%).

Therefore, main stress is made on water resources use in agrarian sector of these countries.

During long-term objectives of water resources development of basin's countries economic development scenarios are used worked out be competent bodies, schemes of irrigated agriculture development for nearest and long-term perspective, "visions" (forecasts) of water resources use, other sources related to future water resources use including CAB (Tashkent region).

Stress is made on recommended scenarios of economic development when it is a sense to speak about long-term objectives of water resources management in applied aspect.

Objectives setting and water management criteria development for-long term period is difficult task, has probabilistic character and depends on selecting of economic development direction both for countries and separate regions – «Rivertwin» project zones Accordingly, task of long-term objectives definition can be considered within framework of their

[1] For Kazakhstan – South Kazakhstan with Keles massif – project zone.

[2] Report «Strategic planning and water resources sustainable development in Central Asia». – Tashkent, SIC ICWC, 2004 – p. 47-48.

compliance with regional, national specific objectives at relevant level of water management and follow goals of CAB countries sustainable social-economic development.

1. SIC ICWC developed different scenarios[3] of CAB countries development, from which the following will be considered below:

- *«optimistic»; «business as usual»; «medium».*

Let us consider some expected results of these scenarios running.

Under «optimistic scenario» population growth rate is expected to be decreased by 2020 down to 0,98%/yr. In result of water saving technologies introduction specific water consumption in irrigation will decrease to 9,4th.m^3/ha that will permit to increase irrigated area by 2020 up to 5,86mln.ha compared with 2000. (5,42mln.ha),including: South Kazakhstan – from 772 to 918th.ha, (growth – 144th.ha), Kyrgyzstan – from 415,2 to 431,8th.ha (16,6th.ha), Uzbekistan –from 4234 to 4508th.ha (274th.ha).

Main growth of irrigated area is expected after 2010; by this time significant improvement of economic situation is expected.

Under «medium» scenario of CAB countries development insignificant population growth rate decline is expected by 2020 down to 1,23 %/yr. Specific water consumption in irrigation will be11,0th.m^3 /ha. Irrigation area increase is expected as follow: in South Kazakhstan – 104th.ha, in Kyrgyzstan – 11,2th.ha, in Uzbekistan – 178th.ha.

Under «business as usual scenario» population growth rate will amount for 1,9%/yr, specific water consumption in irrigation – 12th.m^3/ha. Irrigated area increase is expected as follow: South Kazakhstan – 59,8th.ha, Kyrgyzstan – 7,1th.ha, Uzbekistan – 46,6th.ha.

Obviously, that «optimistic scenario» realization will require revise existing approaches to water resources use e.g. irrigated agriculture development within existing limits. Main prerequisites for «optimistic scenario» realization (objectives helping scenarios justification) are as follows:

- orientation to mutually beneficial collaboration in transboundary water resources use;

- agricultural sector development with stress on regional division of labor;

- development of common approaches to environmental policy implementation;

- wide introduction of water saving technologies;

- land and water productivity increase, etc.

2. In accordance with "General Scheme[4] …", following concepts of development are accepted:

-*development based on existing rate and structure of realized measures.* Developing according this concept, agricultural production decreases in sustainable manner. By 2015 provision by food staff in Uzbekistan will decrease by 25%, area with favorable reclamation conditions will decrease, water and reclamation systems' technical state will grow worse. Therefore, this concept is unacceptable.

[3] Report «Strategic planning and water resources sustainable development in Central Asia». – Tashkent, SIC ICWC, 2004 – p. 45-60.

[4] «General scheme of irrigated agricultural and water sector of the Republic of Uzbekistan for the period oup to 2015» (Summary) –Tashkent, «Vodproekt», 2002 – p.268.

- *stop-development.* Under this concept, irrigated area remains the same, new lands are not developed, all financial means are allocated to land reclamation measures and irrigation and drainage systems improvement. By 2015 all irrigation systems will be rehabilitated.

But irrigated area will decrease by 51,2th.ha (due to land retirement). Irrigated area per capita will decrease from 0,16 to 0,125ha, provision with food will increase only by 3% (from 61 to 64%) due to irrigated hectare productivity increase. In accordance with expert evaluation, this concept is also unacceptable.

- *maximum development.* Under this concept all measures of stop-development concept will be realized, additional irrigated lands will be developed allowing provide population with food.

According to «General scheme…», there is possibility to provide necessary land, water and labor resources under any scenario of development. But only under concept of maximum development food provision, irrigated land favorable reclamation state, effective water and land resources us can be achieved.

Scenario *«recommended development»* is based on concept of maximum development and analysis of all previous concepts' and real possibilities of investment in agricultural and water sector.

To certain extent, assumption about realization of political, social-economic prerequisites of transition to market in agricultural sector by 2015 as well as structural transformations related to transition to market relations between agricultural producer and the state.

At the same time, realization of the concept of maximum development requires capital investments much exceeding those planned retrospectively and for nearest future. In particular, concept authors consider that results achievement will be determined by real investment possibilities and should be postponed up to 2015. Obviously, taking into account modern trends in water and agricultural sector of Uzbekistan concept realization will be shifted to 2015. Probably, term of concept realization can be accepted 2025-2030 coinciding with CAB scenario realization developed within "Rivertwin" project.

Orientation on scenario of maximum development is justified from position of IWRM principles introduction within project zone. During CAB development scenarios elaboration significant amendments can be introduced in suggested official scenarios of social-economic development of Tashkent oblast.

Concept of maximum (full) development is realized by scenarios:

- I scenario. Agricultural production providing population with food by 70% of optimal food allowance;

- II scenario. Agricultural production providing growing population with food by 60% of optimal food allowance keeping positive trend of food provision.

It is meant that levels of development by scenarios are stages of maximum development concept realization with correspondent water-related measures. Only small amendments in volumes of measures according to specific conditions of oblast are accepted.

Setting long-term objectives and WRM sustainability criteria it is necessary to take into account expert analysis data on water and agricultural sector development dynamics («General scheme…» for the period 1991-1998):

- level of investments in agriculture decreased by 4 times;

- level of investments in water sector decreased by 5 times;

- expenditures for irrigation and drainage network cleaning decreased from 58% to 38% whereas energy price increased from 14% to 48%;

- mains and interstate irrigation canals' efficiency is still low (0,86);

- extension of mains and interstate irrigation canals demanding reconstruction increased by 870km, on-farm canals – by 11344km;

- extension of water withdrawing tracts demanding cleaning increased by 2400km;

- specific investments in water-related measures decreased:

  - on new land development from 9993 to 4630ruble/ha[5]; land reconstruction – from 7110 to 2170ruble/ha; land reclamation – from 2610 to 1200ruble/ha;

- land reconstruction and reclamation was carried out by fragments that's why they again need reconstruction;

- low water resources use efficiency in general due to water use discipline infringement, water account absence, irrigation regime violation etc.

Above listed trends and issues in water and agricultural sector were and are specific for all regions of Uzbekistan including Tashkent region.

Taking into consideration above and existing trends and prospective vision, long-term objectives in water resources management in CAB by its main issues are presented.

3. Average annual water resources of CAB (or CHAKIR) are estimated as 9,32km^3 (table), that amounts to 22,8% from Syr-Darya basin resources (table).

Syr-Darya water resources (1910/1911-1075/1976), km^3/yr

№№	Water-related region	Surface flow		Groundwater flow	Infiltration and precipitation	**Total**
		Accounted	Not-accounted			
1	Ferghana valley	25,2	0,75	0,99	0,50	27,44
2	Midstream	0,36	-	0,33	0,50	1,19
3	CHAKIR *	*8,67*	-	*0,35*	*0,30*	*9,32*
4	**Total: upstream Chardara**	**34,23**	**0,75**	**1,67**	**1,30**	**37,95**
5	ARTUR**,downstream	2,45	-	0,51	-	2,96
6	**Total for basin**	**36,68**	**0,75**	**2,18**	**1,30**	**40,91**

Note: CHAKIR * – Chirchik-Ahangaran-Keles irrigation district, «Rivertwin» project zone;

ARTUR ** – Aris-Turkestan rayon.

Water resources by river basins are defined on base of surface and groundwater flow long-term observations. Operational water resource and their distribution between CAR republics are established in basin Schemes approved by protocols of the Ministry of Land Reclamation of USSR dated respectfully by 10.09.1987 № 566 and 07.02.84 № 413.

These documents are recognized by interstate agreements, Agreement of 1992, International Conference on Sustainable development of the Aral sea basin (Nukus, 18-20.09.1995).

[5] Here and after in prices of 1991

Water resources assessments by different authors (V.L.Shults et al.), institutes (Institute of Water Problems; State Hydrologic Institute;) differs by less than 3%, and SANIGMI mathematical modeling gave assumption for nearest 20-30 years (2030) that essential water resources change is not expected.

According to SANIGMI, during next 25 years CAB total water resources will also not change due to climate warming. Warming will impact freezing area and seasonal flow dynamics.

In accordance with «Scheme … of Syr-Darya basin» upstream Chardara reservoir average annual flow distribution between the republics is realized in following proportion: Uzbekistan – 73,3%, Kazakhstan – 7,2%, Kyrgyzstan – 9,8%, Tajikistan – 9,7%. Within «Rivertwin» project zone resources are distributed as follow: Uzbekistan – near 88%, Kazakhstan – near 12%, Kyrgyzstan – less than 1% from total long-term runoff.

Water resources use by CAB countries in perspective should not exceed volumes established The are no essential misunderstanding between Uzbekistan, Kazakhstan and Kyrgyzstan though Kyrgyzstan disputes water allocation principles established earlier.

In particular, Jalalabad region («Rivertwin» project zone in Kyrgyzstan) today uses 15-16% from total water diversion by Kyrgyzstan (third place after Osh+Batkent region – 29%, and Chu region – 22-23%), next 15 years (by 2020) water diversion will be increased from 1,6-1,8 to 2,1-2,2 km3/yr or by 26% on average (totally for Kyrgyzstan – from10,3-11,6 km3/yr in 2005 to 13,5-14,3 km3/yr in 2020 or also by 26%). Jalalabad region is considered as medium priority zone (category 2 like Ferghana and Batkent valleys and Kara-Darya river). Population growth, land developnet and irrigation water use increase is observed in this region.

Though prospective water consumption increase in Chatkal zone of Jalalabad region can't essentially influence on water diversion in CAB, existing "status-quo" in interstate water allocation should be maintained to avoid precedent.

Kazakhstan (Keles massif) and Uzbekistan (Tashkent region) are going to develop economy within water limits established by interstate agreements.

Average long-term water transfer from Chirchik river to Kazakhstan (Keles massif) amounts to 350mln. km3/yr and will be maintained in the future.

In particular, by 2015 in Tashkent region total water consumption (irrigation and non-irrigation) will be 6232mln.km3, water disposal – 3083mln. km3. From total water consumption of 6232 mln.km3 for irrigation is foreseen 2403 mln.km3; non-irrigation water disposal will be 1409 mln.km3 (table). By 2015 in Tashkent region for irrigation will be allocated 3829 mln.km3 or by 314mln.km3 less compared with modern state (4114 mln.km3), disposal – 1674 mln.km3 or by 749 mln.km3 less compared with modern state (2423 mln.km3). It is evident that irrigation water requirement decrease will require big efforts.

Designed water consumption and disposal in Tashkent region by 2015 according to Concept of maximum development and scenarios (mln.km3)

№№	Water consumption			Water disposal		
	Irrigation	Non-irrigation	Total	Irrigation	Non-irrigation	Total
1	**Full development: irrigation system efficiency** – 0,82 (against 0,58 to date)					
2	3829	2403	6232	1674	1409	3083
3	**Scenario I: irrigation system efficiency** – 0,80					
4	4354	2403	6757	1613	1409	3022
5	**Scenario II: irrigation system efficiency** – 0,78					
6	4305	2403	6628	1691	1409	3101

4. Groundwater in alluvial deposits of modern river valleys (Chirchik and Ahangaran valleys (Toituba zone in Ahangaran valley) are important source of drinking and industrial water supply. Groundwater volumes received by rational methods under established regime and quality are considered as operational reserves.

In Uzbekistan 88 groundwater deposits are explored in amount of 622,4m^3 /s. In Tashkent region groundwater reserves amount for 70,94m^3/s compared with Ferghana region (87,5), Namanhan region (70,9) and Samarkand region (64,34m^3 /s).

Significant part of groundwater operational reserves in Tashkent region is constituted by fresh water. For instance, from 70,94m^3/s near 44,3 4m^3 /s (63,8%) are fresh waters (over republic - 233,2 4m^3 / or 37%), rest of water has salinity 1,0-3,0g/l. Only Samarkand region exceed Tashkent one in fresh water resources (51,44m^3 /s).

Spring water is a part of fresh water resources located in mountain and pre-mountain zones. It is used for drinking water supply, treatment and small irrigation.

Spring flow is estimated for Uzbekistan as 244mln.m3 /yr, from which 33 mln.m3 /yr is located in Tashkent region. Only Namangan (56), Samarkand (47) and Andijan (44mln.m3 /yr) exceed Tashkent region.

Specific water use issues can be summarized as follow:

- *groundwater pollution*. Chirchik and Ahangaran groundwater deposits are biggest.

Chirchik deposit's water (right bank) subject to pollution by nitrates, heavy metals from Chirchik industrial zone and rat of water is not recommended for drinking purposes.

There are agricultural and industrial sources of pollution within protected zone of the Right Bank Kibrai water field. In particular, pollution by heavy metals has place from UzKTZhM (Uzbek Combine of refractory and heat-proof metals) and "Electrochimprom".

Chirchik city treatment plant threats river water. Nitric compounds are found on Chirchik water field within 15-20km in amount of 1,5-3,0 allowable concentration. Within Kibrai field cone of depression wastes from inter-rayon collector are observed.

In Left Bank Kibrai water field groundwater quality is much better. To maintain water quality it is necessary to establish protected zone along Chircik river channel up to Verhne-Chirchik water work.

Downstream Chirchik valley water quality growth significantly worse (total hardness, phenols, heavy metals) that does not allow use water for drinking purposes.

Within command zone of Almalik mining and smelting complex groundwater is polluted by manganese, strontium, ammonium nitrogen. Along Gedjikent branch, water has salinity 2g/l. suilfate concentration is 1.3g/l, nitrates – 40mg/l.

Dalverzin deposit is used for drinking water supply (Bekabad city and other settlements). During last 10-15 years water quality got worse due to high total hardness (12-15mg-ekv/l). Additional explorations are needed to find pure aquifers.

- *inter-sector coordination in surface and ground water use.* Groundwater quality control and management is carried out by State Committee of Geology and Mineral Resources. Surfacwaters are managed by the Ministry of Agriculture and Water Resources. Within CAB surface and ground waters are interconnected and ground water is polluted from surface one.

Unauthorized groundwater abstraction makes it difficult to manage water resources and their quality, especially in dry years.

-*observation network issue.* From functioned in 1990 1078 observation wells now only 539 are operational, 268 wells are plugged, 277 wells disappeared.

5. New land development. Water resources management in CAB for perspective can't be considered without coordination with agricultural sector development, particularly irrigated farming – most water consuming economic sector.

Uzbekistan has large reserves for new land development (more than 7 million ha, except for on-farm reserves), but scantiness of water resources does not enable to develop them in full. In the years 1991-1998, 116,000 ha of lands were developed in the republic as a whole, in particular 6,900 ha in Tashkent province. It is much less than in many other provinces in the republic: e.g. 14,000 ha in Khorezm province, 13,900 ha in Kashkadarya province, 12,900 ha in Surkhandarya province, and 12,700 ha in Bukhara province. In Tashkent province, on-farm lands suitable for development amount to 7,800 ha (94,300 ha in Uzbekistan as a whole). Only Karakalpakstan (21,100 ha), Bukhara (13,500 ha) and Jizak (10,000 ha) provinces have more on-farm resources for new land development than Tashkent province has.

Requited investments in new land development in Tashkent province (5750 roubles/ha) is rather higher than the average for the entire republic (4630 roubles/ha).

At the same time, according to the Concept of maximum development, to satisfy own requirements, it will be needed to introduce additional 286,800 ha of irrigated lands in agricultural turnover in Tashkent province by 2015 (that is 64.6% of requirements of the whole republic – 444,000 ha).

In view of large capital intensity of new land development, it is necessary at the initial stage to keep within bounds of internal development, which requires considerably less forces and resources, and concentrate efforts on improving the effectiveness of irrigated lands being used.

6. Reclamation condition of lands is characterized by salinity degree, groundwater table (GWT) and their salinity. In contrast to common tendency towards increase in lands unfavorable in reclamation terms all over the republic, such tendency has not been observed in Tashkent province (as well as in Namangan and Navoi provinces).

Over the recent years, lands favorable in reclamation terms have increased by 135,000 ha in Tashkent province owing to reduction in the portion of lands with satisfactory (113,000 ha) and unsatisfactory (9,200 ha) quality (see table).

In 1998, lands unfavorable in reclamation terms amounted to 10,200 ha, about 8,500 ha in 2004. On the whole, lands of unsatisfactory quality are located in lower river reaches (3 500 ha in Bekabad district, 2 300 ha in Buka district, 2 200 ha in Chinaz district, and about 500 ha in Yangiyul district).

Differentiation of irrigated lands in Tashkent province by groundwater table

Year	Irrigated area, thousand ha	Observed area, thousand ha	Groundwater table, m				
			Below 1	1-1.5	1.5-2.0	2.0-3.0	Above 3
October 1992	398.4	376.5	0.9	13.4	55.5	133.9	172.8
%	100%	100%	0.24	3.6	14.7	35.6	45.9
October 1998	396.9	388.2	2.0	8.3	69.0	146.6	162.3
%	100%	100%	0.52	2.14	17.8	37.8	41.8
Change, thousand ha	-2.3	+11.7	+1.10	-5.10	+13.5	+12.7	-10.5
%	-0.58	+3.01	+0.28	-1.31	+3.48	+3.27	-2.70

Tashkent province is among the regions, in which the area of irrigated lands with salinity less than 1 gram/liter amounts to a considerable value, 63% (see table), and it gives place to only Samarkand (93%) and Namangan (78%) provinces in this respect.

Differentiation of irrigated lands in Tashkent province by groundwater salinity

Year	Irrigated area, thousand ha	Observed area, thousand ha	Salinity, gr./l				
			Below 1	1.0-3.0	3.0-5.0	Above 5	Average
October 1992	398.4	376.2	211.3	152.4	12.5	0	1.5
%	100	100	56.2	40.5	3.3	0	
October 1998	396.1	388.2	246.8	137.8	3.6	0	
%	100	100	63.6	35.5	0.9	0	
Change, thousand ha	-2.30	+12.0	+35.5	-14.6	-8.90	0	-0.10
%	-0.6	+31.1	+9.1	-3.8	-2.3	0	

In the period under consideration, desalination and increase of areas of non-saline and weakly saline lands by 15,200 ha (see table) was observed in Tashkent province.

Overall balance of salts (in 2003) coming with irrigation water and removed from the province by collector-drainage flows is as follows: influx - 1.570 million tons, removal - 1.751 million tons.

Approximately a half of the irrigated area (about 240,000 ha) has natural drainage, the remaining area requires artificial drainage.

Differentiation of irrigated lands in Tashkent province by salinity degree

Year	Irrigated area, thousand ha	Observed area, thousand ha	Salinity degree			
			Non-saline	Weakly saline	Moderately saline	Strongly saline
1992	398.4	376.2	366.6	4.6	3.6	1.4
%	100	100	97.4	1.2	1.0	0.4
1998	396.1	388.2	379.6	6.8	1.6	0.2
%	100	100	97.8	1.8	0.4	0.1
Change, thousand ha	-2.30	+12.0	+13.00	+2.20	-2.00	-1.20
%	-0.6	+3.1	+3.3	+0.6	-0.5	-0.3

Collector-drainage network (CDN) in Tashkent province amounts to 8418 km (in 2004), including 2804 km - inter-farm, 5614 km - on-farm, 141 km - subsurface horizontal drainage. Of existing 117 drainage wells in the province, 94 are out of operation (85 in Bekabad district, 5 in Buka district, 4 in Yangiyul district), 23 are still serviceable (all of them are located in Bekabad district).

At present, lands of unsatisfactory quality in Tashkent province amount to about 2.2%. However, for agriculture in the part of Tashkent province located in CAB lower area (Bekabad, Buka, Chinaz, and Yangiyul districts), they represent a serious problem.

7. Relatively low effectiveness of agricultural production causes low irrigation water use effectiveness. Large potentials for water resources saving are hidden in improving irrigated farming effectiveness.

So, according to the Concept of maximum development ("recommended scenario"), it is supposed to achieve by 2015 in Tashkent province the level of average crop yields:

- cotton – 33.2 centner/ha (average 36.1 centner/ha in the whole republic); 19.8 centner/ha in 2003 (in fact)

- wheat – 34.9 centner/ha (41.7 centner/ha); 41 centner/ha in 2003

- potatoes – 127 centner/ha (138 centner/ha); 212 centner/ha in 2003

- vegetables – 221 centner/ha (234 centner/ha); 225 centner/ha in 2003

- melons and gourds – 154 centner/ha (172 centner/ha); 170 centner/ha in 2003

- fruits– 54.4 centner/ha (59.3 centner/ha),

- grapes – 99.8 centner/ha (70.7 centner/ha).

Once the predicted yields of a number of crops have been already achieved (wheat, potatoes, vegetables, melons and gourds), then the level of yields predicted as for such a major crop as cotton (33.2 centner/ha) is far from the real (19.8 centner/ha). Low crop yields in 2003 are not exception. The analysis shows that over the past 20 years, a sustainable tendency towards reduction in yields of the major export crop has been outlined.

According to statistical data, cotton yields in the province amounted to average 30.2 centner/ha in 1985; 28.1 in 1990; 26.1 in 1995; and 23.9 centner/ha in 2000; over 20 years the crop yields has reduced 1.5 times. In the context of separate districts in the province, the situation appears more critical. For instance, in these years in Kuyi-Chirchik district the following trends in cotton yields were observed: 32.7 centner/ha in 1985, 29.5 in 1990, 26.8 in 1995, 20.8 in 2000, 16.3 centner/ha in 2003, yields decreased by 2 times.

The main factors causing drop and low capacity of a number of irrigated crops, in particular cotton, and, as a result, reduction in water productivity (practically the same quantity of water is used to produce them) are as follow:

- *reducing mineral fertilizer application norms.* This tendency has existed since the early 1990s (see table).

Application of mineral fertilizers to cotton and cereals

(1991 and 1998, % of the given substance)

No.	Crop	Cotton		Cereals	
		1991	1998	1991	1998
1	**1. Nitrogen fertilizers**				
2	Applied per 1 ha, kg	238	191	159	84
3	% of requirement	114.9	85.1	198.4	59.9
4	**2. Phosphate fertilizers**				
5	Applied per 1 ha, kg	142	57	71	24
6	% of requirement	100.4	38.0	130.9	44.0
7	**3. Potash fertilizers**				
8	Applied per 1 ha, kg	50	45	26	12
9	% of requirement	55.9	45.0	153.8	20.0

In Tashkent province, according to data for 2003, nitrogen and phosphate fertilizers are applied in cotton production up to respectively 60% and 45% of scientifically recommended norms. Application of potash fertilizers is practically at zero level (they are used at small volumes by separate agricultural enterprises in the province);

- *poor material and technical basis (MTB) of agricultural enterprises.* The outdated machine-and-tractor fleet does not enable to carry out land treatment at a stated time, owing to which, according to expert evaluations, up to 30-40% of yields are lost.

In 1998, provision of agricultural sector in the republic as a whole (in quantitative terms) amounted to: with ploughing tractors – 88.5%, grain combines – 73.1%, fodder combines – 50.4%, ploughs – 51.3%, cotton pickers – 43.2% of the normative indices. At that, the agricultural machinery use coefficient was 0.5-0.6 that also means poor repair base of farms. In Tashkent province, total number of tractors reduced in the years 1990-2003 by 58%, ploughing ones by 68%. In a number of districts (Yangiyul, etc.), the number of tractors reduced by 2-3 times.

The untimely land treatment results in violation of irrigation terms and lowering of irrigation water effectiveness. A number of other MTB components (provision with sorted seeds, fuels and lubricants, chemicals, etc.) have a negative influence upon crop yields and water productivity as well.

The situation in agriculture is also aggravated by these factors:

- rapid shortening of governmental support for agricultural sector;

- disparity in market and purchasing prices for agricultural products;

- artificially overvaluation of material and technical resources supplied by the government to agricultural producers;

- others (limitation of capabilities of agricultural producers to dispose their own funds on banking accounts, problems of crediting, etc.).

All of that impedes to introduce market mechanisms in rural areas, limits capabilities of farmer, peasant, leaser to raise his labor productivity. These factors cause commercial impracticability of the most of private and shirkat farms not only in Tashkent province, but also throughout Uzbekistan. Achieving the targets stipulated in the Concept of maximum development is practically impossible without proper governmental support of agricultural and water sectors in the country.

8. Problems of pumping irrigation. Areas of pumping irrigation in Tashkent province amounted in 1998 to more than 58,000 ha (about 15% of total irrigated area). The most part of pumping stations was put into operation in the 1960s and 1970s; their equipment produced its resource. In the last years, supplies of spare parts for pumping and power equipment (PPE) were practically missing. PPE was subject to capital repair 5-6 times, while it requires replacement after 3-4 repairs. The service life of PPE is no more than 20-25 years. One of urgent problems of pumping irrigation is its expensiveness due to high prices for energy resources. In this connection, it seems expedient to consider in future the issue on possibility of transferring a part of lands from pumping irrigation to gravity irrigation. The issue in CAB requires a careful study.

9. Long-term objectives of water resources management in CAB

To solve the above-mentioned problems, it seems possible to formulate 3 main objectives of water resources management in CAB to provide its sustainable socio-economic development in the future:

1. Meeting water needs of all economic sectors and natural complexes without causing damage to ecosystems in the basin;

2. Improving environmental conditions in the basin;

3. Meeting requirements of the Syrdarya river for environmental and sanitary flows.

The way to achieve these objectives is possible if key persons support ideas of transition to integrated (hydro ecological) water and other natural resources management in CAB, and it assumes carrying out a number of activities:

- developing basin IWRM plans (particularly – for basins: Keles river in Kazakhstan, Chatkal river (upper reaches) in Kyrgyzstan, Chirchik and Akhangaran rivers in Uzbekistan) and combining them into a single plan of integrated water resources management in CAB (IWRM CAB) through coordination;

- strengthening powers and capabilities of BVO “Syrdarya” for organizing accounting and controlling water quantity and quality in CAB;

- considering the issue of establishing a Trilateral Commission of representatibves from Jalalabad BWA (Kyrgyzstan), NPE “Yugvodkhoz” (Kazakhstan), CAB Administrations of Irrigation Systems (CABAIS) (Uzbekistan) and other stakeholders for joint water resources management in CAB;

- seeking for ways to solve national water and environmental problems without causing damage to other countries, in particular coordination between the Rivertwin Project countries as regards:

  - quantitative and qualitative norms for environmental and sanitary flows over Keles, Chirchik and Akhangaran rivers into the Syrdarya river;

- operation mode of Charvak reservoir in concurrence with other waterworks (Toktogul, Kayrakkum, Uchkurgan, Andijan, Shardara) in the Syrdarya river basin, as well as the Arnasay Lake system;

- developing common approaches and programs of socio-economic development in CAB;

- solving the issues of water resources use damage assessment;

- disseminating positive experience in water management in CAB;

- informing the community about the state of affairs in water resources in CAB;

- providing participation of civil society institutions in IWRM CAB, etc.

A number of water sector problems in CAB countries, in particular:

- transferring province-level water departments to the jurisdiction of local authorities and administrations (e.g. "Yugvodkhoz" in Kazakhstan) or uncertainty of issues relating to interaction of BWAs with district- and province-level agriculture and water departments (Uzbekistan), district-level water departments (Kyrgyzstan) in declaring basin management principle;

- developing mechanisms for managing separate parts of a united technological complex of waterworks in privatizing them (Kazakhstan, Kyrgyzstan), with a view to excluding possibility of their monopolization;

- absence of mutual interest of water users and water authorities in water conservation problems. This is one of reasons for low productivity of water and irrigated hectare in all the project countries;

- over-norm deterioration of capital assets and poor material and technical basis (MTB) of water organizations, further deterioration of water infrastructure. As for this matter, it is necessary too identify priority investment objects;

- poor economic basis for regulation of relations between water supplier and water user organizations, in particular, imbalance between the cost of water supply services and resources of agricultural producers to pay for these services. For instance, water supply services are provided in Uzbekistan free of charge that significantly reduces financial resources of water organizations;

- issues relating to provision of water supply enterprises with office equipment, transport, modern water accounting an communication facilities and equipment. As a rule, their internal means are very poor and do not enable most of them to solve these problems;

- early transition of water organizations to self-repayment. In a number of cases, this leads to subsequent weakening of their MTB, worsening of technical condition of irrigation network within jurisdiction, and drain of water specialists;

- issues relating to establishing and governmental support to WUAs at the initial stage, absence of which reduces the efficiency of these advanced IWRM institutions;

- organizing water use monitoring, including public one. According to the available data, the governmental monitoring of water use does not satisfy IWRM requirements, and the public one does not practically works;

- issues relating to training, retraining and placing water specialists. Supply of specialists is relatively high in Uzbekistan. In all the project countries, drain of highly skilled specialists from the sector is occurring as a result of low wages;

- providing priority to environmental activities, one of the key IWRM elements. Based on the results of sociological survey carried out among the persons interested in applying IWRM in CAB, this requirement has been put in the first place;

- issues of coordination between the national economy sectors – the main water users. For instance, in Tashkent province, surface waters including collector-drainage waters (CDW) are under the jurisdiction of water agencies; groundwater quantity and quality management are subject to geology and mineral resources agencies; water supply and sewerage for settlements are subject to local administrations; water supply and sewage disposal from industrial and construction enterprises are subject to agencies of respective sectors; water quality monitoring are subject to environmental agencies; and microbiological control over water quality are under the jurisdiction of sanitary inspection agencies;

- raising competitiveness of agrarian sector;

- problems of proving population with safe drinking water (Kazakhstan, Uzbekistan);

- defect of regulatory legal basis for running water sector and poor control over observing water legislation by economic units;

- providing equal allocation of water limits along irrigation system in order with a view to preventing conflict situations;

- providing regular inter-agency exchange of information (on hydrology, hydro meteorology, etc.), with a view to effective water resources management;

- issues relating to payment for water supply services and sanctions to over-limit water intake;

- low level of public involvement in IWRM process;

- poor legal basis for public participation in IWRM.

Public participation in IWRM CAB can be ensured by using departments of water agencies in the project area (NPE "Yugvodkhoz" in Kazakhstan – Keles branch, CABAIS in Uzbekistan, Jalalabad BWA in Kyrgyzstan), as well as by establishing as follow:

- working groups (WG) on special problems to ensure IWRM in CAB;

- WGs of specialists from water and adjacent sectors to solve specific problems arising in competitive water uses between economic sectors in CAB;

- WGs with extended membership for developing long-term water management plans,

and by:

- establishing extension services (for training and practical experience exchange);

- organizing trainings and roundtables (advanced training personnel, etc.);

- involving experts to assess problem situation;

- establishing groups of representatives from non-governmental non-profit organizations with respective orientation;

- mass media, and in other acceptable forms with a view to successful introduction of IWRM in CAB;

- using experience and potential of international organizations in water management.

In CAB, water sector development problems should be solved in accordance with the main objectives and directions of national development in the Rivertwin Project countries.

The project countries can set national goals in their parts in CAB in regard to diverse development scenarios depending on priorities, political aspirations and economic capabilities. However, to exclude conflict situations in future, it is expedient to agree such plans with basin partners in that part, which may have a transboundary impact.

When problems of the present and future water resources allocation exist in the region, they are not so topical in the project area. At the same time, the existing restrictions on requirements for water intake from transboundary rivers and river flow regulation by waterworks of interstate significance from the position of observing environmental needs and downstream countries, even indirectly, relate to water resources management in CAB. Thus, ecological restrictions assume ensuring:

- sanitary flows over river channels for different water years;

- environmental flows into river deltas (lake systems, etc.);

- requirements for water of household-ecological systems along river channels;

- flows into irrigation systems for household and drinking needs.

In particular, the Rivertwin Project can substantially help to identify volumes of sanitary flows for rivers and irrigation systems in CAB. At that, according to specialists of SIC ICWC, one of the requirements to sanitary flow volume should be to provide its volume, and in case that river flow is absent, this volume should be supplied to river system in addition (and not owing to water intake limit). This is especially topical for the basin of Akhangaran river that dries up in low water years. As for environmental flows, they should not be included in water intake limits, but be identified according to agreement between the interested parties. Environmental and sanitary flows into irrigation network for drinking water supply should be included in water intake limits and be constant regardless of water availability in year.

It seems that in order to achieve long-term objectives of IWRM in CAB, the Rivertwin Project countries should be based on the following provisions:

- river basin or irrigation system is regarded as a single object, water management and protection is built on basin principle;

- water supply systems are orientated to application of modern water treatment technologies and integrated water resources management;

- reducing water losses and water accounting at all water use stages;

- when there is possibility to privatize parts of water resources scheme, state ownership to waters and large water facilities remains;

- participation of water users in recovery of waterworks operation and maintenance costs is provided as a basis for sustainable development of water sector;

- obligatory payment for water supply services;

- intruding differentiated tariffs for water supply services;

- seniority of household-drinking water supply and environmental flows;

- seniority of investments in reconstruction of waterworks facilities;

- governmental support for rehabilitation and construction of large facilities;

- establishing water use limits taking environmental rights to water into account;

- transparency of decisions on water resources management for all stakeholders;

- introducing market mechanisms for natural resources use;

- removing parallelism in functions of different water management agencies;

- ensuring coordination between activities of agencies relating to water resources management;

- developing effective tools for risk management in water use at all water management levels (interstate, national, basin, local).

Solving the mentioned problems and carrying out the listed measures will enable to considerably approach achieving the three main objectives in the long term as a process of transition to integrated (hydro ecological) water and other natural resources management in Chirchik-Akhangaran basin:

In future, the state of water resources scheme in CAB and effectiveness of its functioning will to a considerable degree depend on introducing IWRM principles.

The agriculture as a whole (in particular irrigated farming) will remain in the long term as one of the most important national economic sectors in all the Rivertwin Project countries (Kazakhstan, Kyrgyzstan, Uzbekistan). It will be one of the main sources of exchange earnings, make significant contribution to the national GDP, play a key role in providing employment of the most part of population forward.

The most efforts should be directed to achieving the main objective – to transit to hydro ecological management in CAB to achieve sustainable socio-economic development in the river basin. The implementation of the project may facilitate specifying parameters of such transition, and correcting official plans for development in CAB in many respects. At that, the orientation to IWRM CAB that raises water resources management sustainability should be recognized as an only right one.