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Water and food security in Central Asia

In Central Asia, since earliest times, a human being learned the art of efficient water use. He used it not only as a means of life-support but also as a natural defender of towns and settlements. He used it as his ally to turn arid steppes and deserts into flourishing oases. Water, in turn, was the great teacher for a man-farmer, whose patience and diligence allowed him to change this region. The amazing unity of a human being and nature based on use of water was formed here.

Over all historical epoches the fight for water was the struggle for surviving; and at that time water was the basis for developing the civilization in this region. It is no coincidence that the need in water resources management has stimulated the development of studies of earth and sky, as well as fundamental mathematics. The names of those who have enriched science such as Al-Fargoni, Al-Khorezmi, Imam Al-Bukhari, Al-Beruni, Ulugbek, Ibn Sino (Avicenna) and many others are well-known all over the world.

Central Asia is the vast region that is represented by the combination of densely populated oases located mainly along upper and middle reaches of two great rivers and their tributaries, as well as by present and former irrigation areas in their lower reaches and deltas with the deserts surrounding them, which often swap places due to natural processes that change directions of streams or destructive activity of a human being.

Most of Central Asia is under arid conditions. Scant precipitation (less than 350-400 mm a year), extremely low humidity (in summer 22-40 %), high evaporation rates (maximum 1700 tn/year), abundant solar radiation are major features of climate in this region covering an area of more than 300 million hectares.

The history of water resources management in Central Asia, one of ancient regions on our planet where there were the origins of humanity, is of interest now not only from the point of view of understanding a role of water but also for providing the progress in the water-consuming sectors and social development. From time immemorial, water and irrigation were always important factors for the progress, developing of culture and sciences, and co-operation of people inhabiting Central Asia. Water resources management always required strict implementing some written or unwritten principles of mutual respect that were often anchored in traditions, rules and customs, as well as in minds of people who had to appreciate, protect and adore water and everything related to water. According to all local traditions and especially in line with the spirit and moral base of ancient relations between peoples created thanks to original religions and later by Muslim religion, water was never a source of profit; water was and must be in the future the basis for survival and even well-being of humanity.

In Turkestan, since the dawn of time, peoples considered farming as one of the most honourable occupations. The Muslim religious doctrine states that this occupation has divine origins: the first plough was made of a paradisal tree "*tuta*" by the Archangel Gabriel who made a few first furrows and then handed over this plough to Adam. The Shariah calls farmers who themselves cultivate the land as "*ashraf-ul-ashraf*" ("the noblest among the nobles")!

Information collected all over the world by the outstanding Soviet scientist Nikolay Vavilov and his pupils allowed them to make conclusion that the major ancient centers of farming have mainly arisen in arid and tropical zones as shown in Figure 1. Central Asia was indicated as one of six most important areas. Developing these areas is characterized by time shifts and differences in the origin of domesticated plants. B.V. Adrianov wrote that the south-western area of agriculture, which dates from 7,000 to 6,000 years BC, is the most ancient agricultural lands in

Middle East and Central Asia. Numerous cultivars (wheat, rye, cucumber, carrot and cotton) were bred here. Many scientists pointed the same periods of developing the ancient civilization centers in Asia Minor, Mesopotamia, Central Asia and Mediterranean Region.

Sustainable food security of states and region at whole depends from big quality of factors that should reflect principal line – long-term balance between food demand and food availability that need to achieve on the each from stage of future development . Let's look on these two sides of problem (fig. 2).

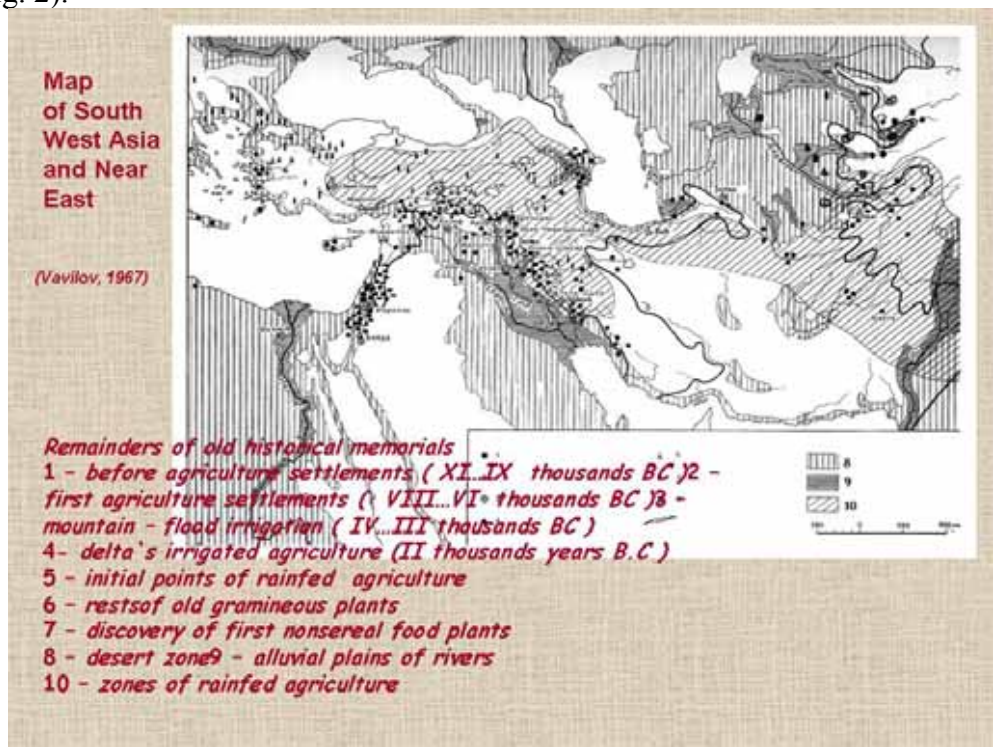

Fig. 1

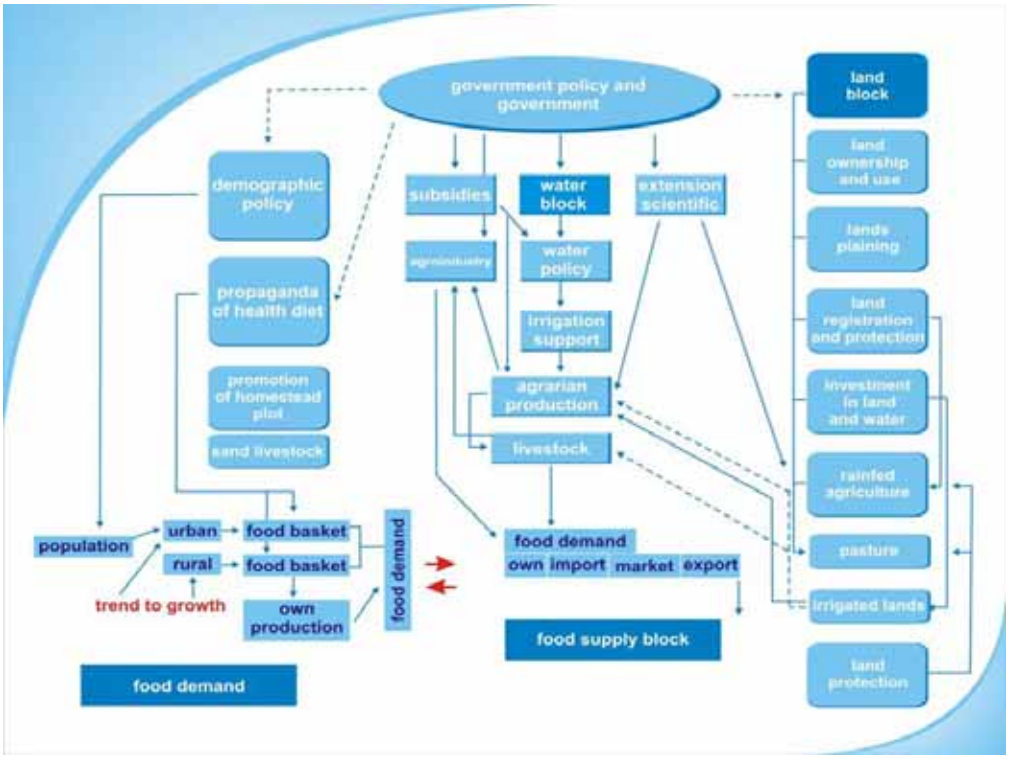

Fig. 2

What we have on the side of demand?
Principal factors:

- growth of population – separately urban and rural – depends from demographic policy of government, their care about creation working places, degree of employment on the rural area;
- food basket – again separately for urban and rural area that follow up to traditions, customs, state propaganda of health diet;
- degree of self sufficient of population that depends from promotion by state and local authorities homestead plots (somewhere it very limited no more 0,06 ha – denspopulated area in Kyrgyzstan, Tajikistan, Uzbekistan, somewhere – big promotion as in Turkmenistan (up to 0,5 ha per family), organizing of special garden plots for urban population outside from cities; permition and ability to keep livestock, sheep, goats, chicken and so.

Side of food availability also depends from government policy especially oriented on the principal blocks: lands, water and investment.
Land block include land ownership, rent and property; size of farms (from 0,4-2 ha in Kyrgyzstan; 5-30 ha in Kazakhstan and Tajikistan; 3-150 ha in Uzbekistan and very broad range in Turkmenistan) forms of cooperation; planning of crop pattern (strict states regulation in Tajikistan, Turkmenistan and Uzbekistan and free for two other), system of land registration and its ability to changes and selling (or transfer in subarendy), protection of lands and pasture; state organizing (or support) of extension service and agrarian education.
Water block include water policy, support and development irrigation, allocation responsibilities between government and public – private sector (WUAs) for water supply and operation of irrigation networks; watersaving; support and attention to water stability; support and responsibility for reclamative works and so.
Investment block includes subsides, tax for lands; payment for water; sponsorship of WMOs and partly reclamation of lands, donors involvement and privilege for promotion of effective use of water and lands.
How these factors look now?
In Soviet time rate of growth population achieved 3,6 % 1980, reduced to 2,8 % in 1990, later to 1,8 % in 2000. Last time tendency has increase in Turkmenistan, but remain low in all other states.
Nevertheless to 2030 different scenarios expect by quantity of population from 55 to 70 mln. persons.
Real rate of growth population accordance to National report are next:

Table 1

Dynamic of population

CA Countries	Population growth rate, in % to previous years						Avg., %	Fact, thsd.	Forecast, thsd.
	1999	2002	2003	2004	2005	2006		2006	2030
Kazakhstan	101.9	101.5	101.7	101.6	101.9	101.9	101.8	2,956.6	4,536.7
Kyrgyz Republic	101.8	101.3	101.4	101.4	101.3	101.2	101.4	2,943.6	4,109.5
Tajikistan	100.6	102.0	101.3	102.3	101.2	103.9	101.9	7,063.8	11,097.3
Turkmenistan	104.1	103.4	103.3	103.2	103.1	103.0	103.4	6,043.0	13,481.7
Uzbekistan	101.1	101.3	100.8	101.2	101.1	101.3	101.1	26,664.2	34,670.2

These data will give in scenarios BAU to 2030 total quantity of population – 34,67 mln. persons.
Specific feature that discovered in last 5-7 years is big temporary migration by so called "quest workers". Most part of such type of migrants is working in Kazakhstan, Russia. By quantity of such migrants first place belong to Tajikistan, where their quantity by different assessment deviate from 0,5 upto 0,8 mln. people or almost 30 % of workable population.
Uzbekistan has approximately same size by assessment of different agency, but it takes only 5-8 % labor state potential. Many same type migrants in Kyrgyzstan, but assessment on the level of government and province not achievable. Such migration created two positive features for food security: reducing requirement of state in foodstuff and increase financial capacity of population, that in Tajikistan has big importance take in account that transfer money from such category of population achieved in 2006 before financial crisis close to 25 % GNP[1].
Tajikistan by investigation of Matteo Fumagalli "The food – Energy – waters' Nexus in Central Asia", Eucom Policy brief, No 2, October 2008 (Center for European Policy studies) has worse situation in region, 1,68 mln. rural population has lack of food (34 %) from which sharp lack has feeling 11 % - 540 thousand persons. Situation in urban area same – here 500 th/ persons has lack of food (33 %) from which 15 % - 200 thousand has sharp deficit. This crisis is more crisis of financial capacity of population and fisical deficit of food. From all Central Asia states only Tajikistan has big differences production and consumption of grain, oils, meat and so. Need to underline that European Union through "Mechanizm of collaboration" contribute to Central Asia in 2007 – 2010 314 mln. EU from which 66 mln. to Tajikistan.
Selfsufficient of rural population by food has big importance take in account that average portion of rural component approached to 60 %. By the survey of Dr. Stulina G.V. ("Gender aspects of IWRM in Central Asia and Caucasian", Tashkent, 2005, GWP, 146 pages) portion food input of private home plots ("tamarka", "melek") is 50 % in Kazakhstan and Kyrgyzstan, 42,3 % in Turkmenistan, 36 % in Uzbekistan and 22,6 % in Tajikistan.
Food basket needed for local population. Below we introduced two tables # 2 and 3. First one discovered dynamic of nutrition per capita principal foods and comparison with data survey of Russian economist in end of 19 Century Senator Palen for rich family that indicated interesting feature in region.

Table 2

Average level food consumption in Central Asia (kG/person/year)

Food	1918	1935	1960	1980	Rich people, report Senator Palen	Gender survey 2005
Meat	8	13	18	26	32	12
Milk	56	43	110	160	105	130
Grain	190	290	280	240	208	46
Fruits	32	34	36	59	60	180
Vegetables	45	75	90	102	58	105

The western approach that tried to adopt to Central Asia conditions "food basket" with big prevalence of livestock deities is in big difference from traditional.

[1] Situation in 2008 became more difficult as result of growth of price on cabbage 281 %, bread 100 %, meat 106 % (USAID Global food insecurity, No 2, 21 May 2008)

Table gave comparison norm of foodstuffs for accepted in Soviet time basket and local consumptions of most satisfacted part of Uzbekistan with quantity of calories close to 2800 ccal/person/day. This basket is most watersaving.
So propaganda of such type diet has big importance from point of view health population, watersaving and economic for state.

Table 3

Which food basket we need?

Product	Norm per capita	Production		Consumption	
		1990	2003	1990	2003
Bread and bakery	130	92,6	238	170,0	198,0
Meat and meat foods	60	23,6	21,9	32,0	32,3
Milk and dairy products	270	147,9	157,1	210,0	161,0
Vegetables and melons	45,0	138,6	127	107,0	137,0
Potato	76,0	16,4	33,0	29,0	35,0
Grapes, berries, fruits	35,0	68,5	45,6	23,0	44,0
Sugar	14,5	n.a.	9,7	24	n.a.
Vegetable oil		n.a.	8,5	12,6	9,8
Fish		n.a.	0,2	4,9	n.a.
Eggs		120	64,0	120	61,0

Provision of population with foodstuff, kg/person/year

What is our capacity to cover requirement of population?
Principal scource of growing food production is development of irrigation.

- Thus, due to internal and external causes, irrigated agriculture that from time immemorial was the priority of socio-economic development and continues to be the basis for generating livelihood and employment (up to 70% of rural population) has lost, to a considerable degree, its great and obvious economic profitability. A substantial factor was a drop of world prices on agricultural output: rice - 2 times (from 300 up to 150 USD/tonne); wheat – 1.5 times (from 200 up to 120 USD/tonne); and cotton fiber – more than 2 times. Such an economic situation has resulted in inability of farmers to support the water sector (under their incomes of 100-200 USD/ha instead of 500-1600 USD/ha in the past). At the same time, the social significance of irrigated agriculture that together with related sectors provides the employment for 40% of population, mainly rural population, remains topical; and any irregularities in sustainable irrigation water supply caused by deviations from the coordinated schedules of water delivery result in huge social damage (on the verge of catastrophe). Therefore, under current conditions, not only the lack of guarantees for implementing the established procedure of water-sharing by riparian countries, but also the water releases' regime that is artificially imposed and unacceptable for the most stakeholders along with overestimated prices of hydropower production (up to 8.5 cent/kWh) make the existing "order" of water-and-energy exchange of hardly probable.
- Weakening of economy in these countries, and considerable drop in national income per capita in all

regional countries have resulted in drastic decrease in subsidizing and support of the agriculture and water sector and also in procurement of agricultural machinery, fertilizers and other chemicals and in deteriorating conditions of water infrastructure, especially at the on-farm level. As a result, water supplies and land conditions have become drastically worse, affecting the productivity of various crops.

- Introduction of market mechanisms into the agricultural sector (privatization, restructuring large state farms and collective farms into hundreds and even thousands of small private farms) was not accompanied with creating appropriate infrastructure of commodity production and water infrastructure necessary for water distribution and use. As a result, a lot of problems have arisen in servicing new private farmers (consultations, training, and knowledge dissemination) and in procuring agricultural inputs.

Decrease in overall incomes in the irrigated agriculture sector over the whole region (almost two times) and in the profitability (a few times) has resulted in impoverishment of the rural population, and, at the same time, in the inability of agricultural producers themselves to protect their interests like producers of hydropower or fuel that now act at the free market. In 1980, land profitability amounted to 2000 USD/ha, on average over Central Asia, against about 700 USD/ha currently!

As result for independence period (table 4) dynamic of irrigated lands some negative in Kazakhstan and Uzbekistan (especially in Karakalpakstan where actually irrigated area decreased on the 160 th/ha), stable in Kyrgyzstan and Tajikistan, growing in Turkmenistan. But future availability to increase cultivated area limited by lack of good lands in some area, common scarcity of water and very big net cost of new irrigated construction and development. From this point main attention should be done to huge capacity that we have in increase yields and productivity. Let's look on the ability to cut lack between actual and potential productivity of lands.

Table 4

Dynamics of irrigated area, thsd.ha

CA Countries	1980	1990	2000	2005	2008
Kazakhstan	696	752	769.7	714.3	716
Kyrgyz Republic	422.8	418.5	429.2	410.9	407.6
Tajikistan	670.6	750.5	749.9	763.1	798.9
Turkmenistan	1,080	1,523.3	2,045.7	2,141.8	2,179
Uzbekistan	3,688.1	4,314.7	4,439.2	4,403.9	4,391.8

Our approach to achievement of potential productivity based on the assessment of biological yield that hasn't any limitation in soil, moisture and climatic conditions and characterized only by variety of crop.

Potential yield (PY) is the maximum yield that can be achieved in present location with proper limitation of climatic conditions and deviation of whether.

Actual Available Yield (AAY) depends from quality of soil, structure, condition of drainage salinity.

Next level definited by degree of land cultivation, fertilize and so possible farm yield (PFY).

Last level – real yield (RY) – characterized by organizing and management degree of performance in farm.

You can see that deference between АУ and РУ – in 2-2,5 time (table 5).

Table 5

Crop productivity levels (t/ha) in Tashkent province

Crop	PY	AAY	PFY	RY
Raw cotton	5.8	4.5	3.6	2.3
Cereals	8.8	6.8	5	3.9

Corn	11	8.6	7	3.5
Rice	9.3	7.2	5.9	3.9
Potato	42	33.7	25.2	18.6
Vegetables	39	39.4	26.3	21.9
Cucurbits	45.7	35.4	27.5	16.7
Fruits	31.5	20.8	11.7	4.7
Grapes	34.5	23	12.3	5.5
Forage roots	53	42.5	35	28.9
Kenaf	34	27	22.5	15.5
Perennial grass of past years (hay)	26.5	21.8	16.3	10.4
Perennial grass of past years (green forage)	60	52.5	39.1	27.3
Maize (silage and green forage)	58	45.3	34.8	24.3
Perennial grass of current year (green forage)	42	35.5	27.9	17.5
Perennial grass of current year (hay)	13.8	10.9	8.8	5.5
Annual grass	31.7	26	20.4	13

Real growth of yield in all states (fig. 3, 4, 5, 6, 7) went up most significally in Uzbekistan (for example wheat – in twice, corn – in 1,5 time, rice 30 %), but this tendency has similar character all states, beside Kyrgyzstan, where yield deviated and even went down (except corn). But level of yield has big potential for growth, especially corn, fruits, rice and wheat.
As result food balance in all states has next picture:

Table 6

	Grain th.th		Oils		Vegetables		Meat		Total product	
	Product	consump.	Product	consump.	Product	consump.	Product	consump.	export	import
Kazakhstan	15446	10644	88	183	2254	2269	673	737	692,7	933,5
Kyrgyzstan	1707	1858	29	40	1240	1236	198	201	113,3	102,4
Tajikistan	661	1028	30	55	379	381	36	55	204,1	110,5
Turkmenistan	2295	2340	29	52	140	141	193	200	86,4	99,4
Uzbekistan	5147	5607	289	303	783	788	518	527	834,7	166,4

So, except Tajikistan all states almost satisfacted by grain, Kazakhstan has big export (4 vln. th), all countries satisfacted by vegetables, milk and almost meat, but all have deficit in oil, sugar.

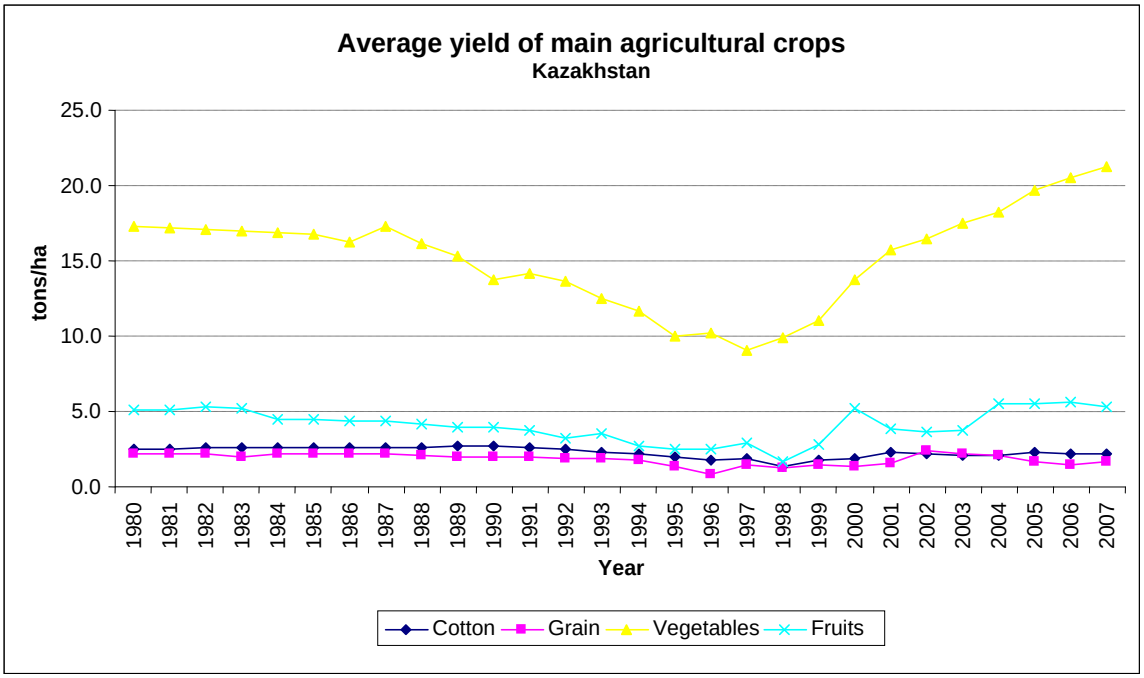
Average yield of main agricultural crops
Kazakhstan
25.0
20.0
15.0
10.0
5.0
0.0
tons/ha
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Year
Cotton
Grain
Vegetables
Fruits

Fig. 3

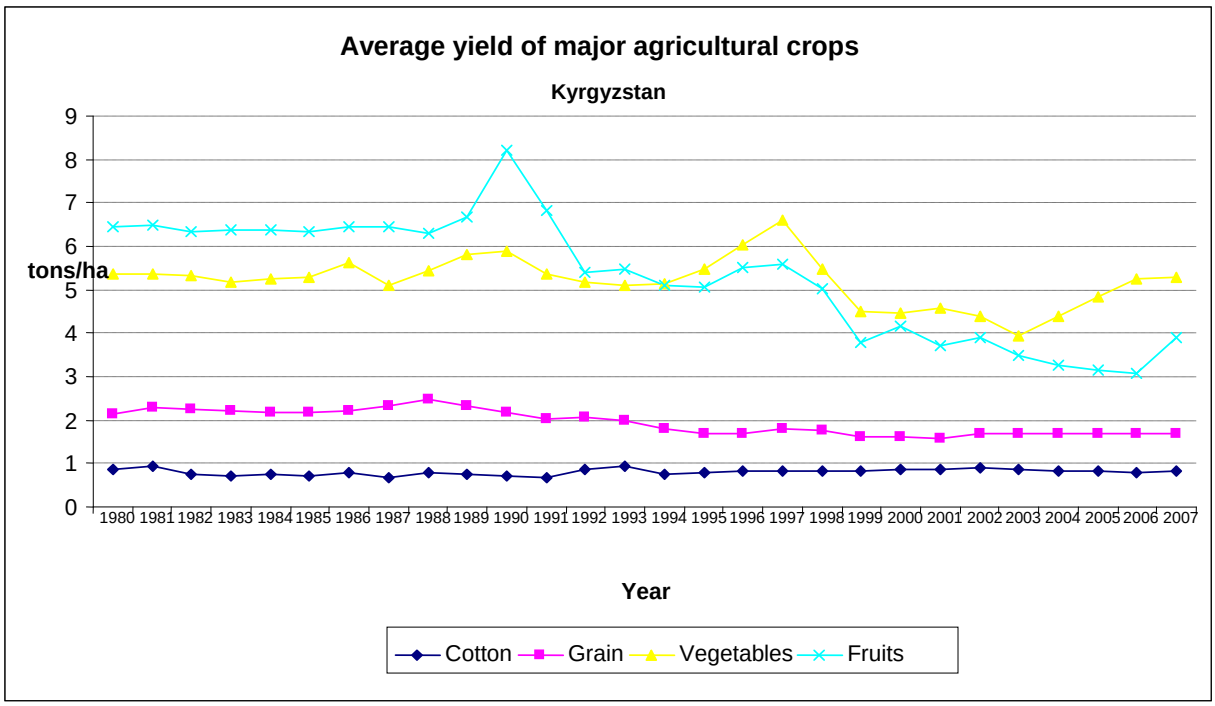
Average yield of major agricultural crops
Kyrgyzstan
9
8
7
6
5
4
3
2
1
0
tons/ha
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Year
Cotton
Grain
Vegetables
Fruits

Fig. 4

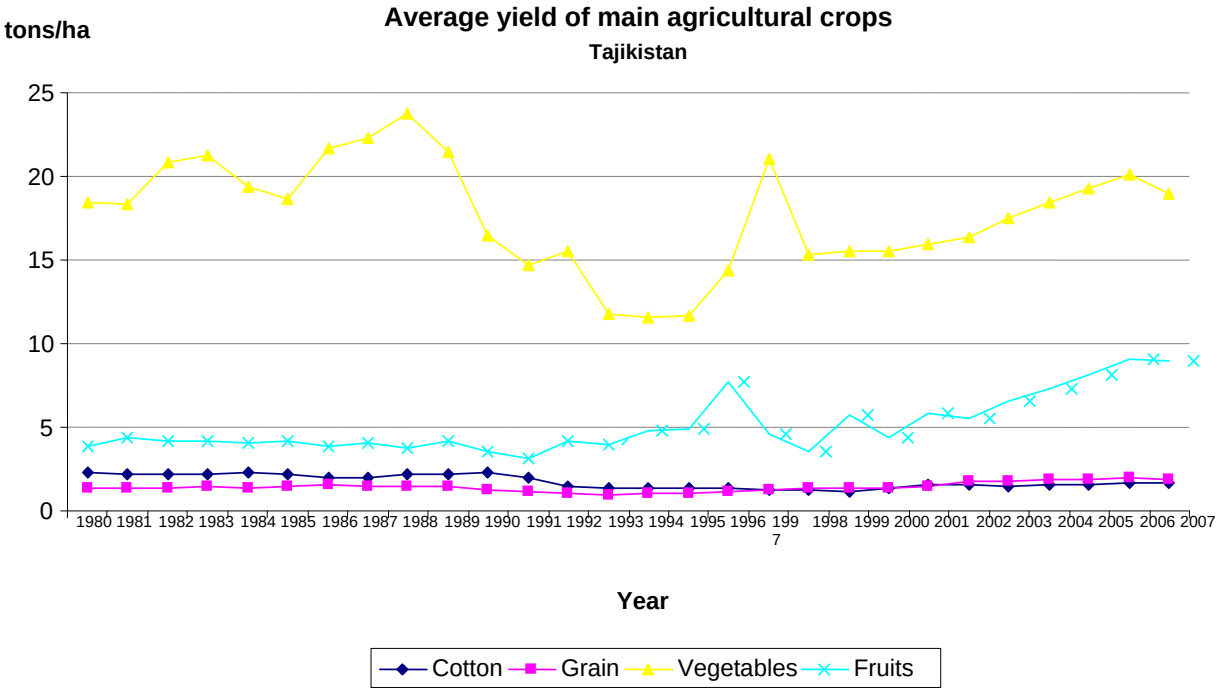
Average yield of main agricultural crops
Tajikistan
tons/ha
25
20
15
10
5
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 199 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
7
Year
Cotton
Grain
Vegetables
Fruits

Fig. 5

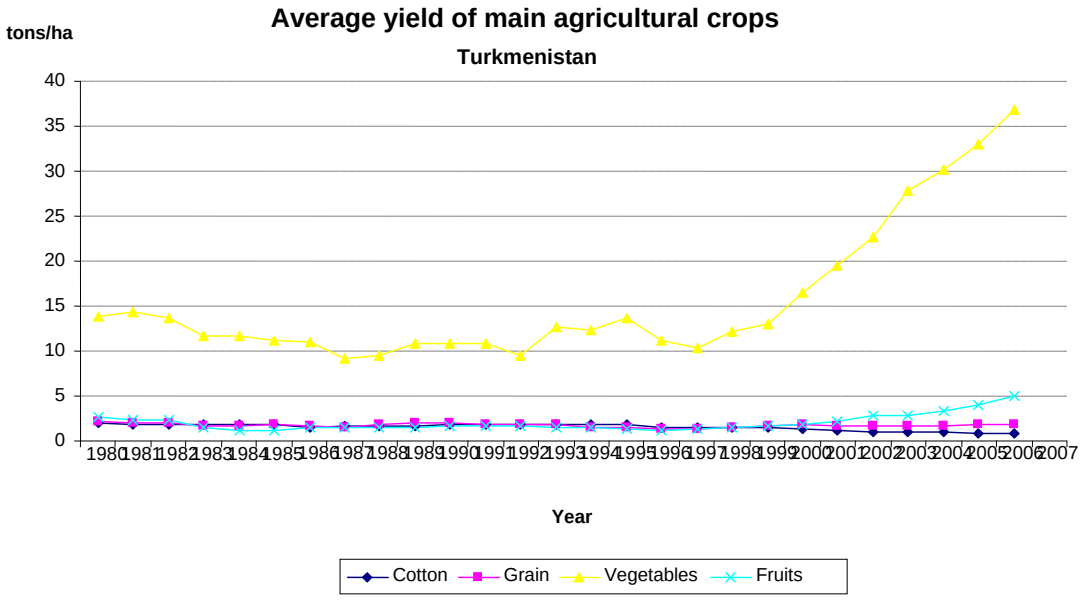
Average yield of main agricultural crops
Turkmenistan
tons/ha
40
35
30
25
20
15
10
5
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Year
Cotton
Grain
Vegetables
Fruits

Fig. 6

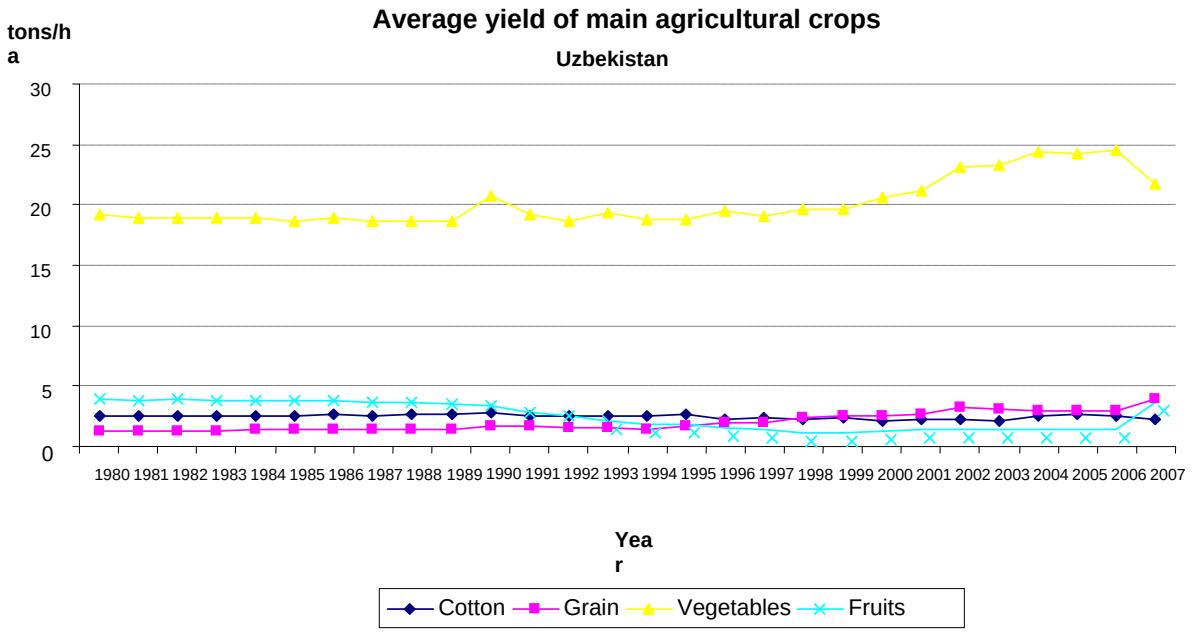

Fig. 7

So now let look ahead – what we can expect in future? Our challenges:

- climate changes – has two principal consequences: all scenarios predicted growth of temperature and simultaneously – growth of water consumption at leas 10-15 %.
  Most important consequences of climate changes are that evenness of extreme situation increased.
  The frequency of the wet and dry years probability 25 % and 75 % and extreme years (10 and 90 %) has increased 1,4 and 2 times accordingly. Moreover – for last 19 years we have same quantity of floods and droughts as for previous 30 years!!!
  So, as result – the role of multiyear regulation and water saving measures grew significantly.
  But in reality region demonstrated refusing from common interests in multiyear regulation and creation of problem for irrigation as result of growing energy hydroegoizm. Example – situation in Syrdarya river with Toktogul reservoir.

Order of work hydropower Naryn complex

The reservoir started to operate stably according to the project operational regime, providing the accumulation of water in winter and appropriate increase in water releases in summer. Over the period of 1982 to 1990, an average volume of water releases during the winter period (since October until March) amounted to 3 billion m^3 against 8.1 billion m^3 of summer water releases (Figure 8). At the same time, inflow into the reservoir made up 2.7 billion m^3 in the dormant season and 9.3 billion m^3 in the growing season respectively.

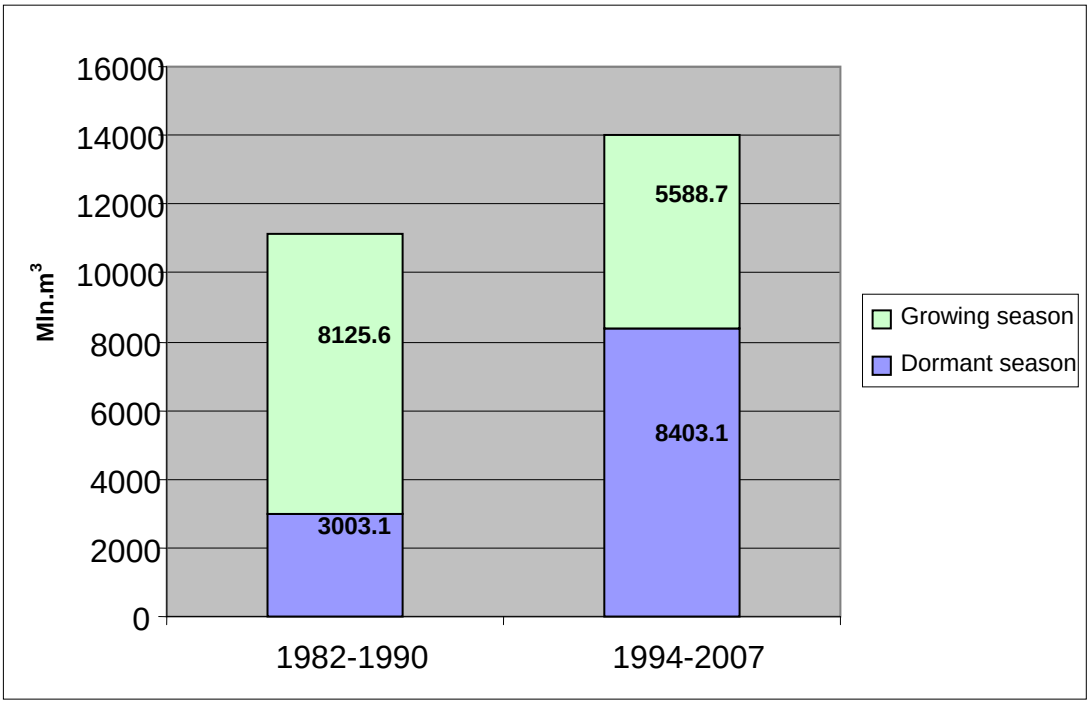

Figure 8. Average volumes of water releases from the Toktogul Reservoir over the periods of 1982 to 1990 and 1994 to 2007

Owing to such a operational regime, the Toktogul Reservoir was filled with water up to the design volume by 1988, allowing to provide the over-year regulation of river flow and accumulating 13-17 billion m^3 of water by the beginning of growing seasons.

This situation has started to change since 1992 when step-by-step shift from the established operational regime of the Naryn-Syr Darya Reservoirs Cascade and gradual increase in accumulating water in the summer period with considerable increase in winter water releases was being observed.

Since 1990, a steady raising of the rate of winter water releases takes place, infringing upon interests of irrigated farming and other water consumers including ecosystems (Figure 9).

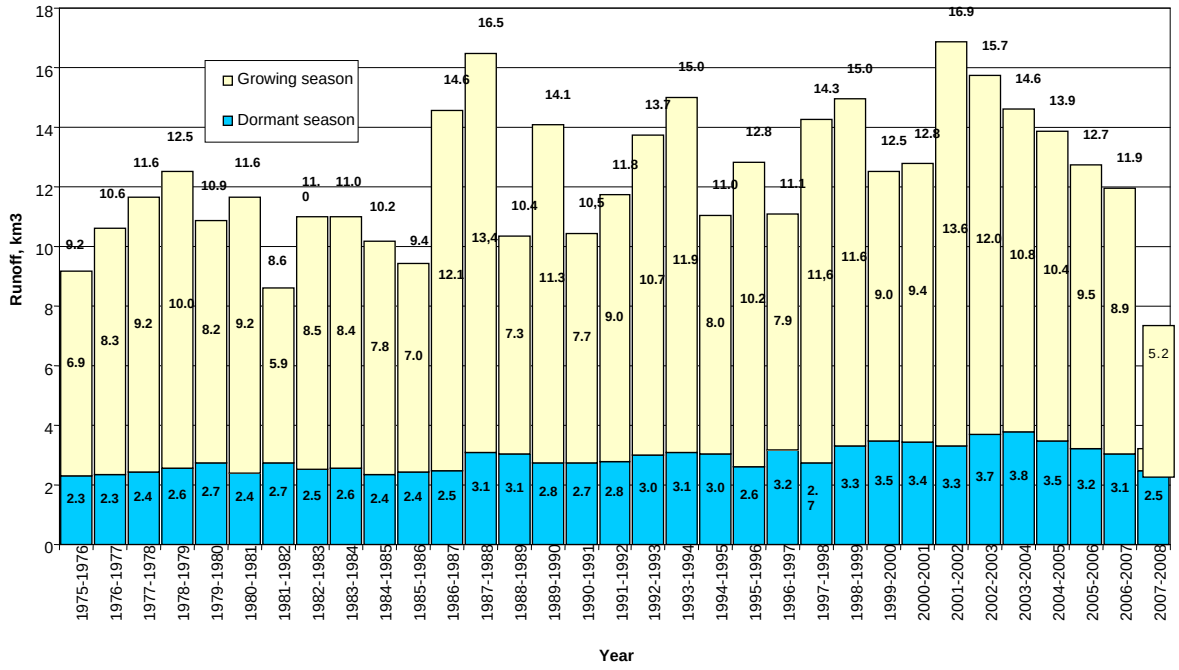

Figure 9. Inflow into the Toktogul Reservoir over the period of 1975 to 2008

Since 1994, this tendency has turned into principles of management, and as a result, the reservoir was being operated according to regime necessary for energy production with abrupt reducing the volumes of water releases for irrigation. Volumes of winter water releases have increased up to the extreme amount of 9.7 billion m^3 during the autumn-winter period of 2007-2008, and volumes of summer water releases has reduced up to 3.6 billion m^3 during the summer periods in dry 2001 and 2002 years.

Figure 10 clearly shows that over the period of 1981 to 1991, operation of the Toktogul Reservoir according to the design regime of accumulating water for the purpose of over-year regulation (especially accumulating of water in the period of 1986 to 1988 with abundant water inflows) has facilitated almost smooth overcoming of consequences of droughts.

It is necessary to note that in spite of relatively low water availability over the period of 1988 to 2002, it became possible, thanks to the well coordinated work of water organizations in the region and the BWO "Syr Darya", to avoid reduction of water supplies to the irrigated farming sector and infringing interests of all water users even in dry years (2000 and 2001), when the level of water availability in the lower reaches of the basin has dropped up to 50%. However, the following period of wet years (2002 to 2006) was not used for accumulating water resources as envisaged by the Operational Rules for the Naryn-Syr Darya Reservoirs Cascade. As a result, droughts in 2007 and 2008 have created the catastrophic situation with water availability in the Syr Darya River Basin since prior to starting the growing season, drawdown of water in the Toktogul Reservoir has practically reached the dead storage level.

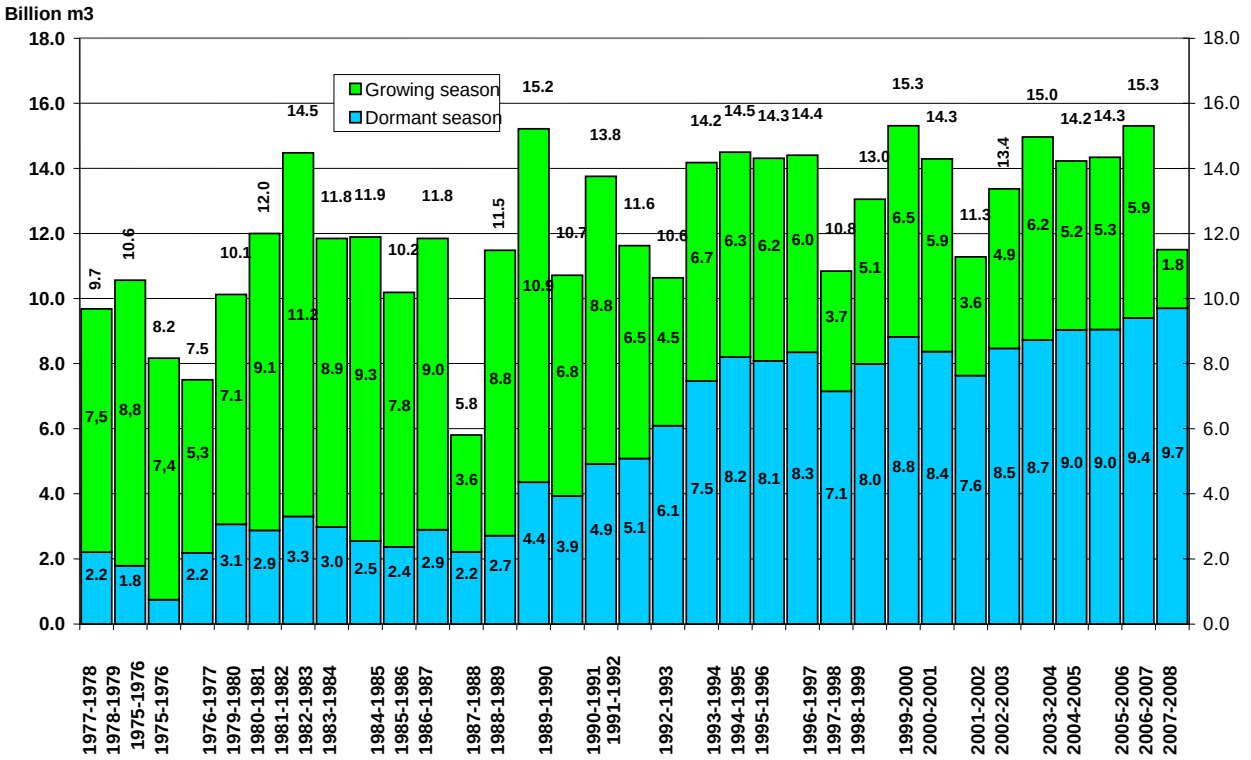

Figure 10. Water releases from the Toktogul Reservoir

Retreat from the key requirement of operational rules the Toktogul Reservoir (shift from over-year regulation towards seasonal regulation for the benefit of energy production led that the reservoir is filled by the beginning of the autumn-winter season and is emptied by the beginning of the growing season).
Such regime had two consequences – lack of irrigation water availability in summer and artificial flood at winter multiyear regulation in water reservoirs under actions of hydropower hydroegoism was destroyed and in 2007-2008 didn't assist in water availability.
Moreover – if natural water availability was in 2008 on the level 75 %, real water availability in Syrdarya deviated from 62 up to 75 %!

Table 7

Water availability in Syrdarya 2008 Summer

Water natural availability of mean long-term norm, %	**April**	**May**	**June**	**July**	**August**	**Sept.**
	77	86	65	55	76	70
Delivery, %						
Kazakhstan	150	147	86	44	58	178
Kyrgyzstan	105	64	57	60	67	81
Tajikistan	34	59	69	74	85	81
Uzbekistan	120	76	60	58	72	105

So, reason of this very clear commercialization of hydropower, growth of energy price caused growth of winter power release to opposite to irrigation requirement.
As result additional benefit in energy in 30 mln. % caused additional losses in irrigation 120 mln. USD.

In recent years, one more factor of disorganization has arisen: the practice of managing the Naryn Hydropower Stations Cascade by the organization "Kyrgyzenergo." In the guise of the need in daily regulation of energy production, in night-time after 6 p.m. this organization sharply decreases the volume of water releases from the last unit of the cascade (the Uchkurgan Hydropower Station) into the riverbed at the entrance to the Fergana Valley, although this type of daily regulation could be implemented at sites of upstream hydropower stations of this cascade.

Already in 2005, the international experts have noted inadmissible fluctuation of water levels in the upstream pool of the Uchkurgan Hydroscheme caused by daily fluctuations in water releases with amplitude of flow rates ± 200 m^3/sec according to the energy consumption schedule at the Uchkurgan Hydropower Station. Last year, this phenomenon had a catastrophic scale, since everyday in night-time the river flow was completely blocked, and at that, Kyrgyz managers make reference to lack of the need in electric energy in the night hours. Such an operational regime of the Naryn Hydropower Stations Cascade considerably troubles water diversion into the systems of Big Fergana Canal and Northern Fergana Canal that supply water for irrigation of agricultural lands in the Fergana Valley. A water level in the river varies from 0.5 to 2.5 m during 1 to 3 hours (Figure 11), resulting in lowering the extent of water supply sustainability through irrigation canals and in infringing the design regulations developed for operating the hydraulic structures.

Everyday, over an area of 350,000 ha in the Fergana Valley, farmers and other water users should overcome the consequences of poorly-regulated water supply, resulting in drastic reducing of water use in the efficient manner!!!

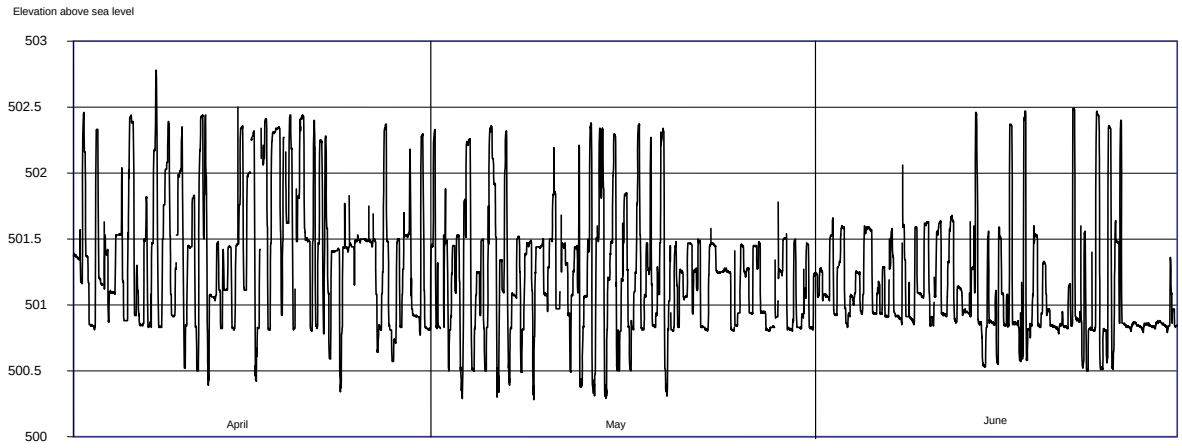

Figure 11. Water level fluctuations in the Naryn River downstream from HPS cascade, since the beginning of the growing season in 2008

It should be noted that such an uncertainty plays against water supply for food production guaranteed in accordance with Article 11 of the International Covenant on Economic, Social and Cultural Rights and the follow-up comments of the Committee on Economic, Social and Cultural Rights (Comment 15) (13). In principle, the approach with energy supply in winter in exchange for additional water releases in summer can be employed; however, it is necessary to exclude discussing of prices on electric energy generated and supplied in summer and their linking to the prices of fuel. Electric energy generated in summer in excess of demands of Kyrgyzstan and for the benefit of irrigation should be compensated for in winter by also electric energy rather than natural gas or coal; at that, its price has to be identical, although, in principle, summer electric energy has undoubtedly the lesser price at the Central Asian market as a less scarce resource. In this case, all speculative approaches will be excluded.

Now – how we can combat future food security?

We are looking on some principal directions:

1. Development of IWRM

2. Establishment of strong state policy oriented on the food security.
3. Increase water rights for irrigated agriculture on all level of water hierarchy.
4. Strengthening collaboration between states for establishment guarantee regime of water delivery.

The implementation of IWRM in Central Asia was started in 2002.

IWRM is based on the following key principles that define its practical backbone:

- Water resources management is implemented within the hydrological units in concordance with geomorphology of the drainage basin under consideration;
- Management takes into consideration assessment and use of all kinds of water resources (surface water, ground water, and return water) and the climatic features of the regions;
- Close co-ordination of all kinds of water uses and organizations involved into water resources management, including cross-sectoral (horizontal) co-ordination and co-ordination of hierarchical levels of water governance (basin, sub-basin, irrigation system, WUA, and farm as the end user);
- Public participation not only in the water management process, but also in financing, planning, maintaining and developing water infrastructure;
- Setting the priorities of ecosystems' water requirements into the practice of water management organization;
- Participation of water management organizations and water users in activity related to water saving and control of unproductive water losses; water demand control along with resources management;
- Information exchange, openness and transparency of the water resources management system; and
- Economic and financial sustainability of water management organizations;

The IWRM conception was coordinated and approved by all water authorities in Uzbekistan, Kyrgyzstan, and Tajikistan in May 2003.

A comprehensive approach for social mobilization was developed along with preparing a training program for social mobilization and capacity building at the levels of WUAs and an irrigation canal. Regular training seminars and sociological surveys conducted in the frame of the project provide new opportunities for involving all stakeholders in reforming the water sector in the Fergana Valley. Thanks to project efforts, new water users associations were established, and earlier established WUAs were restructured. Since July 2002, the project was monthly conducting planned (according to the project agenda) and unplanned training seminars for specialists of water management organizations, water users and members of NGO's in the Fergana Valley. At that, the great attention was paid to dissemination of the IWRM ideology. The communication network that was based on the e-mail and linked all key project participants (the SIC ICWC - national departments - provincial water management organizations - pilot canal administration - WUAs) was developed. The project has established the Information Management System (consisting of a database, a set of mathematical models, and GIS), operating in the on-line regime, which is a powerful tool for planning, operational analysis, and improving the water allocation process and actual water distribution.

Alternative organizational structures for water management at the level of main irrigation canals were created as new departments - Canal Administrations (on the Aravan-Akbura Canal in Osh Province in Kyrgyzstan, Khodja-Bakirgan Canal in Soghd Province in Tajikistan, and South-Fergana Canal in Uzbekistan). In December 2003 the Pilot Canal Water Users Unions were established and officially registered on all pilot canals; and the joint governance principle was put in practice: the agreements related to joint water governance were signed, and the Canal Water Committees consisting of representatives of superior state water management organization (WMO) and water users (CWUU) were created.

The first steps towards establishing the procedures of water resources planning, record-keeping, reporting and monitoring at each level of new water management hierarchy were made. An effectual factor of transition towards IWRM is participation of representatives of civil society in the governance process that is also legally fixed. It is expected that activity will be implemented at all levels of the water hierarchy.

Many technical aspects also depend on the public participation. It is not easy task to provide guaranteed and equitable water distribution over the irrigation system as a whole. When water is delivered in line with

planned amounts and of necessary quality increase in productivity of water and land resources may be expected. Water users themselves should participate in more precise specifying of command areas for each irrigation canal, assessment of their water demands, and accounting additional available water sources (ground water, return water). Adjusting water supply, rotation and use depending on weather and economic conditions, as well as improving hydraulic measurements and record-keeping at all levels of the water management system are also their functions. To tackle arising issues it is necessary to establish extension services that assist water users in the introduction of new technologies, advanced practice of planning and production, and solving water distribution problems. The project has developed and transferred for use "The Model Regulations on Canal Water Committees", as well as recommendations for their adaptation on each of three pilot canals.

The project has rendered the technical assistance in inspections and additional equipping of flow-measuring structures on pilot irrigation canals (an enormous work was implemented to establish the water-metering systems within pilot WUAs). This activity allowed setting the proper water record-keeping on the pilot canals and within WUAs, making the water distribution process more transparent. The project has started real-time management of the water delivery process on pilot irrigation canals and within pilot WUAs in the form of monitoring and updating the planned water supply schedule based on water users' applications with taking into account weather conditions during a growing season. This is the first step towards equitable and rightful water distribution and, at the same time, an attempt to reduce unproductive water losses.

Preparing the passports of demonstrative fields within pilot farms allowed creating an instrument for analyzing farmers' production reserves and potential with the purpose of improving productivity of land and water resources. Testing the instrument for forecasting water consumption in line with weather conditions is conducted in the real-time regime, and its introduction in wide scale during the next phase of the project is planned. Our analysis shows that on 9 of 10 pilot plots, the land and water productivity was perceptibly improved. On one pilot plot located on the SFC, where farmer did not follow the project recommendations, the productivity has reduced. Many women were involved in discussions related to management of the land and water productivity and of other water resources management problems in the Fergana Valley. Based on outcomes of these activities, the enabling environment was created for the wide introduction of extension services for farmers in the Fergana Valley.

Outcomes of introducing **IWRM has shown that the involvement of water users (community initiative) allows considerably improving the efficiency of water use and decreasing a head water withdrawal by more than 25%, creating the system of fair and equitable water use, which, by its nature, is close to traditional water use in accordance with the Sharia canons.**

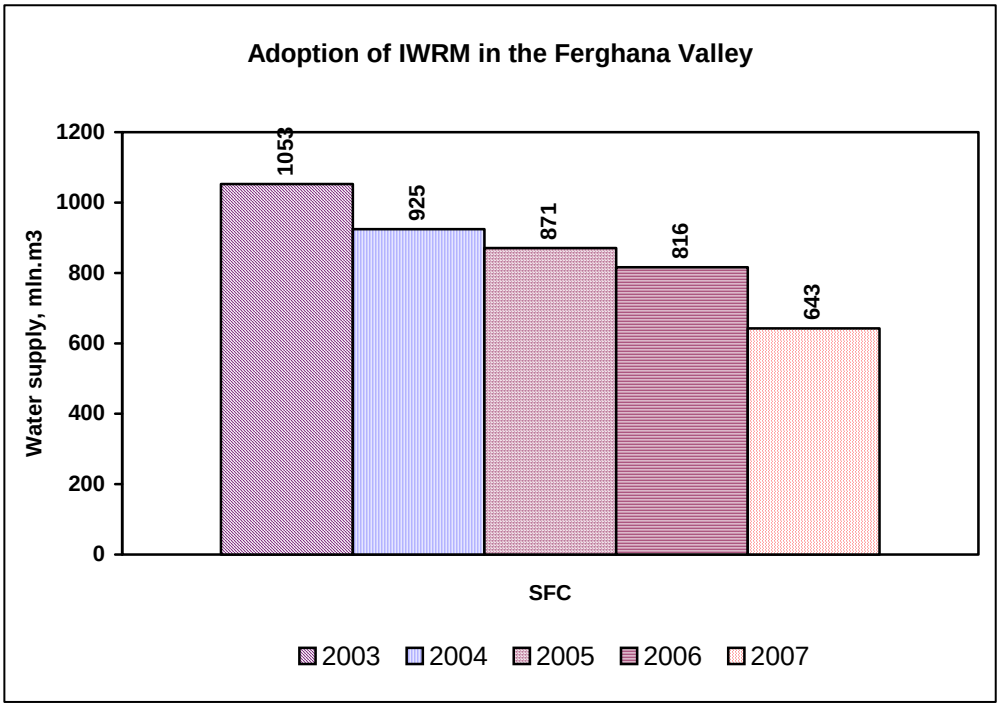

Figure 12. Reducing the water diversion into the South Fergana Canal (SFC) due to introduction of IWRM

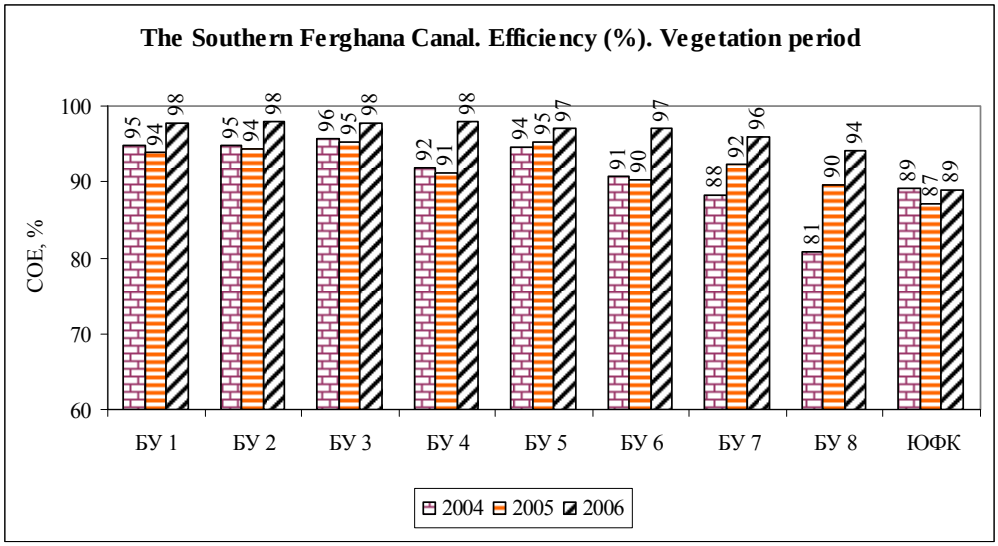

Figure 13. Dynamics of the efficiency at water-balance sites and the SFC as a whole

Now this experience putted to upscaling in Uzbekistan on 7 rayons of different provinces, same as in Tajikistan and other states. If we can achieve reducing of water delivery on the base this experience even on 20 %, significant input in growth of food production, wellbeing, growth of income in rural area and combat of poverty should be done.

The agricultural and water strategy of state should be framework for support efficiency of IWRM and simultaneously for promotion of growth food production. It need to concrete for creation condition for development of private initiative and transformation farmers in real owner of his production, for getting feeling by them of guarantee their long-term orientation with input own investment skill, forces in land.

Average rate of production on private and cooperative farm approached to 1,5 that indicated correctness of this line (table 8).

Table 8

Relation between yield of land in cooperative and private farms, th/ha on 2003

Crop	Private farms	Cooperative farms	Ratio
Corn	3.84	4.6	1.19
Vegetable	22.48	30.3	1.34
Grape	2.38	4.9	2.05
Fruits	3.21	5.7	1.77
Potato	21.10	29.9	1.41

Between other measures required from governments:

- creation of climate for strengthening of WUAs and transformation them in multisided unions;
- establishment of correct system financial interrelation "farmer-WUAs-processing-marketing" that will support stability and insurance of farmers and their partner in their future;
- finalize "market approach", reduce (Tajikistan, Turkmenistan, Uzbekistan) strong state planning no more 50 % of lands with free ability of farmer to select crop, traders and conditions;
- support creation of market oriented rural infrastructure for assistance and proceeding that will be in close cooperation with farmers and their WUAs.

Strengthening of water governance is huge priority of global, regional and local community, common and especially water. Common – because each from citizens of planet is wateruser, water – because those who belong to water community and service are servant of God! Most important to arise these issues on the global level. One from them should be preparation of a global water security charter that includes some major principles:

1. Water is the natural and common social resource that should be first of all used to meet: i) the drinking and communal needs; ii) requirements of food production (irrigated farming) and industrial sectors; ii) the demands related to health, nutrition, minimal employment, and well-being of the population, especially of its most vulnerable groups; and iv) the environment needs;

2. Water must be treated as a commodity only after special processing that turns water into a consumer goods (bottling, desalinization, etc.) or if it can be replaced by its virtual form;

3. Equitable and reasonable access to water for everyone and water use in the amounts that correspond to the most advanced technologies are the moral and legal right that should be secured by the governments;

4. Nobody can possess the preferential right in using water resources of the transboundary watercourses; at the same time, diversion of water from transboundary watercourses can be made only in the amounts that are agreed with other riparians and justified based on modern technologies of water delivery and use."

5. Nobody possess the right to change the flow regime of rivers in such a manner that can result in man-made droughts or floods in downstream reaches;

6. Any actions on the transboundary waters shouldn't inflict significant damage to other stakeholders; and

7. GWG should be structured as a robust set of legal and social rules and norms that cover all levels of water hierarchy and all branches of public life including economy that, in its turn, will provide the guarantee of water availability for nature and human needs.

Based on above considerations, we propose to consider strengthening the system of *water governance* by means of elaborating integrated measures that encompass legal, institutional, financial, and social components with the purpose of co-ordination of all levels of the water management hierarchy. These measures should remove all weaknesses and vulnerability of the existing system of water governance, and also opportunities for ignoring the interests of other water users or creating the uncertainty in their water use regardless of a level of the water management hierarchy.

Strengthening *water governance* at the transboundary level (international watercourses) is especially important. Available documents that form the international water law related to non-navigation use of transboundary watercourses (the Helsinki rules, UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes) envisage the rather correct and fair principles of water use; however, their practical application (even in case of their ratification by all parties) is quite difficult owing to a number of provisions that can be interpreted by each Party of these conventions in its own interests. For example, this is the following provisions: i) equitable and reasonable water use; ii) preventing considerable (tangible) damage; and iii) co-ordination of actions that can change quantitative and qualitative characteristics of water bodies. One more problem is the definition of boundaries of national sovereignty, the rights, duties, and powers of riparian and basin organizations, as well as the provision regarding obligatory collaboration, etc. All these ambiguities, shortcomings and vague wordings were repeatedly mentioned in numerous studies pointing to the fact that in comparing with the Helsinki Rules there are more ambiguities (for example, such provisions as "reasonable water use," "preferential use," "situations threatening to human health or deterioration of social and economic conditions," "ecological flows," etc.)[2]

Therefore, one of topical tasks is the preparation and approval of detailed recommendations (if not revision of these documents) or the protocol concerning the key principles of UNECE Convention, which will help the riparians to be clearly guided by their rights and duties in all aspects of the international water law.

An important matter of transboundary water resources management is the establishing and proper operation of basin organizations. In this case, the more clear and specific rules and regulations rather than simply recommendations regarding the establishing of joint basin organizations and possible spheres of their activity[3] are also required. The UNECE has already attempted to elaborate such rules for the river basins in Eastern Europe, Caucasus and Central Asia[4] based on the

[2] S. Bogdanovich, International Law of Water Resources, Contribution of the International Law Association, Kluwer Law International, London, 2001, 436 pp.

[3] Ch. Gopalakrishnan, C. Tortajada, A. Biswas "Water institutions, political, performance and prospects", Springer, 2005, 209 pp.

[4] The UNECE, River basin complexes and a new institutional mechanism in the field of transboundary water collaboration. 2007.

generalization of the international experience. This document should include the rules of establishing the basin organizations depending on their objectives and the field of activity, as well as the provisions concerning their institutional framework, financing, etc. The important constituents of this document are the provisions concerning the procedures of arbitrage, evaluating of damages and their compensation (these functions should be implemented by basin organizations).
Water rights should be clearly specified at all levels of the water management hierarchy. Ensuring water rights includes not only their declaration and establishing the procedures for water allocation (a proportional share of available water resources, quotas or the certain order of priorities) but also the enabling environment for observance of these rights that embraces the following components:

- Sustainability of water supplies over all chains of the water management hierarchy, and first of all, at the level of transboundary water management (it is impossible to speak about the sustainability if upstream riparians regularly change the regime of water releases from the reservoirs located on their territories);
- Physical infrastructure and the agreed procedures for multi-year regulation of river runoff and its control;
- Procedures for adjusting the national water quotas;
- Physical infrastructure and the agreed procedures for stable and uniform water distribution among water users and water consumers;
- Participatory water resources management;
- Mechanisms for supporting sustainable operation of local water organizations;
- Potential for mitigating of water scarcity due to effects of the destabilizing factors; and
- Financial and material well-being of the water sector.

A special emphasis should be made on supplies of water to ecosystems since most countries take into consideration the needs of the natural complex according to the leftover principle. However, satisfying the hydro-ecological requirements of ecosystems is very important for supporting their economic function; and disregard of these requirements can result in the most destructive consequences for mankind in the future.
The following aspects play a very important role at the national level:

- Establishing the National Water Council as a single body that integrates the participation of all substantial stakeholders in water resources management and their perspective development;
- Elaborating the National Water Strategy and its co-ordination with all executors;
- Regular monitoring and evaluation of all destabilizing factors and adaptation to their changes (or mitigating adverse affects);
- Protection of the underprivileged' rights under transferring water supply services to the private companies;
- A role of the state in maintaining the water infrastructure (water supply and sanitation, irrigation and drainage); and
- Liability for violation of the rights of some economic players in access to water resources.

<u>At least – last: attention to irrigation and drainage in whole world</u>
As well known, irrigation and drainage responsible for creation of almost 50 % of agrarian production on the global scale. Nevertheless last 25 years different by the lost attention, investment, government involvement in support this most important scources of food production. One from indicator – failure irrigated lands in NIS and Eastern Europe states. As can be recognize from table almost 10 mln. ha of irrigated land went out from global potential that almost 4 % from global irrigated lands. Who assess consequences of this on the global food security?

Table 9

Situation with irrigated lands on the NIS and Eastern Europe , th. ha

	1990	**2004**	**Actually irrigated**
Russia	5799	3506	2600
Ukraine	2455	1100	700
Uzbekistan	3908	4230	3960
Kazakhstan	2160	1290	1060
Turkmenistan	1240	1760	1700
Bulgaria	1250	40,0	
Czechia	133	10,0	
Germany	500	200,0	
Hungary	300	100,0	
Poland	301,5	83,3	
Romania	3205	850	500

And any one – comparison of food self sufficiency and virtual water approach. Referring on my statement in "Water and globalization in Central Asia" (Irrigation and drainage, 56, 489-507, 2007) John Wilkey and so Ltd, need again to under line that assessment of water – deficit based on virtual water can destroy real ability of state to national food – sufficiency. Take in account deviation of prices for food on global market security of developing states by own production in farm of prevail own production beside nutrition problem decided very important social importance in irrigated agriculture as factors of employment, scource of income not only in direct agriculture, but on all associated sectors, service and so.

We must remember that cost of our working place in industry in 8-15 times more that one place in irrigated agriculture! So, let protect role of our sectors!