Current problems of water-energy resources of Tajikistan and Central Asia

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Abstract Very significant problem of water-energy resources use in Central Asia is the problem of water division. Today the positions of Uzbekistan, Kazakhstan and Turkmenistan in this question consist in the request to preserve the existing limits of water division and allocation of additional limits for the Aral Sea and the Aral Shore. The positions of Kyrgyzstan and Tajikistan consist in reconsideration of these limits with increase of their shares (not for today, in the perspective). At the same time Kyrgyzstan and Tajikistan demonstratively ground their requests on the increase of water resources limits by the fact that they were deprived by water division and did not get any compensation for this during the times of the USSR. As a consequence they possess now the least specific area of irrigated land per man in accordance with other republics, and they cannot even provide their population with the minimal level of consumption owing to their own agricultural production. In order to exclude this and, besides, taking into consideration the fact that today there is not any reliable and objective control of water use inside separate republics, it may have sense not only to exclude the Aral Shore, but the Aral Sea itself too from the number of water users, and instead if this to set limits to Uzbekistan and Kazakhstan.

Introduction

The concept Central Asia (the former name is Middle Asia and Kazakhstan) that is used nowadays includes the republics of: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Afghanistan. Hydrographically the region of Central Asia (CA) is distinguished as the Aral Sea basin, which in its turn consists of two basins-the Syrdarya and the Amydarya Rivers.
The main indicators of technical and economic development of Central Asia economic region are given in Table 1.

Table 1. Indicators of macroeconomic development of Central Asian region

Country	Territory, th. km^2	Population, mln. people	Per capita gross inland output by purchasing capacity parity, th. USD/man	Per capita energy consumption, tons of conventional fuel /man
Kazakhstan	2636,20	14,95	3,56	3,67
Kyrgyzstan	198,50	4,90	0,68	0,66
Tajikistan	143,10	6,20	0,99	0,84
Turkmenistan	488,00	4,70	1,52	3,30
Uzbekistan	447,36	24,60	2,26	2,70
CA	3913,16	55,35	2,22	2,64

Table 2. Surface water resources of the Aral Sea basin

Country	The Amydarya River basin, km^3/year	The Syrdarya River basin, km^3/year	The Aral Sea basin	
			km^3/year	%
Kazakhstan	—	4,50	4,50	3,9
Kyrgyzstan	1,90	27,4	29,30	25,3
Tajikistan	62,9	1,1	64,00	55,4
Turkmenistan	2,78	—	2,78	2,4
Uzbekistan	4,70	4,14	8,84	7,6
Afghanistan	6,18	—	6,18	5,4
CA	78,46	37,14	115,6	100,0

After Soviet Union collapse the Republic of Kazakhstan, Kyrgyz Republic, Republic of Tajikistan, Turkmenistan and Uzbekistan gained independence in Central Asia. Total area of Central Asia Region (CAR) is about 3882 th. km^2 with the population over 53 mln. people. The Syrdarya river is one of the two great Central Asia rivers and its basin live more than 20 mln. people. The Syrdarya river basin as part of the Aral Sea basin occupies 485.5 th. km^2 territory. The length of Syrdarya river is 2337 km, its water resources are 40.6 km^3. The Amydarya river is the largest by its area of water intake (226,8 th.km^2) and by its water ability in CAR, and its length is 2574 km. According to approximate evaluation underground water resources in the Aral Sea basin make 43.7 km^3/year which 15.8 km^3/year (36.2%) of them being approved exploitation reserves. Moreover, a large quantity of return waters is formed in the Aral Sea basin make 45.8 km^3/year, a small part of which is only repeatedly used for irrigation-6.0 km^3/year, and a great part of the waters is led to rivers(23.5 km^3/year) and natural reduction (16.3 km^3/year).Intensive development of irrigated in CAR especially began during existence USSR (mainly from the 60^{th} up to the 90^{th} of the post century) As a result by 1990 total area of irrigated lands in the region has in creased up to 8.8 mln. ha. Similar growth in Central Asia in the Soviet period was observed in power engineering too. Total established capacity of all electric power stations in the region by the middle of the 90^{th} grew up to 37.8 mln. kW (Petrov, 2006).

Agreement regulating water-energies interrelations between countries of the Central Asia

One of main problems in Central Asia connected with contradiction between irrigation and hydroelectric engineering. Irrigated agriculture demands maximum use of water during vegetative period from April to October. Hydroelectric engineering is concerned with paramount use of river flowing in winter, the coldest period of a year when rivers contain little water, from October to April. Thus by the irrigative regime filling reservoirs is necessary in winter and their use-in summer, and by the energy regime it is vise versa, filling reservoirs is necessary in summer and their use-in winter. It is impossible to combine their within one reservoir. In any case it is necessary to note, that today's contradictions between irrigation and water-power

engineering are connected by that in each of river pools – Amydarya and Syrdarya today is present only on one large hydrounit. Naturally, they cannot work at once in two different modes. Therefore to divide functions in use of a water drain it will be possible only due to new construction. Therefore the cardinal decision of the conflict of interests between water-power engineering and irrigation in the countries of Central Asia is new construction of large hydroelectric power stations with reservoirs.

All problems of technical character are to some extent connected to regulation of a river drain. In the most full kind they are shown today in Syrdarya River basin.

This present-day scheme of interrelations between Central Asia republics began to be created already in 1994. In March 17,1998 it was register officially by signing Bishkek "Agreement on use of the Syrdarya River basin water and energy resources between the Government of the Republic of Kazakhstan, the Government of the Republic of Kyrgyzstan and the Government of the Republic of Uzbekistan", which was joined by the Republic of Tajikistan in June 17, 1999.

Agreement on use of the Syrdarya River basin water and energy resources between Kazakhstan, Uzbekistan and Tajikistan (June, 17, 1999) 17 March, 1998 provided that:

Extra electric energy generated in excess of needs of the Republic of Kyrgyzstan and the Republic of Tajikistan by the cascade of Naryn-Syrdarya hydropower stations connected with the regime of removals of water.

Into vegetation and long-term flowing regulation in the Tocktogul and the Kayrakum reservoirs is given in equal parts to the Republic of Kazakhstan and the Republic Uzbekistan.

Its compensation is according to concordance or as pecuniary compensation to the Republic of Kyrgyzstan and the Republic Tajikistan to make necessary annual and long-term reserves of water in reservoirs for irrigative needs. While performing reciprocal settlement of accounts a common tariff policy on all types of energy resources and their transportation must be provided.

Bishkek Agreement signed in March 17,1998 can be considered as absolute success.

Unfortunately its practical implementation leaves much to be desired.

Factors keeping back performance of Agreement on water and power resources use of Syrdarya river basin

It is quite difficult to divide all factors keeping back, bring together to some exact groups and select from them having purely republican aspect. Many of these factors belong to both republicans and to region as a whole. Therefore an approach made below of such division a little conditional, but in our opinion it doesn't have any serious meaning for problem considered by us.

Factors of republican – regional character

1. Absence of modern water-use problems analysis in basin (in the region), as a united system. The experience, including our expert work of all last years shows that at large difficulties, many- planning, wide inclusion of problems taking large amount of personal tasks belong:

- power system (regimes parallel work, transfers, regulating of frequency, joint work HES and HPS, tariffs, common market);
- irrigation (interstates and national systems, zones of planning, compound of agricultural growing, systems, harvest, prices and tariffs);
- water distribution (common principles, strategy);
- ecology (pollution, salting, climate and microclimate change);
- Aral, near Aral zones, Sarez lake (safety, evaluation of damage, protection projects);
- management system (structure, compound of institutions, rights and duties, subordination);
- right and economical questions connecting with interaction between states and economic subjects.

Without their system analysis and development of exact and understandable structure showing their hierarch, correlation and possibility of separate consideration any discussion of problem, as a rule, starts to spread on all at the moment (depending from professional or service interests of separate specialists) and effective developing of general opinion becomes very difficult.
Now, when such system, structural analysis of general problem and accumulated large factorial materials are necessary this work could be carried out enough quickly and effective.
2. Non-sufficient developing of normative - rightful base in sphere of joint transport rivers water and power resources use.
In result of absence such common, agreed normative – rightful base for specialists in all republics, public figures, and mass media and finally electorate power – system managers form their own ideology. Especially it is dangerous when all these ideologies are formally based on separate laws and normative – rightful acts of national and international characters without their joint analysis. Arising at it polarity of conclusions makes very difficult search of agreed decisions.
As an example of ten made citing on Constitution and Water Code of our republic could be given, establishing priority unconditional right on national use of all resources including water (for example Constitution of Kyrgyzstan clause 4: "Land, its bowls, water resources, air space, forests, plant and animal world, all natural wealth are state properties"), often dividing by only experts and external contradictory to them with meaning cities on International right putting in first plan principles of common benefit: "do not injure", "polluter pays" and similar that often propose others.
Another characteristic example is cities on International right, recognizing water resources as product and necessity to appoint of others based on Almaty's Agreement from February 18th 1992, foreseeing generality and unity of all water resources of the region.
That's why such development of normative and rightful base without a doubt is necessary. For that it is not about comprehensive document but separate private problems, which is not about general principles but rather about rightful regimes. For example, it is about a right of state on flowing regimes within its reservoirs, about general correlations of national and international rights etc. As an approach for developing the two last rightful regimes corresponding document are given in Attachment.
3. Absence of objective, correcting and convincing analysis of world experience on joint use of Transboundary Rivers water and power resources.
For that it is necessary to mark that during last several years mainly because of cooperation of the USA Agency for international development (USAID) practically all participants on development of Agreement experts have large enough and various material and often received at first hand. But without generalization and analysis it is used selectively, fragmentary depending on others tastes and tasks. Its systematization is necessary, moreover joint with separating general and private, occasional and regular.
4. Here the situation is the same as in previous point. Everybody has exhaustive material for all these questions but takes from it what one likes. It is necessary individual analysis for each republic, but their joint discussion and creation of single resulting document, with general conclusions. Of course, for that it is necessary to decrease maximum covering sector of a problem.
5. Not optimally, complexness, absence of exact structure, real rights and duties of modern water and power resources management apparatus. Bad connection: between national and interstate units of management.
Attentive analysis of all documents and reports of specialists and experts shows that here is namely the main reason of bad Agreement performance.
A lot various organizations with indistinct status, rights not attached by real possibilities and duties without real responsibility, make inevitable such situation. Root reconstruction of all system is necessary.

But now the most real way in this trend is neither creation of new above- state structures, like Interstate Consortium on water and power resources and no increasing interstate status of existing Interstate coordinating water – economy commission (ICWC), Scientific – informational center (SIC), Basin water – economy Association (BWA) its secretariat, branches etc, but on the contrary arranging their status to simple governing organs. At the same time responsibility of the states for performance of agreements signed by them should be increased that fully corresponds with acquired sovereignty independence and international recognition. For that it is expedient creation of special joint commissions on international with participant equal numeral of specialists on permanent base from all countries.

6. Absence of general method of account services and compensation volume in correlations between states on problem of joint use and regimes of basin's water resources.

This reason presents now as the main. Solution of it simplifies at once solution of all other problems making them clear and understandable, creates for them necessary base. For developing common technique of services and compensation accounts it is necessary governmental development of mathematical models, optimization and imitational types for both developing general agreed solutions and for their management.

7. A difficult economical situation of Central Asia Economical Union (CAEU) republics.

In condition of sharp fall of production in all branches, population life level and its social life, naturally all state forces are directed on decision of nowadays, urgent tasks, moreover, connected partially with energetic. Forces and mean do not remain for decision of perspective tasks. Moreover any compromises with refusing from any own rights, means, resources etc. have difficulty.

8. Absence of single economical expanse.

Absence of single currency, non – convertible of national currency, absence of common (both national, and regional) market for all main products and services, customs barriers, shortage of financial means, and as a sequence wide development of barter even on national level, these all are well-know factors, braking performance of any agreements and contracts, including the Agreement.

9. Relatively favorable hydrological conditions in the region for the last 10 years.

How it is paradoxical, positive factors and favorable hydrological situation in the region for the last 10 years (normal, above normal, water-plenty of river in basin) in our case also could serve as factor keeping back performance of the Agreement.

It can be remembered how process of preparation and signing of Agreement was made more active in the beginning of 1998 in expectation of unfavorable prognosis (low water-plenty) and in conditions of deep many – years work making up Toktogyl's reservoir. Prognosis does not justify itself, water-plenty was increased, Toktogyl's reservoir was filled a little and again period of relax comes in expectation for the next low water level.

Factors of republican character

- Negative political and social processes in the republic in 1991-1996years. Unconditionally it is one of the main reasons; creating instability and sharply worsening economical situation of the republic meaning isolated it from regional processes.
- Held-up with including of Tajikistan to inter-republican process of negotiations in all levels. In the result Tajikistan had to lead up into moving by full courses process. Of course it is not a best variation.
- Territorial location of Tajikistan in Sir-Darya river basin. If it is taken account that Tajikistan "was late" to the beginning of negotiations on the Agreement so its location in the middle between Kyrgyzstan and Uzbekistan with Kazakhstan put it in very unfavorable situation, which results are turning out up to now. Tajikistan "was simply forgotten". Up to now in results Kayrakum reservoir often is perceived simple as transit with minimum rights and maximum duties.

~ Absence of own models, techniques and accounts on determining national optimal regimes of Kayrakum reservoir work. in the republic. In the result all proposes, requests and demands of water workers and power engineering specialist are weak based that forms to them accordance relation from other republics.
~ Impossibility of distribution on national level Syrdarya and Amydarya river basins.

Especially it is characteristic in relation to power system. 85% of hydropower is received by North Tajikistan geographically located in Basin of Syrdarya River from Vakhsh HPS Cascade, located in Amydarya river basin. It does not allow Tajikistan to use applied by other republics approaches. In the result optimization criteria of Kayrakum reservoir work is mixed with regime of Nurek's reservoir work. Often experts of other republic do not understand it.

Risks concern to the technical risks connected to reservoirs, first of all, natural and technogene failures of dams (their destruction as a result of loss of durability, internal erosion, washout or overflow of waters through a crest of a dam) and occurrence as a result of it a destructive wave of break, and ecological risks, one of basic of which is resettlement of the population from a zone of flooding of the reservoir. Concerning these risks the estimation of their general size and comparison of it, as with the risks arising in connection with refusal of construction of water basins, and risks of other kinds of activity of the person is important. For example, really marked risk of destruction of people in road accidents in Russia in 2004-2005 years made ~ 0.02 %, and risk of a mutilation ~ 0.2 % one year.

Today in Tajikistan there are 9 maintained reservoirs with volumes from 0.03 up to 10.5 km^3 (table 3).

Table 3. Parameters of the reservoirs of the Republic of Tajikistan

Basin of the rivers	Quantity of water basins with the area			Total area water mirrors (km^2) and full volume (mln. m^3) at NHL reservoir		
	Less 10 km^2	More 10 km^2	Total	Less 10 km^2	More 10 km^2	Total
Syrdarya	2	2	4	5,73 / 83	566 / 4490	571,71 / 4573
Vakhsh	2	1	3	15,54 / 219,5	98 / 10500	113,54 / 10719,5
Pyanj	2		2	5,15 / 51,7		5,15 / 51,7
Total	6	3	9	26,4 / 354,2	664 / 14990	690,4 / 15344,2

NHL - normal headwater level

Summarizing, it is possible to draw a conclusion, that the decision of a question of increase of efficiency of sharing of water resources of the countries of the Central Asia in modern conditions and on prospect is their further development with a view of power. irrigation and other branches, that is construction of new reservoirs and HPS. The list of perspective hydrounit for such construction in Tajikistan is resulted in table 4. In table 4 are not shown opportunities of construction of small HPS. At the same time it is necessary to note their large opportunities in republic. The general potential resources of small water-power engineering in Tajikistan: capacity – 21057.0 MWt; development of the electric power – 184.5 TWt·h. in per year.

Table 4. Perspective scheme development of hydropower industry in Tajikistan.

Cascade of HPS in Rivers	Power, MWt.	production, TWt · h/year	useful volume of reservoir, km^3
Pyanj	18322,5	84,918	17,36
Vakhsh	9178	35,36	13,229
Syrdarya	126	0,6	2,5
Obikhingou	3700	9,3	1,55
Surkhob	2100	8,7	1,45
Zarafshan	640	3,01	1,64
Fandarya	510	3,18	0,78
Matcha	500	3,02	1,21
Kofarnigan	1570	4,98	2,695
Bartang	581	5,04	3,85
Varzob	870	3,05	0,084
Gunt	284,4	1,758	0,212
Total	38366,5	162,916	46,56
From them:			
Acting	4043,4	16,158	7,084
Constructing	4390	16,48	9,22

HPS – Hydropower station

The common stock of power resources of Tajikistan really accessible to industrial use presented in Table.5.

Table 5. The general structure of power resources of Tajikistan (mln.t.cond. fuel)

Hydropower resources	Coal	Oil	Gas
158.12	667.30	37.00	15.00

Resulted in Table 5 the structure of power resources is calculated on usual, standard to the scheme. At once it is necessary to note, that in such kind it gives the deformed picture, underestimating a role of renewed resources, in the first turn of hydropower resources, in favor of mineral raw material. It it is connected that mineral fuel is estimated on their general stocks while renewed resources on their annual potential.

To lead to their comparable kind it is possible introduction for deposits useful minerals of already known concept of “life cycle ", used it is usual in investment projects. It will enable to establish annual potential of resources of mineral fuel which can be compared with hydroenergy potential and others renewed resources.

Certainly, life cycle cannot be counted on actual today's consumption of power resources, even in view of prospect. Also, apparently, it is impossible to define proceeding from technical opportunities development of deposits. Life cycle should provide an opportunity long, a moustache development of the country.

Very roughly it is preliminary possible to accept, that life cycle coal deposits makes 50 years, and oil and gas 20 years. In view of it the general structure of power resources of Tajikistan, led annual stocks will look as is shown in table 6. It it is cardinal differs from that,

that is presented in table 5. Thus, really, the standard way of an estimation of power resources gives deformed, from the point of view of their comparison, estimation.

Table 6. Annual stocks of power resources of Tajikistan (mln. t. cond.fuel)

Hydropower resource	Coal	Oil	Gas
158,12	13,35	1,85	0,75

This analysis shows that Tajikistan does not have any other alternative in power, except for hydropower resources. But thus their stocks are huge and today are used only on 3-5. Therefore Tajikistan, certainly, will be interested in the long term in export of hydropower, in development of the general regional market of the electric power.

Development of all these resources of the large and small rivers except for reliable regulation of a river drain in all its aspects, including for needs irrigation, will be equivalent to decrease in consumption of organic fuel in volume 100 mln. t of conditional fuel one year. It in turn will lead to decrease in issue of CO_2 on 350 mln. t / year. Thus once again we shall emphasize, that these hydropower resources are annually renewed, that is as against oil and gas, inexhaustible. Their essentially cheaper price is important also, is especial in conditions of a sharp rise in prices observable now on organic energy carriers. And all this is possible in one very small country - Tajikistan, the area of 143,1 th. km^2 and the population 6,4 million person, but all this only at construction of HPS with large reservoirs in mountain sparsely populated areas. The general {common} useful volume of all water basins of Tajikistan (46.56 km^3) thus will be equal almost 50 % of all mid-annual drain of all region of the Central Asia (115.6 km^3) that one only, without participation of other republics can provide all necessary kinds of regulation of a drain, in all his aspects, both for irrigation, and for protection from floods.

Considering that fact, that all current and planned in the long term construction new large hydroelectric power stations are constructed and will be is under construction on the mountain rivers, and also in view of the big flows of deposits of the mountain rivers the problem sedimentation of reservoirs is actual in plane of production of electric energy and water-supply of the irrigated grounds (Normatov, et.al.,2006). The account of the sedimentation factor and morphmetric characteristics of reservoir at optimization of work of HPS is impossible in the frame of simple calculation and is required a necessity for development of mathematical model. For example, Mountain reservoir is Nurek HPS with reservoir on the territory of Tajikistan one of the deepest in the world is located in a vein of the Vakhsh River which basic parameters are presented in table 4. For the period 1972-1989 years the sediment runoff of the Vakhsh River was measured in 1977,1980-1982 years on hydrological post (Hydropost) Komsomolabad and in 1978,1985 years on Hydropost Kishrog. The sediment runoff measured on Hydropost Komsomolabad changed according to river water discharge from 55.2 to 38.3 mln.t on Hydropost Kishrog from 86 up to 59 mln.t. Thus, the sediment runoff of the Vakhsh River on the damside of Nurek reservoir can be estimated 60-65 mln. t. As a result of the executed calculations in view of the above-stated estimations it is established, that to 6^{th} year of operation the useful capacity of a reservoir will decrease up to 200 mln. m^3 and to 11^{th} year on 650 mln. m^3. In view of all above-stated on fig.1 is presented the initial forecast sedimentation of Nurek reservoir. Thus, according to the forecast intensity sedimentation of reservoir in first five years will to make 40 mln. m^3 in a year, and in all the next years - 90 mln. m^3 in a year. Saturation of a stream by deposits before the reservoir at the water discharge 1260 m^3/sec will reach in first year operation of reservoir -1.3 kg/m^3, for 6^{th} year of operation-1.7 kg/m^3 and on 11^{th} year of 2.1 kg/m^3. The fractional structure of the deposits inflow to a reservoir roughly will compose of particles in diameter less 0.01mm.

Let's consider one of the most important for operation of Nurek HPS parameters - changes of useful volume of reservoir. On fig.2 is presented results of actual gauging of volume Nurek

reservoir which shows sharp reduction of volume of the reservoir at the initial stage with the subsequent restoration up to a reference value.

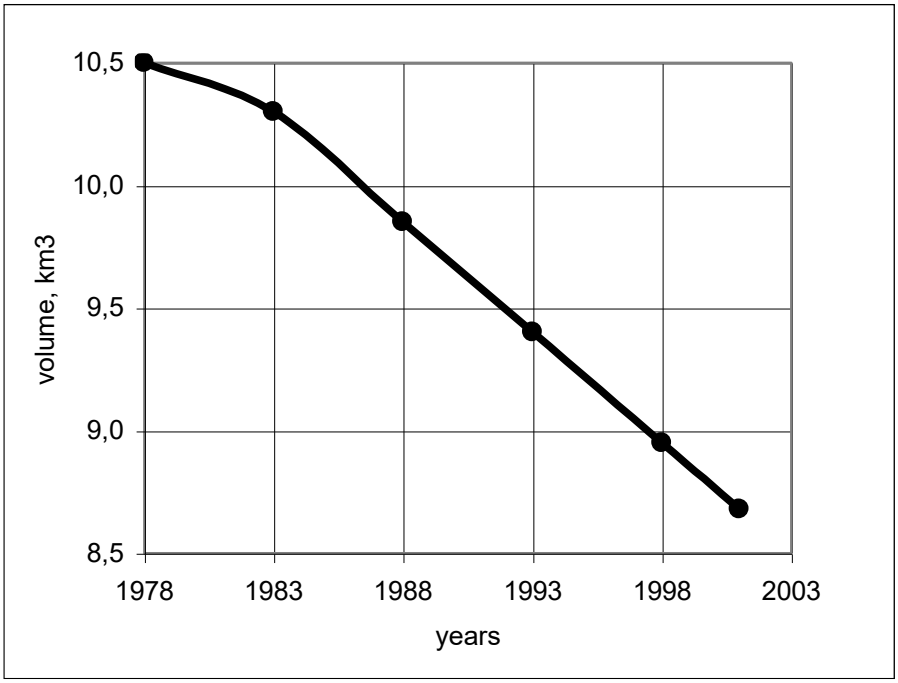

Fig. 1. Forecast of the Nurek reservoir full volume sedimentation

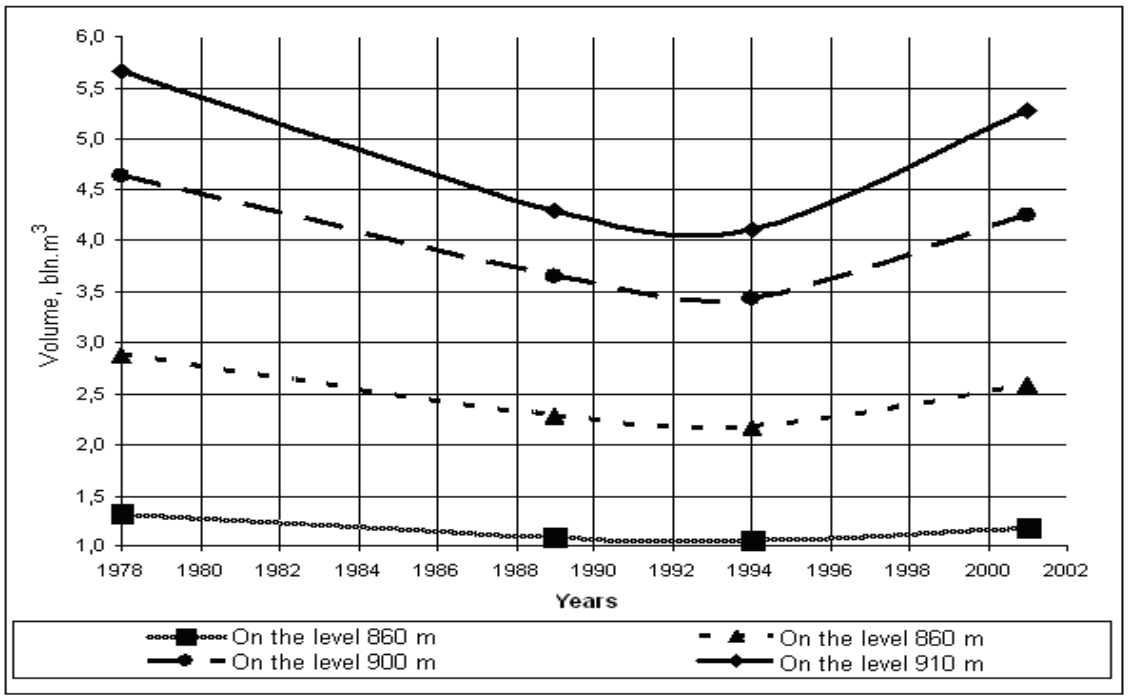

Fig.2. Actual change dynamics of the Nurek reservoir full volumes above 840 m

Thus as shows fig.3 at all stages actual sedimentation of reservoir sharply differs from the initial forecast. It is possible to assume, that restoration of useful volume of the reservoir occurs due to processing coast. It is possible also to assume, that in this case the increase in useful volume occurs due to reduction of dead volume. But as shows on the fig.4 at actual gauging occurs not only increase useful, but also full volume of Nurek reservoir. On the basis of the above-stated it is possible to approve, that today all actual gauging of the Nurek reservoir volumes are

insufficiently reliable, and they do not allow to make the analysis and to give an explanation to processes of sedimentation.

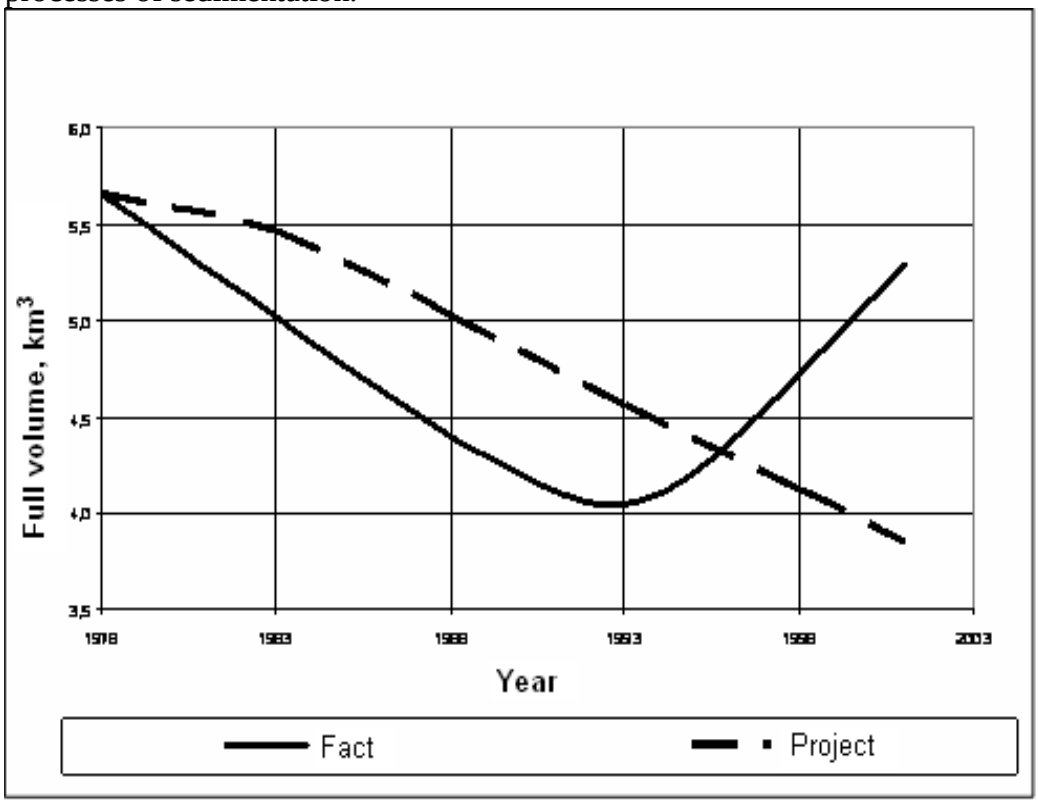

Fig.3. Sedimentation dynamics of the Nurek reservoir useful volume

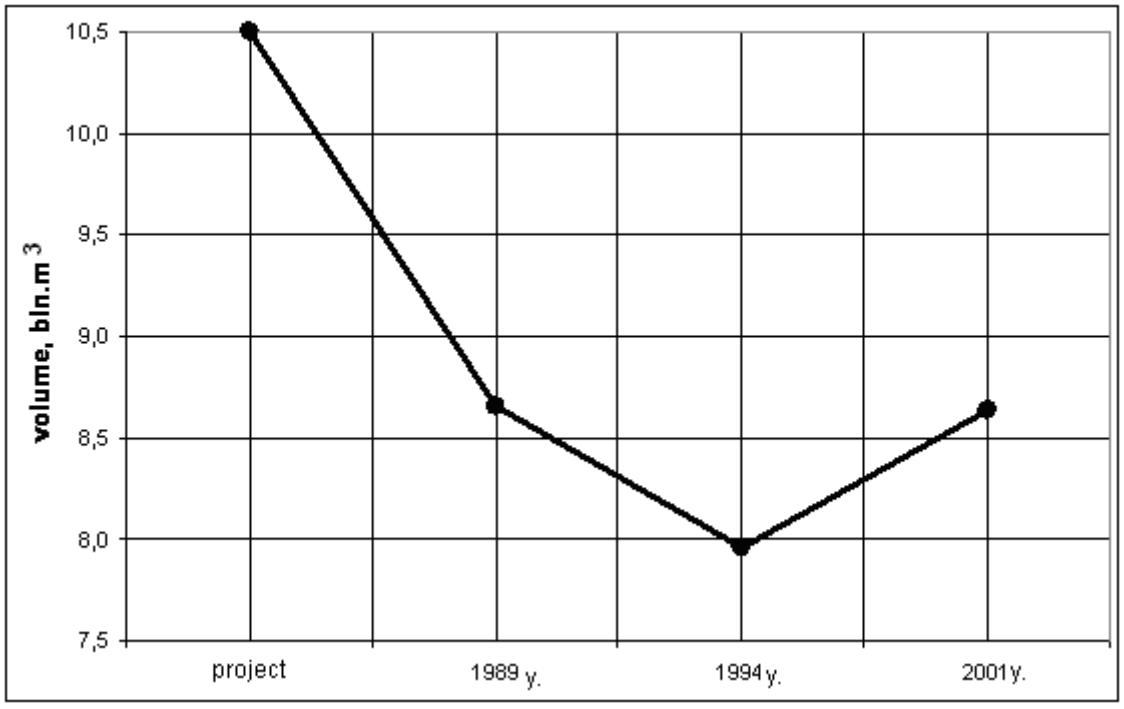

Fig. 4.Actual change of the Nurek reservoirs full volume

Analytical calculations of the Nurek reservoir volumes and sedimentation

For of analytical calculations were are used daily values of main parameters of Nurek HPS: the water volume passed through the turbines of Nurek HPS (Q_1, m^3/sec), idles water outlet through hydrounit (Q_o, m^3/sec), inflow of water to the reservoir (Q_3, m^3/sec), level of upstream face of the reservoir (L, m) .

For it chosen any base point (W_o; H_o) other points of a curve dependence of volume of reservoir from level of water in reservoir (W=f(H)) can be received directly on the equations:

$$W(H_{i+1}) = W(H_i) + W_a \cdot f(\Delta H) \quad (1)$$

$$W_a = f(\Delta H) = \{Q_3 - (Q_1 + Q_o + Q_2)\} \cdot t \quad (2)$$

where, t = 1month. As base for all further calculations we accept point W_0 = 10.5 km^3, H_0 = 910 m. corresponding a design condition of the reservoir.

For calculation of evaporation and the face area of the reservoir following dependences have been used accordingly:

$$Q_2(t) = k \cdot S \quad (3)$$

$$S = 0.39408 \cdot H - 267.86306 \quad (4)$$

where, S – area of reservoir, km^2

Calculation of dependence H = f(W**)** by use of above mentioned methods for Nurek reservoir for 2003 and 2004 years presented on the fig.5 and fig.6.

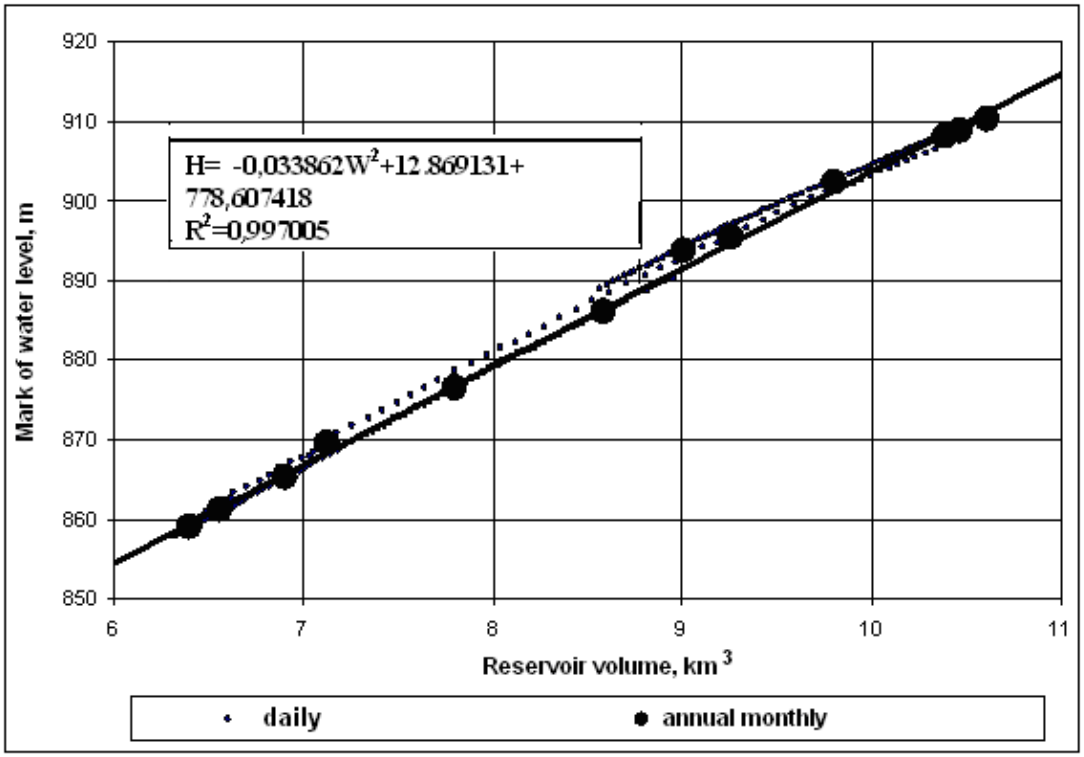

Fig. 5. Calculation of the dependence H=f(W) by use of Nurek HPS data (2003 y.)

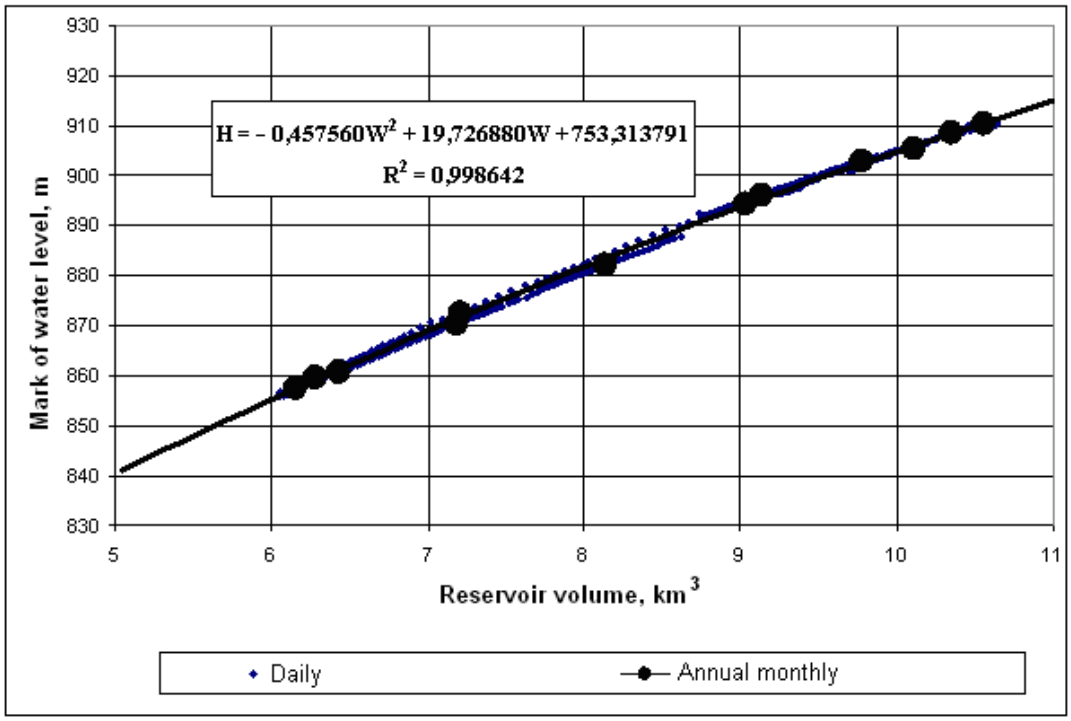

Fig. 6. Calculation of the dependence H=f(W) by use of Nurek HPS data (2004 y.)

Operating modes of the Nurek reservoir are shown on the fig.7 at working-filling regime corresponding to 2003 and 2004 years. From fig.7 can see that these modes practically identifiable. Every year in the summer the reservoir is filled up to normal headwater level (NHL) 910 m and works up to level of deep volume (LDV) 857m. Considering analogousness of operating modes of the reservoir and practical identity of analytical curve volumes of the reservoir in 2003 and 2004 years on fig.9 their presented general middling and project meaning of the Nurek reservoir volumes curve. They practically repeat each other-the general useful volume of the reservoir for them the same, small sedimentation the order 5% analytical curve shows only on average marks, and to a mark of 840 m the useful project volume of the reservoir practically is completely restored.

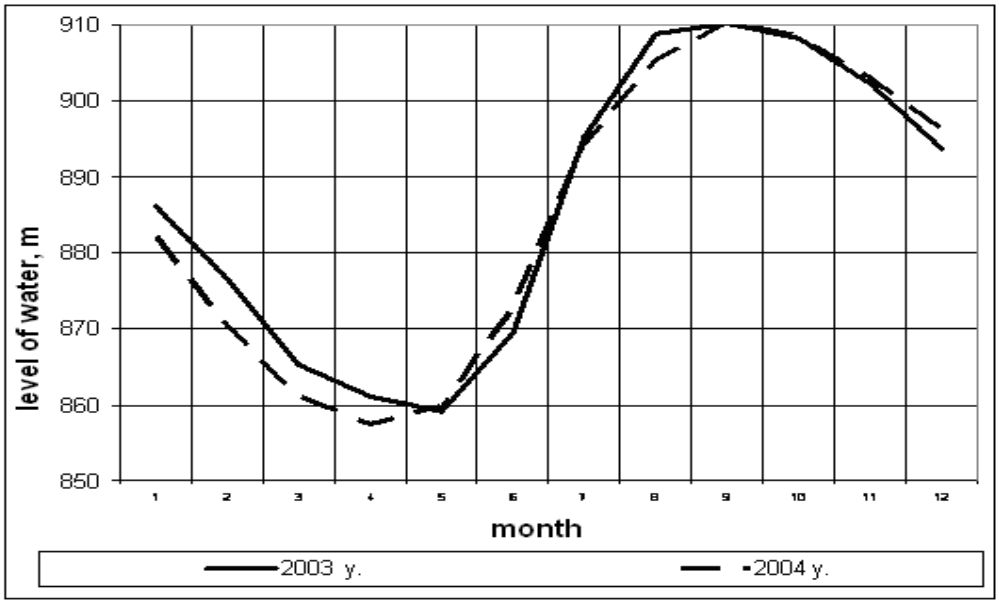

Fig. 7. Work regime of the Nurek reservoir in 2003-2004 years

Monitoring state of Tajikistan mountain glaciers

Quite recently 28-30 November, 2006 in Kazakhstan held Regional Workshop on "Assessment of Snow-Glacier and Water Resources in Asia". Participants in the Workshop experts and professionals from Central Asia Region together with international expert nothing that changes in glaciers in the world's largest and highest mountain system will have significant effects on nearly 1,5 billion people. They recognize that glaciers are key indicators in monitoring and detecting global warming and climate change.

Tajikistan is mountain country which 93% of his territory occupied by mountains and in Tajikistan there are more 8400 glaciers by the total area of 8476, 2 km^2, or about 6% of all territory of the Tajikistan. The center of the main area of glaciations of Tajikistan is Fedchenko glacier - the largest mountain glacier in the world.

Only for forty years from mountain range of Academy of Sciences, Zaallay and Kaindi have disappeared 14 not large glaciers the general area of 7,6 km^2. Average speed of movement of glacier in connection with loss of weight has decreased from 72 up to 69 cm daily. In total for 20^{th} century the glacier has lost about 12-15 km^3 ice.

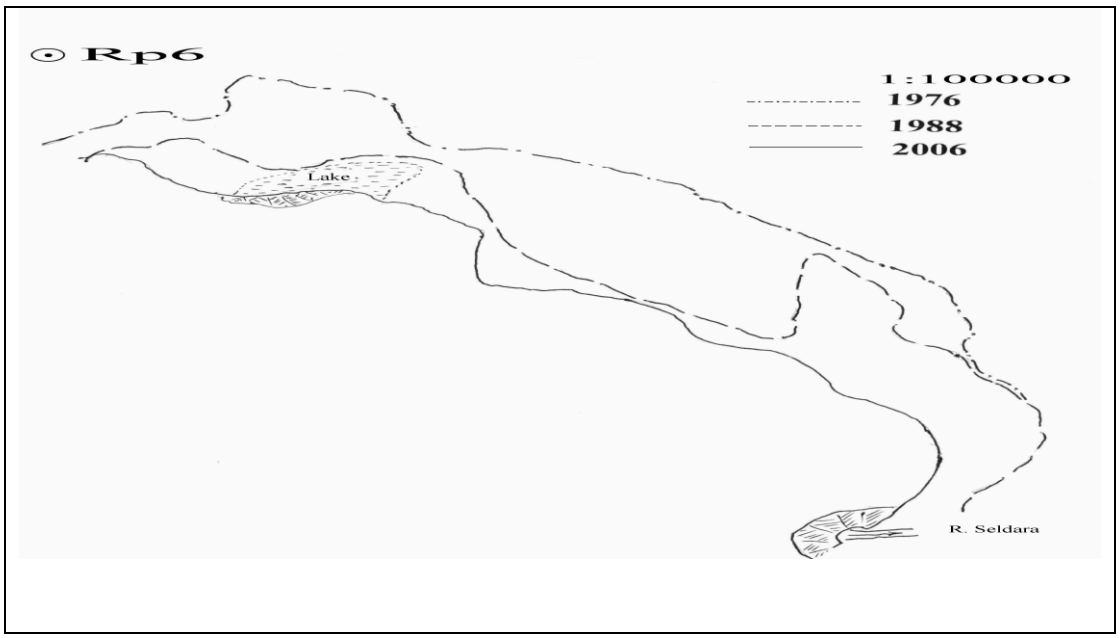

Fig. 8. Deviation of Fedchenko glaciers

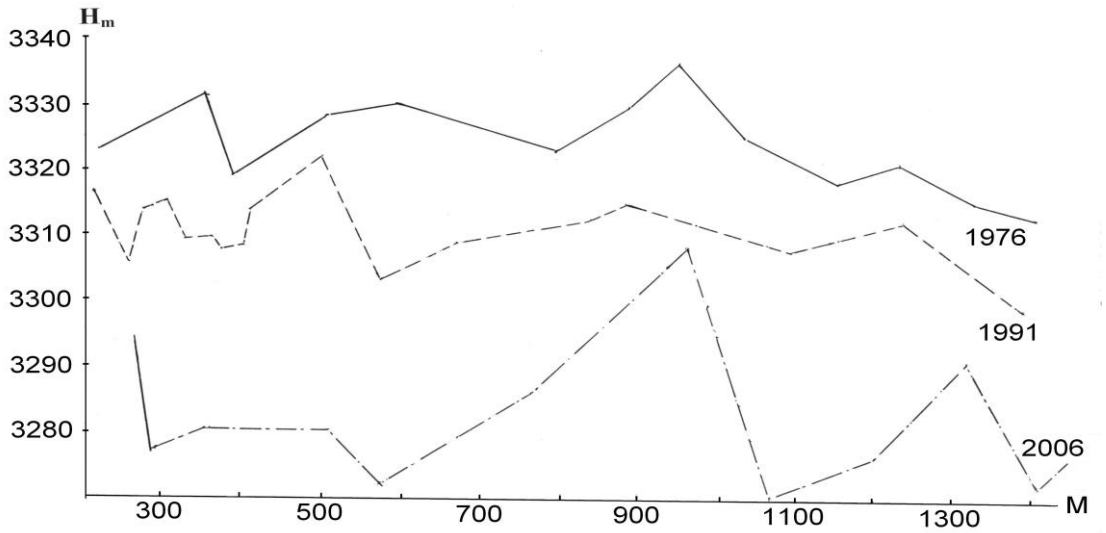

Fig. 9. Cross section change of the profile No.4 of the Fedchenko glacier

The next expedition on glacier Fedchenko in September, 2006 demonstrated that glacier Fedchenko continues to be reduced non-uniformly with speed of 8-10 meters in a year.

Strategy of Integrate Water Resources Management

The main goal of project is elaboration the national (Tajik) strategy of integrated water resources control of Vakhsh part of Amydarya River transboundary basin on condition affirmed by Government with purposes, conception and program of country development for 2015-2020 years and high uncertainness of real possibility and term for realizing these plans (Normatov, 2007).

By understanding that elaboration of concrete strategy could not be divided from practice of its realization elaborated in framework of given project strategy conception of IMWR creates reliable conceptual base for providing rational and effective use of water resources with maximum possible and balance profit lo all consumers by minimum negative influence on environment. The strategy of IMWR bases on main principles which provide achievement of three goal of ecological steady development (ESD): economical development, social development and protection of environment. On this strategy of IMWR sub-basin Vakhsh River bases on international right of Tajikistan as an independent sovereign state to use all having water resources in bound of its territory according to national legislative standards and with account of another states' interests situated in transboundary basin of Amydarya River.

In this case priority will be given to:

- Many branches approach to control of water resources include protection of all fresh water sources and resources. There is effective use of water resources in irrigation in compare to widening sewage-farm.
- Planning the stable and rational use, protection, economy and control of water resources in the base of demands and priorities of society on framework of national development's politics with account of economical effectiveness, social usefulness and necessity of realizing projects.

In framework of given Strategy with purpose of improvement the control of water resources are proposed to accelerate passage to hydrographic method of control. For this as the first step it is proposed to conduct Republican Commission and in its structure Working Group. The main task of Commission is harmonization interdepartmental interest, planning Lo use water resources and solution of practical problems of passage to integrated control of water resources, cooperation on conducting administrations (Committees) of channels, basin administrations.

On staff of Republican Commission there could take part representatives of Ministries and Departments that somehow or other draw in on control of use of water resources and also representatives of society including non-government organizations.

The main tasks of Commission are:

- Long term planning of water resources' use and planning of development.
- Drawing up recommendations on definition and agreement political aspects on sphere of using and guarding water resources.
- Consideration of suggestion on improvement of regional and interstate water dividing, improvement of regimes of water resources using.

• Informing society about development plans and water resources using.

All activity of Commission and Working Group must be directed on improvement of water resources control, gradual achievement of basin Commissions and Committees independence by active participate of all interested parts and sectors.

Short-term measures (5-10 years)

In the beginning stage of realization of strategy first of all it will be created active Working Group for preparing necessary documents and suggestions for Republican Commission main tasks of which had been mentioned above.

Fulfilling adopted decisions of Government on conducting administrations (Committees) of channels, refund Administration of Irrigation System according to hydrographical principles of water resources control and providing representations of all interested parts of water using and society;. There will he elaborate and co-ordinate basin plans of control, use and guarding of water resources.

Middle-term measures (10-15 years)

As extraordinary measure by end of period it will be redistributed of function and changed structure of main interested sector ministries. It needs decentralization of water resources on basin level. There is creation the system of complex monitoring of nature resources and necessary base of statistics.

Long-term measures (15-20 years)

There is completion of mastering water-energetic resources of Vakhsh River's basin.

Creation regional marked of water resources.

Conclusion

The above-performed analysis of Central-Asian water-energy complex problems shows that on the whole the region possesses necessary resources and potential for normal sustainable development. The main obstacle for their efficient use is not rather economic crisis, from which all the republics of the region suffer now, than from the existing interrelations between them. The reason of all this consists in the breakup of traditional ties and euphoria of independence of young states and well-known populism of politicians. Therefore the top-priority objective today is overcoming all this and forming good neighborly mutually beneficial relations between the republics of the region. Unconditionally the final, purpose in correlation between the countries of the Central Asia in sphere of water – use is the development of single agreed conception and strategy for joint water and power resources use of Aral Sea basin and as one of its components Syrdarya river basin. But as it was mentioned above the task is very complex, it requires a lot of time, especially with account of transforming period experienced now by all our republics. For that in any even favorable case it can be decided only step by step, successive detailing and solving separate problems. As the first-tern problems are supposed the followings:

-To make more active and complete started development mathematical models optimization and management use of water and power resources of the Syrdarya and Amydarya rivers basin (both in seasonal and many-years plan).

-To carry out inventory making and analysis of operating up to now agreements, declarations, treaties in area of water and power resources. To develop supposes on carrying out them accordance with existing conditions.

-To carry out analysis international rights norm, regulating correlation between states in area of joint water and power resources use. To develop recommendations on separate the most important for the Agreement questions:

•correlation and national rights
• rights of states on establishing work regimes of available reservoir and other hydro-construction under their jurisdiction
• main principles of water-distribution with account of long-tern perspective;
• rights and duties on performance of the Agreement, including in case of breach the duties by the another side
-To carry out systematic analysis of common water use problem with detailing separate tasks. Develop general structure of a problem and program for it successive decision.
-To perform analysis of modern management of water and power resources use in republican and regional levels. Develop supposes on their improvement with account of creation in perspective all-regional market for main products and services.

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