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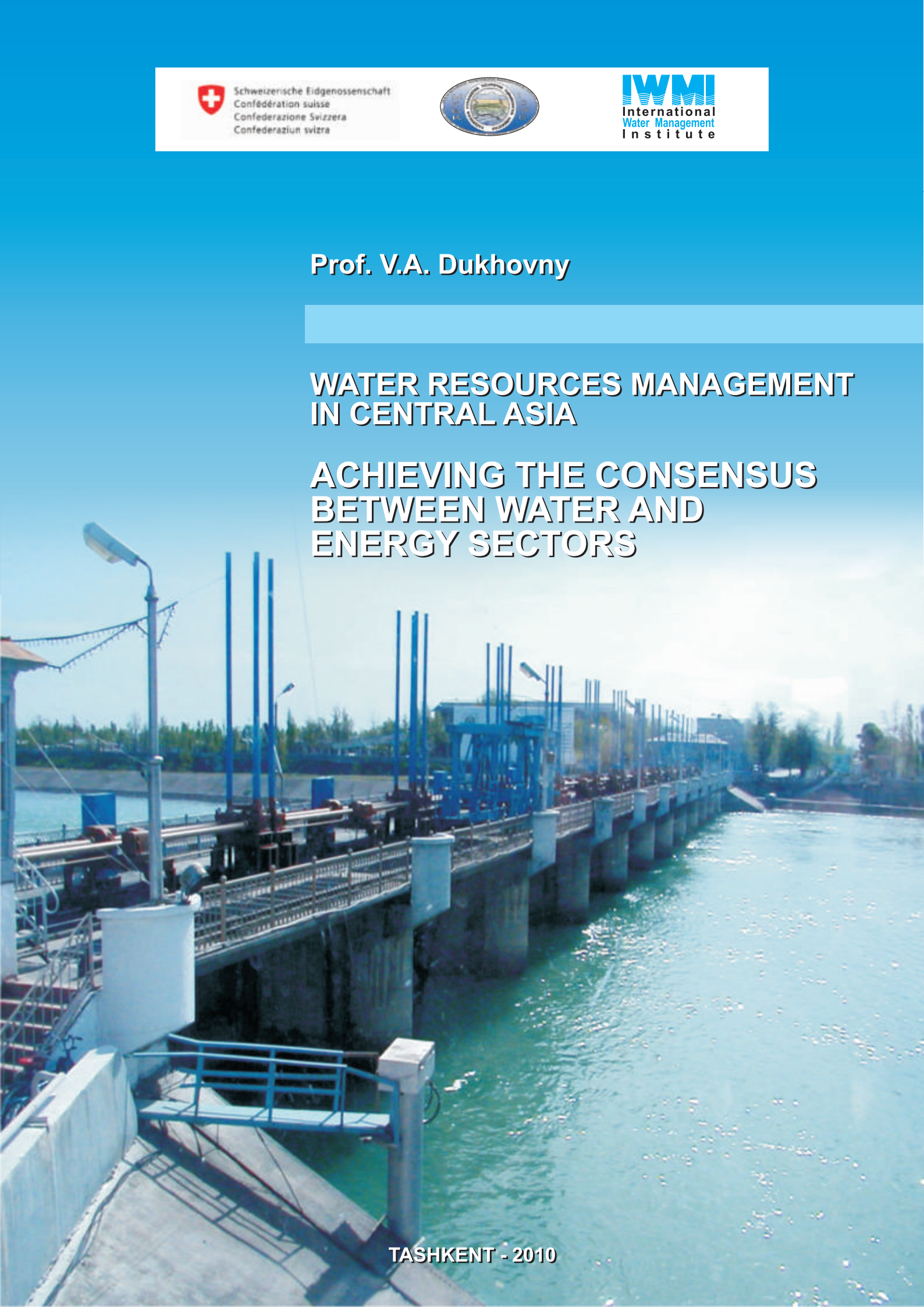
WATER RESOURCES MANAGEMENT IN CENTRAL ASIA

ACHIEVING THE CONSENSUS BETWEEN WATER AND ENERGY SECTORS



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Climate change, increased demographic pressure, and unilateral sectoral development combined with raised environmental awareness lead to aggravation of water relations in Central Asia. Although, at present, as a whole water should be enough for both irrigation, household and other needs, including hydropower, there is continuous tension around the issue of reconciling various water users, particularly upstream and downstream, within the space of Central Asia.

The unbiased assessment of situation related to water use is based on an information system and database. Such system operates successfully on the portal **www.cawater-info.net.** The system helps to make systematical analyses of water releases on annual, quarterly, and even ten-day basis and of water allocation among the states and planning zones. By using this feature, the experts from SIC ICWC have developed a forecasting tool as the set of models combined with various water-related development scenarios (climate, socio-economy, agriculture, water sector, and environment) that are integrated through the common interface.

The analysis and forecast by 2035 allows us to have future outlook and, at the same time, develop measures to ensure essential water supply for the regional development and the nature through enhanced cooperation, while keeping to the international water law principles, promoting water saving, and, especially, implementing integrated water resources management. Experience in promoting IWRM in the four provinces within the Ferghana Valley shows that the involvement of water users themselves, the use of all types of water, and the linkage of various water hierarchical levels and different sectors allows substantial reduction of water delivery, given some improvement in water and land productivities. Implementation of IWRM is a return to the century-old traditions and rules of an attitude of care to water and the equitable water allocation. The regional future rests with the countries and people of the region and no outside assistance could replace our local people's attitude to water as to a holy thing.

Reviewer: Prof. Sh.H.Rakhimov, Doctor of Technical Science

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Preamble

Among the latest developments that alarm all the world there is one event which seems to be local but is quite indicative because it signifies the growing danger that threatens our planet. A drive for profit to the detriment of nature and manifestations of oil-and-energy greediness to the detriment of the status of world water resources are obvious! Lately, a submarine oil gusher rages in the Gulf of Mexico resulting in poisoning of its waters and destroying all living things, as well as unemployment of thousands of people and losing opportunities related to use of gulf waters. The Government of the most powerful nation in the world (the USA) is bearing losses (by this time, US$ 2.5 billion); and nobody is able to appease the devil that is its creature.

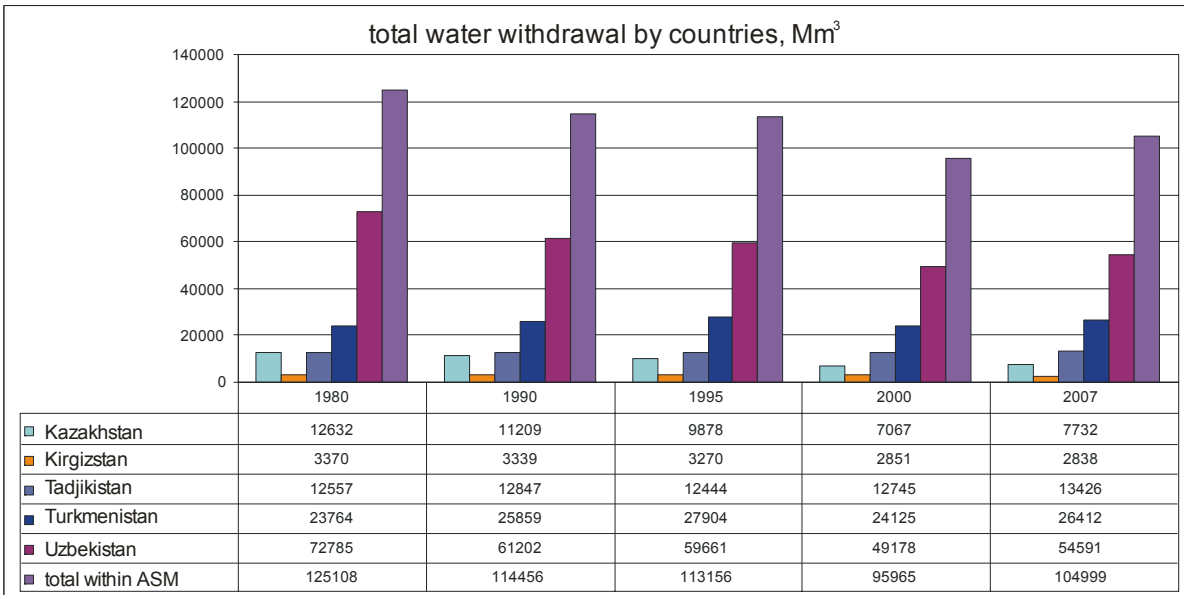
The similar events can be expected by all mankind but in the much greater scale – all over the world – if we will not able to neutralize uncontrollable greediness of oil producing companies and producers of other kinds of energy that do not pay heed to their destructive impacts on such a sacred natural resource as water in chase of their profit.

Whether intentionally or not, the question concerning interactions of water and energy sectors is arising again! How to be: together or apart? What they present: similar to each other resources, which can be transformed into goods or different substances that require the quite reasonable approach and should be used taking into consideration some mutual interrelating but without any mixing, because their mixing can be fatal as the incident in the Gulf of Mexico? Of course, it is impossible to stop the socio-economic development, especially a progress in the energy sector, because, for example, only 6% of the population is supplied with electric energy in Africa, and about 20% of the population is insufficiently supplied in Central Asia. It is not issue to supply energy to those who have not it. This can not destroy nature. However, the current tendencies related to commercialization, excessive consumption, and regular attempts to present water as the analogue for energy and the energy sector as a dogma of our time should be stopped.

Today, all in the larger extent, science inclines to the supernatural beginnings of Earth and life on our planet in its different manifestations. It means that water was created by God, and as its chief manager he sends us today the signs in the form of events in the Gulf of Mexico, and floods in China, Poland, and Brazil, as if he is speaking: “People, be careful! Turn your faces towards the water, nature!”

Central Asia, as the more ancient region of the world and the centre of civilization that was born about 4000-5000 years ago on the basis of development of irrigated farming, was always in close dependence from water as the source of life, food supply, and prosperity of a human being. Water joined peoples in their efforts to

adapt to nature's whims and hydrological fluctuations in water sources. With accumulating experience and knowledge, it forced people to study certain regularities in the combination of astronomic, climatic, and hydrological events. On the basis of local water resources, farmers have developed the irrigation systems, which amazed European and Chinese travelers many centuries ago. The population growth and agriculture-intensive approach to economy development under satisfying the material needs of tsarist Russia firstly and then the Soviet parent state have resulted in one-sided focusing on meeting the needs of society in water resources, food, and employment mainly on the basis of extensive development of the agricultural sector without taking into consideration the capabilities of nature. At the same time, water withdrawals were changed in all Central Asian countries in comparing with 1980: some decrease in Kazakhstan, Kyrgyzstan, and Uzbekistan versus some increase in Tajikistan and Turkmenistan.



	1980	1990	1995	2000	2007
Kazakhstan	12632	11209	9878	7067	7732
Kirgizstan	3370	3339	3270	2851	2838
Tadjikistan	12557	12847	12444	12745	13426
Turkmenistan	23764	25859	27904	24125	26412
Uzbekistan	72785	61202	59661	49178	54591
total within ASM	125108	114456	113156	95965	104999

Figure 1 Water Supply Trends in the Aral Sea Basin (1980 to 2005)

Development of the hydropower sub-sector within the water sector had the associated nature as one of lines in use of water reservoirs' capacity for seasonal and multi-year regulation for the purpose of sustainable water supply for public water-supply service and industry, and mainly for irrigated agriculture. It was typical for last century to consider the hydropower sector in all design documents as the component of integrated water resources use rather than an end in itself, under prevailing the interests of water-saving and irrigation in spite of the positive assessment of significance of the hydropower sector for this region. For example, we can quote an extract from the report prepared by the Commission for Formal Acceptance of the Toktogul Hydro-Scheme Project[1]: "*The primary function of the Toktogul Hydroscheme is over-year compensatory regulation of the Naryn River's flow for the*

[1] "Measures for optimizing water resources use in the Syr Darya River Basin taking into consideration operation of Toktogul cascade of water reservoirs for the benefit of Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan" Tashkent, SIC ICWC, 2008.

purpose of improving water availability for irrigation in the Syr Darya River Basin, which is a key water consumer, and meeting the needs of communal and industrial sectors in water. Using this hydroscheme for the purpose of energy production is incidental use."

"Status quo" that was formed in that period was based on well-balanced, planned water resources distribution among riparian republics in line with "The schemes of integrated water resources use" and the common market of electric power, which was regulated using the unified system of tariffs for fuel resources and electric power. Although water resources were rather inefficiently used, however water, hydropower, and fuel (gas and coal) were in the sufficient quantities for all in accordance with the water balances regulated by the State Planning Committee of the USSR, on the one hand, and the balance of fuel and energy resources, on the other hand. Undoubtedly, all this well-being was based on infringement of the needs of nature that has resulted in disappearing of the Aral Sea and desertification of adjacent areas, which the UN Secretary-General Ban Ki-moon has called as "one of monstrous catastrophes in the 20th century."[2]

After gaining of independence, possibilities, orientation and aspirations of riparian countries have immediately changed. The paradigm of "joint use of water resources" was approved by the Agreement signed by riparian countries on February 18, 1992[3] that maintain, de jure, water allocation principles and commitments of all riparian countries regarding use of water diverted from transboundary water sources. However, later this paradigm was transformed into two lines of behavior in reality: water management organizations continue to plan their water use as before according to canons of "the federal water allocation principles", but hydropower generating companies that are owners of water reservoirs with hydropower plants ("Kyrgyzenergo", Naryn HP Cascade; and "Tajikenergo", Nurek HP) have shifted to the hydropower regime of using water accumulated in reservoirs, making reference to the notorious Harmon doctrine. After long-term discussions between representatives of the water and hydropower sectors with signing numerous annual protocols, which tightened up a stranglehold on the neck of Uzbekistan and Kazakhstan in the Syr Darya basin and finally resulted in the 1998 Agreement, that, per se, legalized the barter of "water and electric energy in summer versus gas and coal in winter." Nevertheless, this agreement was being executed until the time when appetites of hydropower companies became contradicting the interests and possibilities of downstream riparian countries. The current stage of relations between upstream and downstream riparian countries has become tighter; at the same time, a degree of tension in relations depends on, to a considerable degree, natural annual water availability in main river basins.

The following sections are devoted to characterizing the current situation and prospect of interstate water relations in Central Asia.

[2] The meeting with journalists in Nukus, April 5, 2010

[3] The agreement between Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan: "On cooperation in the sphere of joint management, use and protection of water resources diverted from interstate sources" 1992, www.cawater-info.net/library/rus/icwc.pdf

I Water and Energy – Differences in the Essence and Identity in Complicacy

Fresh water, nothing can be compared with it according its role in life of mankind, society, existence and preserving of nature, and also, in general, in developing the ethic, culture, art, science, and even religion. It is no mere chance that all religions are presenting water as the origin of all beginnings, as sanctity and creation of God, symbol of God, life-giving existence of God, his environment and inherent content.

The Quran (25. al-Furqan: The Criterion; 28. al-Qasas: The Narrative) runs as follows: “And We send down from the heavens pure water, to quicken therewith the dead country, and to give it for drink to what We have created” and “Have you considered the water which you drink? Do you make it come down from the clouds, or do We make it come down? If We pleased We could make it pungent - why then do you not give thanks?” (56. al-Waqi`ah: That Which is Coming). A human being consists of water and needs water; purifying force of water specifies its sacred and symbolic status being the key element of religion ceremonies and rituals (christening, ablutions, asperges, etc.). In Buddhism, “to cross a flow” means finding of the enlightenment and going through a world of illusions. For the enlightened in Buddhism, a river is the goddess which cleanses you outside and inside.

The note of UN Secretary-General, which was prepared according to the Resolution # 64/198 of the UN General Assembly, runs as follows: “Fresh water, as air, represents the environment indispensable for existence of people and civilization on Earth, and for fauna, flora, and ecosystems as well.”

Supporters of the parity between water resources and energy resources usually emphasize that the current civilization and life of people under the present conditions are unthinkable without energy supply, electric power, gas or another source of energy for cooking. However, the water is not only the source for supporting life, but also it is life itself of people and, how it was stressed in the above mentioned note, of all living things: plants and animals, and what is the most important, the water is an integral part of nature per se. Our rivers, ponds and other water bodies will disappear without water; groves will dry up and parks will become bare as if will be prepared for a public execution… A man can survive without food one month, without electricity during many years, but without water no more than one week!

Another postulate of these supporters consists in the following: water and energy, especially fossil fuel such as oil, gas, and coal are the elements of national prosperity and integral feature of national sovereignty. It would be so if all kinds of waters on Earth have not been involved into the single hydrological cycle that exists on the permanent basis and undergoes changes. Water is flowing, not recognizing national boundaries; water is withdrawn for some kinds of uses and then returns back from users into a river in the form of sewer and waste waters; water evaporates forming

clouds and then falls on the land surface as precipitation. Heraclitus who is famous for his doctrine of change being central to the universe spoke: “You cannot step twice into the same river”, because its flow, visible or invisible, takes place permanently.

Supporters of water commercialization try more and more to create the visibility of linkup of water resources and hydropower generation for the benefit of hydropower monopolies. Under this “dressing,” they try to imitate the single market mechanism for management of water and hydropower sectors in the interests of gaining commercial profit and simultaneously strengthening the certain geopolitical positions. Such terms as “water and energy resources” or “water and energy potential” continually appear in official documents and published papers but their sense is rather different from earlier-used terms “water-power resources” or “water-power potential.” In the world practice, and particularly in the multilingual glossary of the International Commission on Irrigation and Drainage (ICID), they mean the resources of energy potential of water sources i.e. potential energy resources that can be created on the basis of regulating water resources by means of construction of dams. According to the new interpretation, we deal with some symbiosis of water and energy resources, because in line with their sense they cover the sphere of water resources management and the sphere of energy resources management, which, according to the organizational structure in each riparian country, are managed by absolutely different economic players and, per se, represent absolutely different entities for management. In confirmation of this postulate, we describe a few distinctive indications that were previously mentioned:

- Energy resources can be received from different sources: hydropower, heat power-stations based on various fossil fuels, solar power, wind power, bioenergetics, and nuclear power. All these kinds of energy resources are interchangeable. At the same time, according its value for a human being, nature, and society, water is the crucial substance that can be replaced by anything neither for a human being nor for all living things.

- Energy resources are goods, which can be bartered or sold, but water, excluding water in bottles, never was goods; and the international water legislation does not recognize commercial transactions with water resources. Specific services related to water delivery, treating, desalination, regulation and distribution can be paid; bottled water can be sold, and, at last, the right for water use can be sold, but water cannot be a commodity, by no means.

- Water resources, as opposed to energy resources, are a fundamental element of the natural complex, without which nature cannot exist. At the same time, the world existed and was developing without electric power[4].

Combining terms “water resources” and “energy resources” in one phrase at once results in the incorrect understanding and interpretation of the international legal norms and the right for use of water and energy resources within territorial boundaries. The international legislation (the 1992 Convention, 1997 Convention, and other legal documents) prescribes the notion of international watercourses or transboundary water resources. At the same time, there is not the notion of international energy resources or transboundary energy resources in the international

4 V.A. Dukhovny, Water and Energy: Together or Apart? www.cawater-info.net/library/carewib.htm

legislation. Although, there is the notion about the transnational energy complexes (as example, in the EC).

Efforts of uniting water and energy resources as the means of commodity circulation result in ignoring of the role of water for nature and social needs of a human being that were clear declared at the Rio Conference in 1992 (the Earth Summit). Water that turns turbines produces the cost of generated electric energy; water in the industrial sector is used for producing industrial goods (machines, mechanisms, materials, etc.); even water for irrigation can be partly included into the cost of agricultural output (although all over the world water for irrigation is subsidized, even in the USA and European Union). However, who will pay for water for preserving nature, for water which should flow in a river in order that a river remains a river? May be, God who created these rivers and nature as a whole!

On the other hand, if water is an article of trade then why owners of this commodity accumulate it in water reservoirs in summer when its price so high, and then irrationally release it in winter, creating man-made floods and causing damage. A commodity should be stored and used if and only if it is the most expensive and effective!

Undoubtedly, use of water and energy faces similar problems. First of all, this is no uniformity of their distribution over the planet and even within one country (both resources and demands). Therefore, a ratio of reserves and demands both for water and for energy creates unequal opportunities for covering the balance of water and energy resources - there is their excess in some geographical zones and deficit in others. Covering any deficit in some geographical zones is being made at the expense of excess in other geographical zones. However, there is one principle distinction: deficit of one kind of energy (for example, fossil fuel) can be covered by another kind of energy (for instance, solar energy), but water deficit can be covered only by water!

The international practice provides the excellent examples of linkup of using water and energy resources. The first example of applying the international water law is the International Joint Commission of Canada and the United States that during almost 100 years successfully manages water resources of Great Lakes and transboundary rivers with their enormous hydropower resources. Similar to many other developed countries, their water management agencies establish water quotas and regime of water withdrawals, first of all, for the natural complex and then for meeting demands of different economic sectors on equal terms. For example, *the minimum ecological flow through the Niagara Falls was established at the level of 600 m^3/sec in winter and 1000 m^3/sec in summer*, and in case of water shortage the deficit is equally covered by the USA (the right riverbank) and Canada (the left riverbank). In contrast to the situation in the Syr Darya river basin where the owners of hydropower plants (HPs) require the payment for water releases, the US Reclamation Bureau establishes the schedule of water releases from reservoirs located on the US West including the schedule for HPs operation; and owners of hydropower plants pay for water releases related to their operation.

Thus, we can talk about separate use of water resources and energy resources but under their mutual co-ordination, taking into consideration water resources available for use i.e. for hydropower generation and other purposes (water supply, irrigation, recreation, etc.). Therefore, under elaborating the plan of regional water resources

development and use, it is logical to establish the rules and procedures for both water resources use and energy resources use, and their mutual co-ordination by means of preparing the balances for water and energy resources. The similar practice exists also in Spain and many other countries (for example, operation of hydropower plants on the Rhine River).

Exclusive features of water provide to stakeholders the right of selecting of priorities at all levels of water-management hierarchy in contrast to efforts of owners of hydropower facilities to dictate of their own interests (and even to organize political games) to all other water users. **In this case, the Water Code or Code of Water Ethic should be applied**.

II. Integrated Water Resources Management (IWRM) – the Basis for Conflict-Free Satisfaction of the Needs of Society and Nature

The IWRM concept involves the systematic approach for satisfying all needs in water of all stakeholders, taking into consideration the needs of natural complex and possibilities of using all types of waters. In line with the theoretical propositions that were represented in the number of published works of the SIC ICWC,[5] IWRM includes the following:

- Planning and management within hydrological boundaries;
- Active participation of all stakeholders in joint planning and management;
- Considering the needs of all stakeholders;
- Accounting all kinds of waters available in the basin;
- Focusing on water-saving and the potential, technically-possible level of water consumption and on potential productivity of water resources in all economic sectors-water users;
- Supporting the maximum efficiency of water use, which should take into consideration social, economic, and associated effects within a river basin, as well as integrating of water and land resources; and
- Focusing on maintaining of the ecological equilibrium and satisfying the needs in water of nature.

Such an approach is quite close to the approach of Dr. A. Druzik,[6] in the frame of which he suggested to review the basin complex outlooks as well. This approach also includes considering all kinds of interrelations within the basin with assessment of possible options and their impacts on water and associated resources, as well as on socio-economic and environmental indicators. The same author made an example of quite successful planning in the frame of the IWRM projects for the Savannah River on the south-east of the USA and the Kenzi River on the northwest. Another example is the Columbia River basin where the interests of hydropower, environment, and fishery entered into competition; as well as the Saint Lawrence

[5] Integrated Water Resources Management: Putting a Good Theory into Practice. Central Asian Experience. Edited by: Prof. V.A. Dukhovny, Dr. V.I. Sokolov, and Dr. H. Manthritilake. Tashkent, 2009, SIC ICWC, GWP, 380 p. http://www.cawater-info.net/library/books.htm

[6] A. Dzurik "Water resources planning", NY - London, 341 pages, 1996

River basin where planning of the water complex was conducted by the United States Army Corps of Engineers using the IWRM approach (2007).[7]

Concerning the Aral Sea Basin, the same approach was proposed in the projects: "The Scheme of Integrated Water Resources Use and Protection in the Syr Darya Basin" (Design Institute "Sredazgiprovodkhlopok", 1979) and "The Scheme of Integrated Water Resources Use and Protection in the Amu Darya Basin" (Design Institute "Sredazgiprovodkhlopok", 1984). It is necessary to note that these schemes coordinated the needs in water resources of water supply, industry, and agriculture at the sufficiently acceptable level, also considering the interests of the hydropower sector (as the associated sector), simultaneously satisfying the needs in fuel and energy resources in the frames of the united planning made by the State Planning Committee of the USSR. As a whole, it was assumed that the needs of this region will be met at the expense of strengthening the use of return waters and implementing the comprehensive reconstruction of I&D systems with simultaneous improving their efficiency and the efficiency of field water application methods.

However, these schemes did not meet some requirements of the present-day IWRM planning: they did not take into account the environmental needs of the Aral Sea and adjacent areas in full; they were not supported by the realistic action plan for their implementation; they did not base on any assessment of alternatives; but what is the most important that co-ordination and discussion were conducted only on the level of national governments without participation of all stakeholders; the financial and economic analysis did not correspond to the principles of market economy that was already developing at that time, and therefore, the financial sustainability of development could be provided only under preserving the administrative principles of water resources management (the principle "top-down").

Establishing two basin water management organizations in 1987 (BWO "Amu Darya" and BWO "Syr Darya"), which have started to monitor the water distribution process on inter-republican rivers and water use practice in the republics has become the important step towards implementing IWRM at the basin level. Activity of two BWOs has resulted in considerable decrease in amounts of water withdrawals from inter-republican rivers by 1990.

Use of the IWRM concept in respect to transboundary waters in Central Asia allows coordinating the future development and interests of riparian countries in water and energy resources, at least, at the level of possible solutions.

At present, such a model is elaborated by the SIC ICWC together with the IHE-UNESCO; and we hope that with technical and financial assistance of the EC IFAS and the World Bank, that take an interest in this work, it will be possible to find the right ways and to build platforms for co-ordination of inter-sector and interstate activity in the region.

The essence of this project consists in the following:

In the frames of IWRM, planning of long-range development at the basin level, per se, is implemented according to two major modules (Figure 2): the hydrological model and the socio-economic model. Accordingly, the first module is nothing more

[7] E. Stakhiv., "Case study St. Lawrence water complex." Arlington, 2008, USCE, Volume 2, 510 pages.

than “resources management”, and the second module – “water demand management.” A key task of planning is to provide any excess of resources over demands or, at least, their parity, i.e. their balance. It is naturally that the prospective planning should be based on evaluating of different scenarios, and in this case we face the quite serious complexity due to interrelations of two modules, as well as due to possible arising of numerous variants. It is necessary to mention that, according to the planning system adopted all over the world, the hydrological module or the water resources model is built up according to the hydrological principle (along the river channel), but the socio-economic module is built up according to the territorial principle, covering some parts of watershed or so-called “planning zones” (PZ) that are coordinated with national development plans. However, these two blocks are extremely dependent due to not only coordinating of the balance but also due to their relations. The fact of the matter is that water consumption in each PZ forms its productivity in the irrigated farming sector and in other economic sectors associated with water economy, and in addition, water diversion into each ZP is accompanied by formation of return waters, which are released into a river and affect the hydrological cycle in the basin in dependence from their salinity and volumes.

On the other hand, when socio-economic indicators concerning demography, well-being, food demand, industry and other social aspects represent the components of water consumption (demand management), water withdrawal for irrigation in each ZP and in a country as a whole, along with the regimes of water releases from reservoirs serving also for hydropower will be competitive items of the water balance and future development that specify a volume of gross production in the agricultural sector and a volume of electricity produced in the hydropower sector. However, this problem should be solved differently than it was solved in the frames of the schemes developed in the Soviet time on the basis leaving no alternative: all possible options under combining of different positive and negative factors must be analyzed; and, as a result, we will specify the whole range of available opportunities and potentials. In this case, serious difficulties arise in the process of selecting the options of prospective development that we consider as the combination of climatic, industrial, agricultural, hydrological, and economic variants (Figure 3). As a whole, we deal with 36 variants as minimum, without variants of engineering solutions. Such an approach under planning IWRM gives the opportunity, to some extent, for coordinating the needs in water for irrigation, water supply, environment and hydropower generation (depending on the regime of water releases via the hydro-schemes, it is possible to calculate the volume of hydropower production and to compare it with energy resources demands and possibilities for their covering).

The mentioned approach allows, on the one hand, to take into consideration not only direct economic effects of irrigated farming in each planning zone but also associated effects due to processing agricultural output, developing the service sector, and improving the living standard of population in the rural area. Our investigations in the frames of the IWRM-Fegana Project have shown that US$1 of net effective income in the irrigated farming sector can provide US$1.8-2 of incomes in all associated economic sectors. Under taking into account the increase in salaries and covering taxes, the effect will be more considerable.

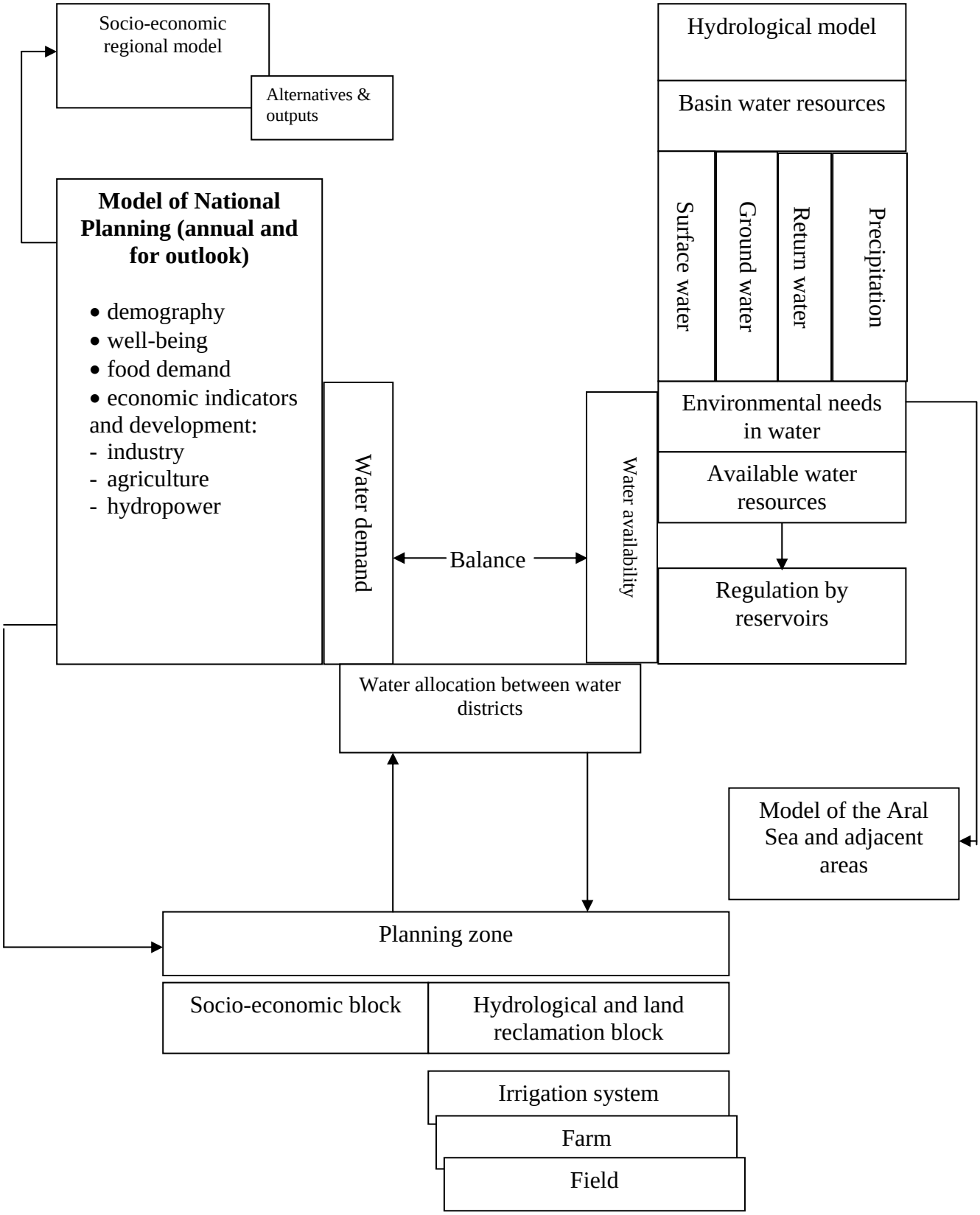


Figure 2 Two Modules of Thematic Modeling

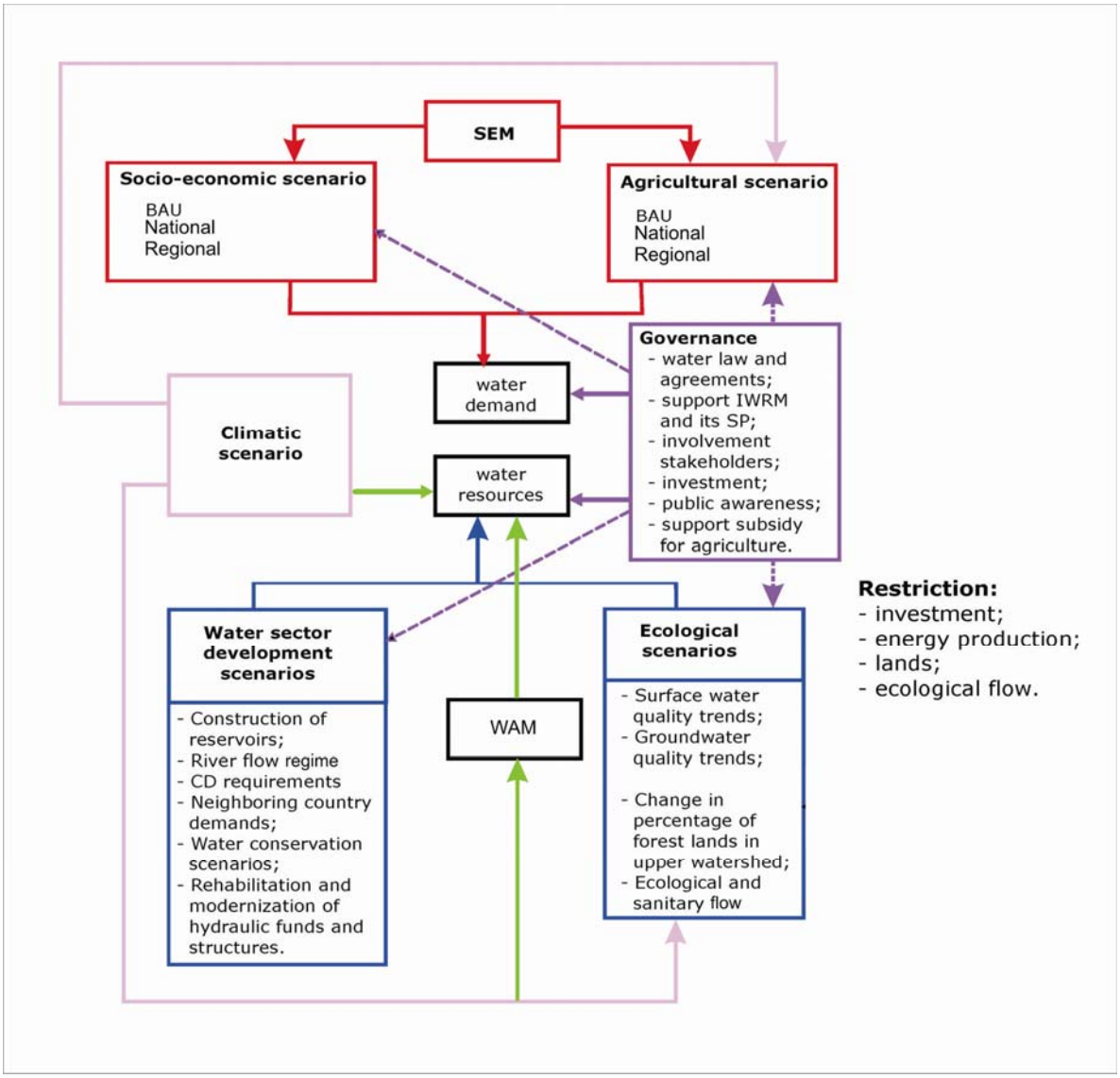


Figure 3 Scheme of links between specific scenarios under modeling

It should be mentioned that the irrigated farming sector and associated economic sectors provide considerable employment in the rural area that is also the guarantee of labor resources stability; at the same time, decline in agricultural activity initiates a huge wave of labor migrants.

As opposed to the irrigated farming sector, which may have less direct effect per a unit volume of water, the hydropower sector does not have associated effects, although it provides the considerable contribution for satisfaction of everyday needs and creating of conditions for developing production. At the same time, there is the dependence from a scale of projects. Experience of the Association “Pamirenergy” (supported by the Swiss Agency for Development and Cooperation) shows that the development of small-scale hydropower projects in mountain regions is much more effective according to the cost of electric energy, recoupment of capital investment, and involvement of labor resources than construction of large-scale hydropower projects that involves mainly skilled non-rural workers.

In mentioned models of Integrated Water Resources Use and Protection (IWRUP) the environment needs are first-priority, and they can therefore ensure necessary water supply for objects of nature (deltas, river beds, lakes, fishery ponds, etc.). It is typical that our modeling of different operational regimes of the Rogun Hydropower Plant has shown that among 18 scenarios under consideration only 3 scenarios provide proper satisfaction of ecological requirements. The number of years with insufficient water supply, according to the national vision scenario, made up 88%, with average water availability of 79%, and number of years with water availability less than 90% made up 66% i.e. during 66 years (out of 100) water supply will be less on 10% and even more. Under the scenario "business as usual," the number of years with insufficient water supply will decrease up to 40% in comparing with the national scenario. Under the scenario "business as usual," annual losses in the irrigated zone of Uzbekistan, over the period of operation of the Rogun HP, will amount to US$190 million a year, and under the national vision scenario, annual losses will be increased 5 times.

Based on the IWRM principles, the planning should be aimed at fair and equal satisfaction of the needs of all water users, taking into consideration receiving the equal increment of national revenue by all riparian countries.

In the frame of the CAREC Program, the World Bank suggests a somewhat different approach that is based on specifying electricity consumption, electricity production potential, and construction of power lines for selling electric energy in commercial purposes without special attention to those difficulties, which other water users will face. At the same time, full neglecting of the needs of the natural complex, and emphasis on the increase in commercial profit during winter water releases can result in selection of the regime of winter water releases as the priority for work of the water complex that can be fraught with enormous losses for socio-economic activity and the environment.

It is obvious that this is a way of opposition and confrontation, and therefore it is necessary to come back to the IWRM principles aimed at achieving the consensus and fair satisfaction of all interests.

III Independence - and "who are located upstream those are masters of the situation"

At the beginning, after declaring independence, water resources management in the Amu Darya and Syr Darya basins have not practically changed in comparing with the former period of this activity in the frames of the single federal state. The Agreement "On cooperation in joint use, management and protection of interstate water resources" signed by the ministers of national water resources ministries on March 18, 1992, which later on was supported by the following wise agreement that was signed by the Heads of State on March 26, 1993 allowed, de jure, to save the status-quo on the basis of the following articles:

Article 2: Parties are obliged to provide strict observance of agreed procedures and rules of water resources use and protection.

Article 3: Each Party participating in the Agreement is obliged not undertaking any actions within the national territory, which can affect the interests of other Parties and are able to harm them or to lead to change of agreed flow rates or pollution of water sources.

Article 10: The ICWC and its executive bodies should ensure:

- Close adherence to the agreed regimes of water releases and established quotas (limits) of water use;
- Realization of the measures for rational and thrifty water resources use…

Intensive activity of national governments and personally presidents of five riparian countries for establishing the basis for co-operation in the field of water resources management in Central Asia that was conducted over the period of 1992 to 1995 and was reflected in a number of interstate agreements (1993, 1994, and 1995) has laid the foundation for unprecedented joint work related to distribution of transboundary water resources of two main rivers between five riparian countries. It should be mentioned that water quotas established by the resolutions of the Ministry of Water Resources and State Planning Committee of the USSR are already kept more than 19 years. National governments, through their representatives in the Interstate Coordination Water Commission, also organized the great work aimed at water-saving, decreasing of water consumption per a unit irrigated area, training activity, and, later, introduction of integrated water resources management.

However, it was found that maintenance of the established regimes of water releases from reservoirs is much more difficult task, because all managing decisions related to operational regimes of reservoirs are being made by the owners of dams and hydropower plants (hydropower companies).

In the Central Asian region, the national governments of downstream riparian countries understand the difficult situation in the upstream riparian countries (Kyrgyzstan and Tajikistan) related to deficit of energy resources due to lack of sufficient reserves of fossil fuel and make concessions. In particular, instead of earlier established volumes of water releases from the Toktogul Reservoir of 8.2 km^3 in the growing season (1982 to 1990) it was agreed to decrease these volumes up to 5.7 km^3 including 3.5 km^3 for own needs of Kyrgyzstan (irrigation and hydropower production) and 2.5 km^3 for meeting the decreased demands of Kazakhstan and Uzbekistan for irrigation. At the same time, it was suggested to coordinate use of water and energy resources in the interests of all riparian countries (as the State Planning Committee of the USSR was doing in the former time). Such an approach was reflected in the 1998 Agreement of riparian countries for the Syr Darya basin where this co-ordination was envisaged on a parity basis with executing a number of principle provisions, which were described in the preamble of this agreement, but unfortunately no were developed in its text.

The simplified variant of the text of this agreement with obvious “emphasis on energy production” adopted under pressing of “outside advisers” has resulted in the seeming co-ordination of energy and water resources at the expense of infringement of interests of irrigation and the environment. Schedules of water releases for supporting the energy regime were taken as a basis. To please this approach, the ICWC had to agree with infringement of the needs of irrigation and full satisfaction of requirements of the energy sector. Naturally, the downstream riparian countries have started to adapt to actual water availability in water sources and to decrease barter supplies, as much as possible.

As a result, the widely-advertised agreement puts more questions than gives answers on them. Practice of recent years has shown that the Agreement does not satisfy the riparian countries located in the lower reaches of rivers in dry years; riparian countries located in the runoff formation zones in years with average water availability, and create threats for all Parties of this agreement in wet years.

Practical realization of the 1998 Agreement was related with a persistent chain of negotiations, protocols and monitoring of their execution, as well as a constant “jangle on nerves” of those who managed water resources and who used them. The mutually profitable basis declared in the Agreement, under influence of growing globalistic challenges of the hydropower sector, was transformed in the policy of diktat of the hydropower regime of water releases over the irrigation regime of water releases in the Syr Darya basin.

Since 1992, the Association “Kyrgyzenergo”, slowly and initially in inconspicuous manner, started the step-by-step retreat from the agreed procedures of operating the Naryn-Syr Darya Cascade, increasing the volumes of water accumulation in the summer season, and water releases in the winter season – at the beginning, from 3 km^3 in 1991 to 7.5 km^3 in 1994 (see Figure 4); and already in 1990, operation of this reservoir was shifted to the hydropower operational regime with drastic decreasing of the volume of water releases for irrigation. Such actions infringed

Part 1 of Article 10 that requires the adherence to the agreed regime of water releases.

However, the following period of wet years since 2002 until 2006 (Figure 5) 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.

Retreat from the key requirement of operational rules developed for the Toktogul Reservoir was the reason for such a situation (shift from over-year regulation towards seasonal regulation for the benefit of energy production when the reservoir is filled by the beginning of the autumn-winter season and is emptied by the beginning of the growing season). The reservoir was practically operated based on actual annual inflow (inflow was balanced with water releases, taking into account water losses).

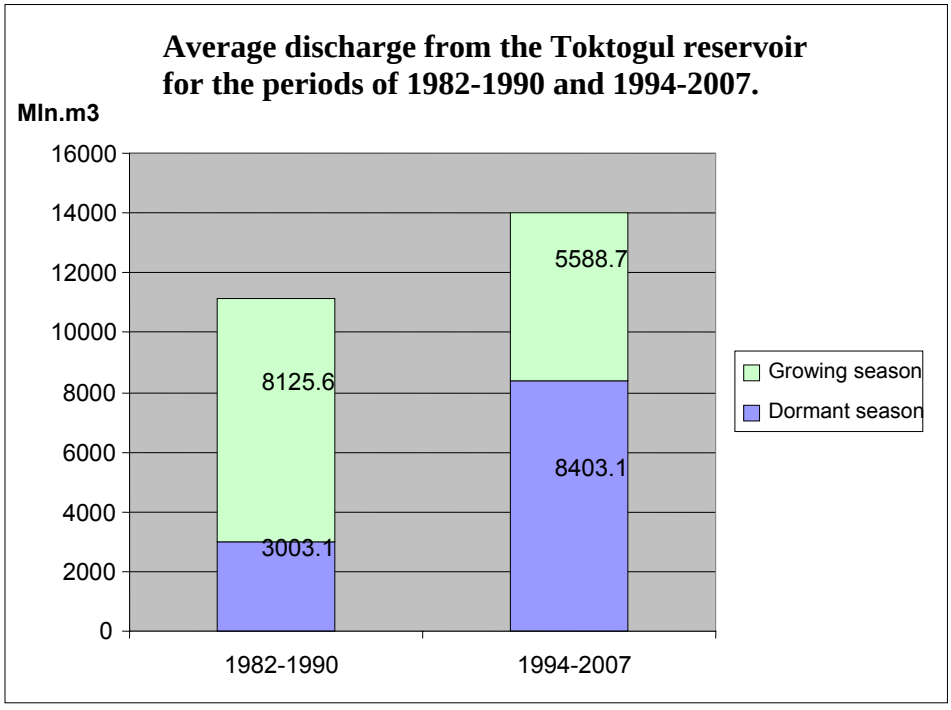


Figure 4 Average volumes of water releases from the Toktogul Reservoir over the periods of 1982 to 1990 and 1994 to 2007

Such a regime of seasonal regulation for the benefit of energy production created the situation when even in wet years (for example, in 2003 and 2005) lower water availability was observed in June and July. For instance, in 2004, in spite of water availability that was sufficient to provide irrigation water supplies at the 100%-level according to planned water use during the growing season, in June at the site from Uchkurgan to Kayrakkum this indicator amounted to 84.4%, 78.4%, and 81.5%

during sequent ten-day periods of this month, and at the site from Kayrakkum to Chardara the situation was the following: the first ten-day period – 83.9%; the second ten-day period -73.7%; the third ten-day period – 87%; and only in July irrigation water supplies were at the level of 100%. This arms-twisting policy based on energy producers' pressure and hydroegoism has naturally led to the search of commercial compromises over a long period of time and delayed drawing up the agreed operational regime until the end of June.

This situation took place simultaneously with excessive water releases from the Toktogul Reservoir in winter months resulting in creation of man-made winter floods in middle and lower stretches of the river (Figure 6). Until 1991, the volume of maximum water releases in the winter season didn't exceed 5 km^3 and corresponded to the natural regime of river flow. However, since 2002 until 2008, annual water releases from the Toktogul Reservoir that were made exceptionally for commercial purposes (electricity production) were varying over the range of 8.5 km^3 to 9.7 km^3, creating the excessive load on the Kayrakkum Reservoir and Chardara Reservoir in winter. Therefore, water releases from the Kayrakkum Reservoir, in excess of the established requirements, amounted to 2 to 5 km^3/year, and from the Chardara Reservoir more than 5 km^3/year. Winter flow rates of the Syr darya River has reached 800 m^3/sec, instead of former 400-450 m^3/sec, causing considerable damage of riverbed and delta, and monthly winter inflow in the Chardara Reservoir under influence of water releases from the Toktogul Reservoir (in December-February instead of July-August) has stimulated the general increase of monthly winter inflow in the Chardara Reservoir up to 1,800 million m^3 instead of less than 1,000 million m^3 in the past.

As a result of this practice, we observed the abrupt increase in unproductive water releases into the Arnasay Depression, rise of a water level there (even higher than the catastrophic level in 1969), and flooding of considerable areas. Moreover, the fact is that the ICWC has preserved only functions of water allocation in accordance with the established quotas, but lost the ability to regulate the regimes of water releases from storage reservoirs. It is typical that in the past (up to the 32-nd Session in 2002), the ICWC itself was approving the quotas (limits) of water resources allocation and the regimes of water releases from storage reservoirs, but at the mentioned session, at Kyrgyz and Tajik Parties' insistence, the ICWC has approved the quotas (limits) of water resources allocation, but has submitted the regimes of water releases to the energy departments for receiving their endorsement. Thus, the provision of Article 11 "Decisions made by the ICWC are obligatory for all water users and water consumers" was nullified.

As a result of adopting the 1998 Agreement, a conclusion of bilateral and multilateral inter-government agreements and protocols, in which the owners of hydropower plants submit their requirements concerning barter operations or monetary compensations and signing of which was usually delayed up to June, creating uncertainty in the regime of transboundary water use, has taken on the priority significance. Participation of Tajikistan in these agreements has envisaged, in particular, the commitments concerning water accumulation in the Kayrakkum Reservoir and following water releases that meet the interests of irrigation. However, the real practice shows that the commitments concerning water accumulation in the Kayrakkum Reservoir are executed only in the mid of the growing season; and water releases are made at the beginning of the autumn-winter season. Water releases

from the reservoir are mainly made in amounts that are less than the agreed ones (Table 1), aggravating the existing water shortage in dry years with heavy consequences for water supply to irrigated lands that are located downstream of the Kayrakkum Dam, at a peak of the growing season.

At the same time, delays of water supply to other riparian countries on the commercial base take place on a regular basis as a result of changes in the operational regime of reservoirs that are made by the owners of hydropower facilities on various pretexts.

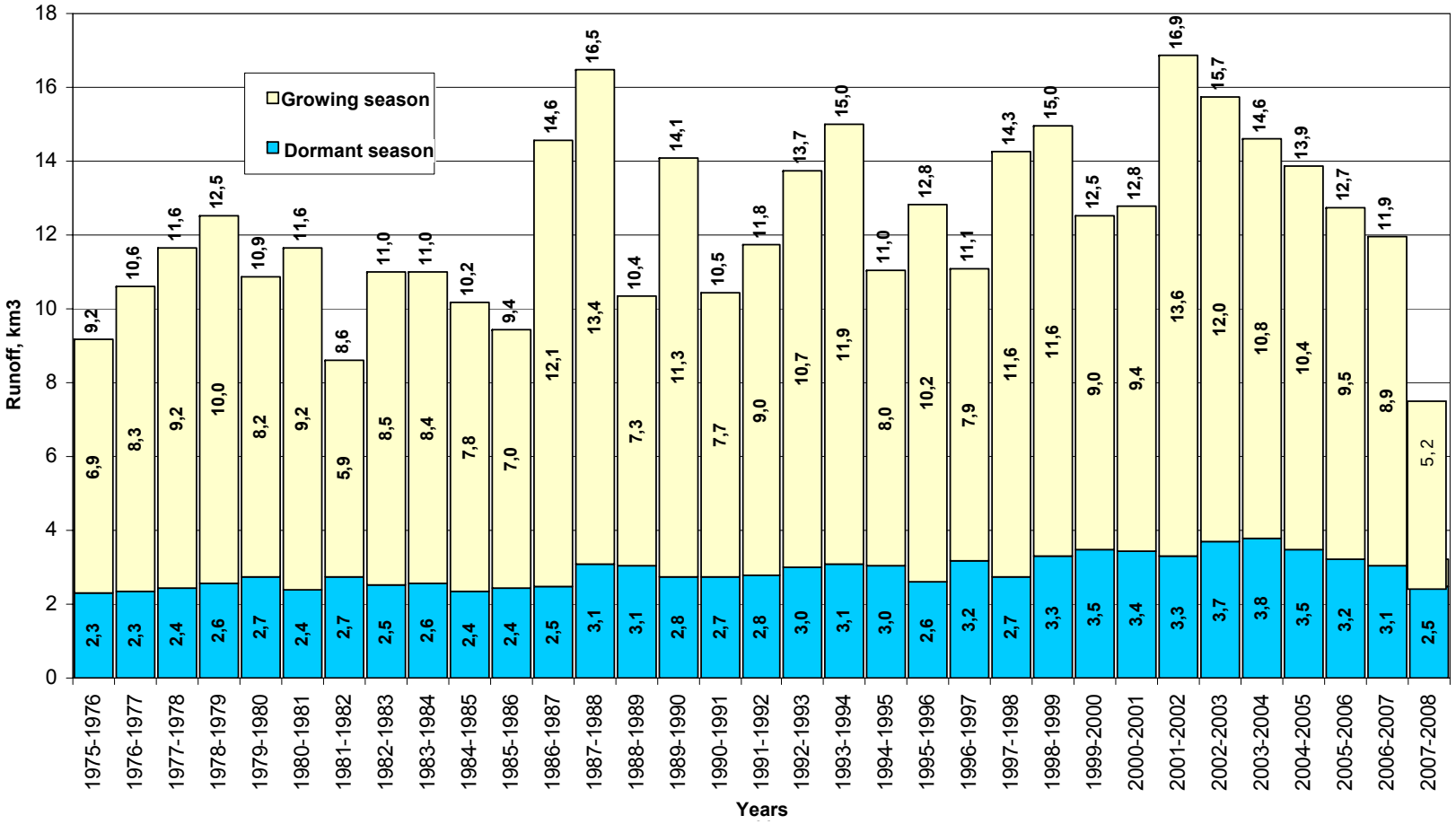


Figure 5 Inflow into the Toktogul Reservoir over the period of 1975 to 2008

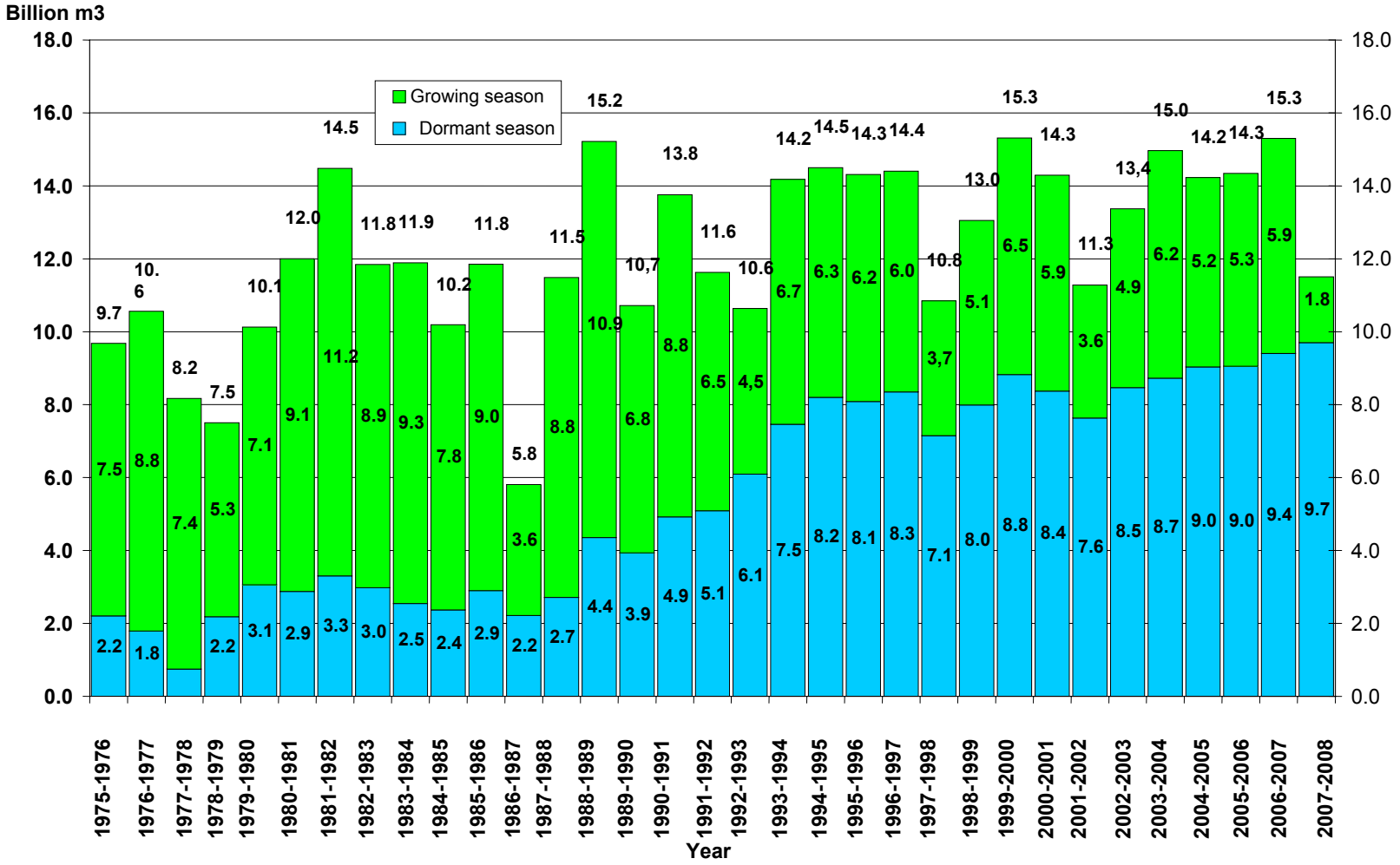


Figure 6 Water Releases from the Toktogul Reservoir over the period of 1975 to 2008

The position of the Association "Kyrgyzenergo" that can be characterized by some pressure on downstream riparian countries has always had the pronounced drive for commercial result. Taking into account that summer water releases, apart from generating electricity for own needs (3.2 billion kW-hr in summer), serve for energy production for sale, the owners of hydropower plants constantly pushed up prices for electricity from 4.8 to 9.8 cent/kW-hr! Under conditions when prices for electricity did not exceed 2.5 cent/kW-hr at the regional market, this seems as speculation and compulsion. During recent years, in order to force the downstream riparian countries to sign the agreement for purchasing of electricity at these prices (per se water resources) the Management of Naryn HPs Cascade initiated one more problem for operation of the irrigation systems in the Fergana Valley.

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 Plant. 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 Plants 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 7), resulting in lowering the extent of water supply sustainability through irrigation canals and in infringing the design regulations developed for operating the hydraulic structures.

Hydroegoism of hydropower producers and its effects are clear described in the report of the JICA (Japanese International Development Agency) published in February 2009.[8]

"The existing system of water resources management, especially 5 last years, leads to increase in water releases from reservoirs during the non-irrigation season. If such a trend will take place in the future then water deficit will become aggravated due to the consumption growth in the hydropower and irrigation sectors…" (Page 2.6)

"Man-made inundations affect 69 settlements in South-Kazakhstan and Kyzyl-Orda provinces in Kazakhstan where 40,000 people live. Available data on damage over the period of 2004 to 2007 shows losses amounting USD 17.51 million and 55,733 hectares of flooded areas. 1148 dwelling houses were damaged. A huge quantity of refugees (more than 30,000 people during the flood in 2005) is evidence of the gravity of this problem… (Page 2.28)

"In the sphere of hydropower production, rehabilitation of the stable operation of the Toktogul Reservoir should be immediately done by means of reducing the winter water use for ***generating*** electricity…" (Page 3)

[8] Study of Intra-Regional Cooperation on Water and Power for Efficient Resources Management in Central Asia, JICA, Tokyo, 2009

Table 1

Comparing actual and agreed water releases from the Kayrakkum Reservoir in the growing seasons over the period of 2005 to 2009

Year	Place and Date of signing the inter-governmental protocol between Tajikistan and Uzbekistan	Water releases from the Kayrakkum Reservoir, m^3/sec								
		June			July			August		
		Agreed	Actual	Non-fulfillment	Agreed	Actual	Non-fulfillment	Agreed	Actual	Non-fulfillment
2005	Tashkent, February 10, 2005.	499	533		600…650	617		600…650	574	26
2006	Tashkent, February 27, 2006	500	459	41	600…650	535	65	600…650	521	79
2007	Tashkent, December 26, 2006	500	444	66	650	558	92	650	592	58
2008	Tashkent, December 27, 2007	525	345	180	650	419	231	625	399	226
2009	Tashkent, February 18, 2009	520	374	146	550…600	519	31	350...520	571	

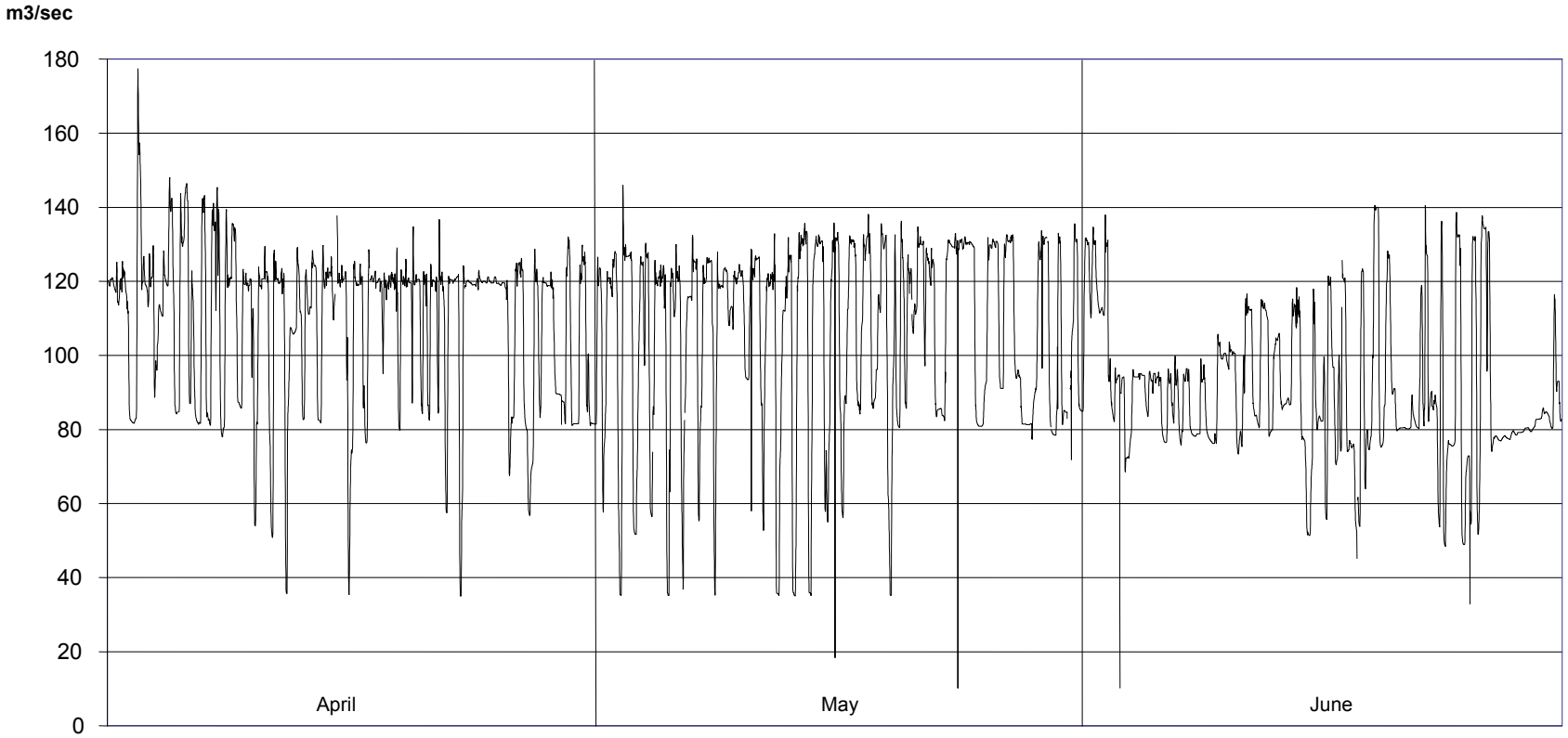


Figure 7 Impacts of water level fluctuations in the Naryn River downstream from the HPs on the stability of water supply into the BFC and SFC

As the saying goes: “A bad example is infectious” – Tajik hydropower producers also practice the hydropower regime of water releases. During the whole period of independence, the Nurek Hydropower Plant and reservoir are operated according to the hydropower regime i.e. in summer the reservoir is filled up to the full volume (by 1st September), and in winter is almost completely emptied under producing the maximum hydropower volume (by 1st April a water level drops up to almost the level of “dead-storage capacity”, see Table 2).

Table 2

Filling the Nurek Reservoir in the course of year, million m^3

Year	Water reserves as of 1-st April	Water reserves as of 1-st September
1999	5,717	10,543
2000	5,830	9,987
2001	5,983	10,458
2002	6,390	10,533
2003	6,196	10,514
2004	6,011	10,552
2005	6,089	10,509
2006	5,985	10,591
2007	6,005	10,406
2008	5,902	9,666
2009	5,981	10,590

Apparently, the Nurek Hydroscheme operates to the prejudice of the irrigation regime and does not provide the optimal water supply to irrigated lands in Uzbekistan and Turkmenistan. This is especially topical in dry years, for example, in 2000 and 2001, when natural inflow into the reservoir was on 5.3 and 4.9 km^3 respectively more than water releases from the Nurek Reservoir in the growing season. As a result, the extremely unfavorable situation was observed in the middle and lower stretches of the Amu Darya River in 2000 and 2001. In 2000, in the Amu Darya basin, Tajikistan has received 93% of the water quota (water limit) established by the ICWC, while Turkmenistan and Uzbekistan, downstream of the Tuyamuyun Dam, have received by 50% of the water quota. At the same time, Karakalpakstan, downstream of Nukus, has received only 32% of water quota. Thus, droughts of 2000 and 2001 that were aggravated by the excessive water withdrawals of those who located upstream and the irrational regime of water

releases from the reservoir have resulted in retirement of 200,000 ha of irrigated lands on the territory of Uzbekistan in the lower reaches of the Amu Darya River, which were not rehabilitated up to now. The total damage due to droughts in this region of Uzbekistan has exceeded USD 280 million a year! A national income in the agricultural sector of Karakalpakstan did not reach the reference level of 1999 until now.

Participation of Tajikistan in the 1998 Agreement has envisaged that the Kayrakkum Reservoir will be operated under the irrigation regime, and Uzbekistan and Kazakhstan entered into a commitment to maintain the approach canal of Makhram Pump Station and to assist in reinforcement of dams of the Kayrakkum Reservoir. However, the real practice shows that water releases from the reservoir, with a rare exception, do not reach the agreed volumes creating the situation of artificial water shortage in years with sufficient water availability or aggravating the real water shortage with grave consequences for water supply of irrigated lands located downstream of the Kayrakkum Reservoir in the peak of the growing season.

Table 3

Comparing of the actual and agreed water reserves in the Kayrakkum Reservoir at the beginning and end of the growing seasons (2005 to 2009)

Year	Place and Date of signing the inter-governmental protocol between Tajikistan and Uzbekistan	Water reserves, million m3					
		As of 31st May (no less)			As of 31st August (no more)		
		Agreed	Actual	Non-fulfillment	Agreed	Actual	Non-fulfillment
2005	Tashkent, February 10, 2005.	3418	3488		870-900	1512	612
2006	Tashkent, February 27, 2006	3418	3217	201	1000-1100	1009	
2007	Tashkent, December 26, 2006	3418	3438		1400	1055	
2008	Tashkent, December 27, 2007	3418	3271	147	1000	999	
2009	Tashkent, February 18, 2009	3418	3513		1000	1486	486

In the 2008 dry year, since April and until 1st August, the volume of water releases from the Kayrakkum Reservoir was less on 700 million m^3 against agreed one but then in September, the surplus in 200 million m^3 was released; in 2009, when the total inflow into the reservoir was on 1.1 km^3 more, the previous situation has repeated and only on 0.8 km^3 more was released; at the same time, up to 10th July, water releases from the Kayrakkum Reservoir constantly were less than agreed ones with the total deficiency in supply of 170 million m^3.

In 2009 and 2010, the hydropower companies, without coordination with somebody, have applied the regime of filling the reservoir that was absolutely disadvantageous for all irrigation systems. For instance, during the whole growing season of 2009 until last ten-day period of July, Tajikistan has kept a full supply level (FSL) in the Kayrakkum Reservoir for the benefit of the hydropower sector, and only partly in August and then in September they started to release water when it was already useless for irrigation. Thus, about 1,500 million m3 of water was not supplied from the reservoirs of seasonal regulation in the growing season peak! At the same time, in November, when water was needed for pre-sowing irrigation of the planned areas under wheat, the outlet gates of the Kayrakkum Reservoir were again closed, completely ignoring all agreements on ecological flows (under agreed operational water releases of 225 m^3/sec and ecological flow of 100 m3/sec, an actual flow rate downstream from the reservoir amounted to only 70 m^3/sec).

It should be mentioned that infringements of agreed operational regimes of the Toktogul Reservoir (Kyrgyzstan) and Kayrakkum and Nurek reservoirs (Tajikistan) for the benefit of the hydropower sector are very important warning signals for all downstream riparian countries:

- The interest of countries located in the runoff formation zones in establishing of the hydropower regime under regulating the flows of Central Asian rivers dominates over the common interests of all riparian countries and economic sectors in the region. It is obvious that both countries (Kyrgyzstan and Tajikistan), for the sake of commercial profit in the hydropower sector, are ignoring not only the interests of downstream riparian countries but also the interests of irrigated farming in their own countries because in dry years, agricultural activity on all irrigated lands was proportionally restricted by the actual regime of water supply for irrigation. As a result, in the Syr Darya basin, farmers of Kyrgyzstan and Tajikistan have also suffered a loss.

- Hydropower regimes under operating the storage reservoirs exclude the regimes of multi-year river flow regulation, which are especially important for overcoming the effects of climate changes.

Thus, one-side use of water resources for the benefit of generating the maximum possible amounts of electric power create the threats for the water and food security and consequently for socio-economic stability in the region. Impacts of winter water releases from the reservoirs on ecosystems and the natural complex as a whole are not simply negative ones; they are threateningly dangerous. The lower reaches of rivers are dried up in summer and suffered from the disastrous floods in winter. In summer, when the maximum water withdrawals are necessary, rivers are transforming into small streams; water levels are dropping, impeding water diversion by gravity and using pump stations that hang in midair (as along the middle reach of the Syr Darya River), and it is necessary to install additional boost pump stations (so-called “zero pump stations”). However, in winter they become powerful and destructive streams that impede outflow from the drainage systems.

As a result, the hydrological regime of rivers is topsy-turvy!!!

IV. Future of Central Asian Region – the Water Vision for the Year 2035

The SIC ICWC, during the entire period of its activity, carries out the forward planning of the future situation in the Central Asian region, assuming to raise the awareness of decision-makers concerning the complexity of coming water problems and methods of their solution. The following works can be mentioned: participation in the UNESCO project (2000) "Development of the Water Vision for the Aral Sea Basin by 2035"[9]; developing the advanced ASBM model together with the consulting company "Resource Analyses" (the Netherlands)[10]; modeling of the Syr Darya basin (the NATO Project SFP 980986)[11]; participation in the project "RIVERTWIN" (Chapter 2) for assessment of impacts of the Rogun Reservoir, etc.

In the frame of the project for specifying the outlooks of water resources development, at present, the SIC ICWC together with the IHE-UNESCO develops the set of models for the long-term forecasting (V.A. Dukhovny, A.G. Sorokin, and Joop de Schutter), preliminary assessments of which are given below. The climatic scenarios were adopted according to the forecast of the Uzgidromet that is based on data of daily observations starting since 1951, as well as data on maximum values of climatic variables over the entire observation period. Taking into consideration the mixed character of climatic zones location over the whole Central Asian region, climate changes in other riparian countries were taken into account in accordance with Scenarios A2 and B2 of the model "MAGICC/SCENGEN".

The derived assessments of river runoff in the Aral Sea basin according to the scenarios of climatic changes have shown the following:

- In case of climatic scenarios fulfillment (scenarios of regional changes in precipitation and air temperatures), essential changes in available water resources will not occur in the Syr Darya river basin by 2030. Under Scenario B2 some increase in runoff over upper watersheds is possible, but, as a whole, all deviations will be within the natural runoff variability. A trend of some runoff decreasing is forecasted for the Amu Darya river basin;

- Under the scenario of increasing air temperatures but invariable precipitation, the decrease of available water resources on 5-8% from the base amount in the present period can be observed in the Amu Darya river basin already by 2030, but in the Syr Darya river basin, substantial changes in available water resources will not occur; all deviations will be within the natural runoff variability;

[9] Water-related vision for the Aral Sea Basin for the year 2025, UNESCO, 2000, 237 p. under the editorship of Prof. J. Bogardi.

[10] The PROGRAM for the development of upgraded Aral Sea Basin model (ASBMM) with the aim of creating DSS – demonstration and sophisticated versions, UNESCO IHE - SIC ICWC.

[11] NATO SFP 980986, Integrated Water Resources Management for wetlands restoration in the Aral Sea Basin (Northern part), 2006-2009

- Without considering the changes in precipitations, only changes in air temperatures can result in reducing the runoff of Syr Darya and Amu Darya rivers in the long-term outlook (by 2050). Over this period, a possible reduction in the runoff of the Syr Darya and Amu Darya rivers will range from 6 to 10% and from 10 to 15% of the normal value respectively.

Thus, available water resources in the Aral Sea basin were evaluated for the outlook of 2030-2035 for two scenarios:

Table 4

Assessment of Available Water Resources in the Aral Sea Basin

Indicators	Normal year	The 2008 driest year	Scenario B2		Scenario A2	
			An average year	A dry year	An average year	A dry year
1. Surface water,	116,483	86762	110,933	82,600	106,695	80,021
Including: Amu Darya	79,280	59460	73,730	55,298	71,352	53,514
Syr Darya	37,203	27302	37,203	27,302	35,343	26,507
2. Ground water	16,891	13572.8	16,472	13,178	15,747	12,598
Including: Amu Darya	5,989	4791,2*	5,570	4,456	5,390	4,312
Syr Darya	10,902	8721.6	10,902	8,721	10,357	8,286
3. Return water	32,450/21,580	12948**	20,899	12,539	20,114	12,008
Including: Amu Darya	19,060/9,730	5838	9,049	5,429	8,757	5,254
Syr Darya	13.39/11.850	7110	11,850	7,110	11,257	6,754
4. Water losses in riverbeds	13,900	13900	13,900	13,900	13,900	13,900
Including: Amu Darya	8,900	8900	8900	8,900	8,900	8,900
Syr Darya	5,000	5,000	5.000	5.000	5.000	5.000
5. Ecological needs	8.0	5.2	8.000	5.7	8.0	5.7
Including: Amu Darya	4.8	3.2	4.800	3.2	4.8	3.2
Syr Darya	3.2	2.0	3.200	2.5	3.2	2.500
Total available water resources	133,054	94,122.8	126,404	88,717	120,656	85,027
Including: Amu Darya	81,299	57,989.2*	74,645	53,083	71,799	50,980
Syr Darya	51,755	36,133.6	51,755	35,633	48,757	34,047

Table 4 shows that according to the forecast, in an average year, the runoff of Amu Darya River can decrease on 9.8 km^3; and in a dry year the decrease will be on 18.5 km^3 in comparing with an average year. In the Syr Darya basin, the decrease in runoff will not forecasted for an average year, but in dry years it will make up about 10 km^3 in comparing with an average year. In 2008, the total available water resources were already evaluated at the level of 95 km^3; these figures are close to the forecasted values.

Then it is possible to superimpose the water scenarios over climatic scenarios, taking into consideration two options: the opportunity (or not) of multi-year regulation, which is possible only under the irrigation regime (or close to it) under conditions of induced infiltration into ground water (artificial ground water recharge), as well as drastic reducing

water consumption by means of strategic shift in crop pattern on the threshold of dry years.

Table 5

Combination of climatic and water scenarios

Water management scenarios	Climatic scenarios					
	Usual natural runoff		Scenario B2		Scenario A2	
	An average year	A dry year	An average year	A dry year	An average year	A dry year
Total	133,054	94,123	126,404	88,717	120,556	85,027
the Amu Darya River	81,299	57,989	74,649	53,083	71,799	50,980
the Syr Darya River	51,755	36,134	51,755	35,633	48,757	34,047
Hydropower (the irrigation regime W1):			126,404	95,833	120,556	89,985
the Amu Darya River			74,649	56,200	71,799	53,850
the Syr Darya River			51,755	39,633	48,757	36,635
Hydropower (the hydropower regime W2):			119,274	81,264	113,996	76,386
the Amu Darya River			69,719	45,831	67,439	43,551
the Syr Darya River			49,555	35,433	46,557	32,835

This estimate takes into consideration that when hydropower plants operate under the irrigation regime along with the agreed regime of runoff regulation, water releases into the Arnasay Depression, river lower reaches, and desert lakes, in excess of the volumes coordinated by the ICWC, will not take place, and therefore, in an average year, water resources will equal to the runoff norm, and in a dry year, at the expense of multi-year regulation, a supplement to the runoff at the rate of about 3.5-4.0 km^3/year will be in the Syr Darya basin, and, as was determined in our work[12], 3.0 km3/year in the Amu Darya basin.

On the contrary, when hydropower plants operate under the hydropower regime, the situation becomes much worse; in an average year, actual available water resources are reduced by 5 km^3/year in the Amu Darya basin and 2.2 km^3/year in the Syr Darya basin. Thus, we specified that in the optimal variant, total available water resources in an average year amount to 126.4 km^3, including 74.7 km^3 in the Amu Darya basin and 51.8 km^3 in the Syr Darya basin, and in a dry year – 95.8 km^3 (in the Amu Darya basin – 56.2 km^3 and in the Syr Darya basin – 39.6 km^3) i.e. the values are close to already observed ones. In the worst variant, the available water resources in average years on 7 km^3 less, and in dry years almost on 14 km^3 less; and such situation can result in increasing the range of river flow fluctuations and developing of hydropower egoism.

Thus, we have evaluated the variants of forming available water resources, and now we can compare them with water demands.

The complexity of forecasting is related with the uncertainty of building up different scenarios of development by each riparian country, and consequently with great number of different options that can be represented on the side of ***water requirements***. Nevertheless, among great number of scenarios we selected three ones, which are based

[12] V.A. Dukhovny, A.G. Sorokin, Assessment of Rongun Reservoir impacts on the hydrological regime of the Amu Darya River, Tashkent, SIC ICWC, 2007, 119 p.

on assumption that all riparian countries will develop evenly; although, undoubtedly, a various progress can be observed. However, if all riparian countries will progress in the frames of ***the optimistic scenario*** this will provide the best perspective, but the adherence to ***national scenarios*** leads to the most pessimistic future. The general characteristics of scenarios are the following:

The scenario "business as usual"

This scenario can be also called as "a *scenario of non-intervention*" or "a *scenario of worsening.*" According to this scenario it is assumed that the current situation is going on over the period under evaluating (25 years), including the low level of financing O&M and modernization of the irrigation and drainage systems and conservation of the state control in agricultural production (so-called state orders) in countries where this system exists still. Obviously, this scenario can be used as the basis for comparing with other scenarios.

In particular, in line with this scenario it is assumed the following:

- Further economic reforms and progress in private farms' establishing in the frames of gradual transition towards the free market;
- Interstate agreements related to water resources and hydropower management are invariable, and all difficulties of observance of these agreements remain in force, implying that in upstream riparian countries, hydropower plants will operate according to the regime allowing to produce a maximum amounts of electric power during the winter season; and
- The efficiency of irrigation systems will not exceed 56-60%.

The scenario of national preferences

The fundamental assumption inherent in this scenario is that the increase of investments into the agricultural sector will be quite sufficient for stabilizing agricultural production at the current level in all regions. The agricultural sector will remain under the governmental control to an even greater degree there where this control exists nowadays.

Other important assumptions inherent in this scenario are the following:

- Increasing of the gap between riparian countries according to such indicators as the level of well-being, GNP per capita, financial capacity, level of market freedom, internal and external investments will take place; and
- Implementing of some economic reforms that will include the further land privatization and further movement towards the free market economy, although with different rates. Transboundary water resources management will be implemented at the basin level but it is unlikely that the basin framework agreements and yearly-signed bilateral and multilateral agreements will provide the real governance of water resources and hydropower production.

Each riparian country will aim at gaining the maximum profit from own water resources and therefore the irrigated areas will be increased up to 9.4-9.5 million hectares, creating additional competition under supplying water resources to neighboring countries and other

water-consuming sectors. The conflict of interests will be strengthened, affecting satisfaction of the needs of ecosystems and national economics.

Optimistic scenario (or regional) since it satisfies the regional interests in the largest measure

According to this scenario, it is assumed that all five riparian states will adapt the free market principles to economic management in spite of the fact that certain possibilities will be provided for achieving social and environmental objectives. The resources will be allocated in such a manner that allows maximizing their contribution into economic development under conditions of ecological restrictions and social stability's limitations.

Other important assumptions are the following:

- Water allocation mechanisms that will provide their optimal use in such sectors as agriculture, water supply, hydropower, and the environment protection for the overall benefit of riparian states will be agreed and put into practice with time;
- Under conditions of optimal water resources use, the hydropower sector will not be considered separately from other energy sources or for each river basin, on the contrary it will serve for power production and distribution over the whole region. Competitive markets of electricity and energy resources will become the essential element for achieving this objective;
- Concerning the irrigated farming:
    - Farm restructuring will be in progress at rapid paces along with the natural increase in incomes of private farms;
    - The IWRM principles will be put into practice everywhere; based on IWRM, certain institutional reforms will be undertaken, in particular: involvement of stakeholders into water resources governance and management; reorganization of irrigation systems according to the hydrographical principle; introduction of water charging that will encourage the efficiency of farmers' activity and the efficient water use that is more important in this case. Consequently, the on-farm water resources management and irrigation methods will be improved resulting in reducing water consumption and, in turn, lowering the probability of waterlogging and soil salinization;
    - Limitations in funds for purchasing seeds, fertilizers, pesticides, new machinery and equipment, etc. will be liquidated;
    - Changes in the crop pattern, size of sown areas; structure and organization of private farms, agricultural practice, and investments to new machinery and equipment will be driven by the free market;
    - Costs for rehabilitation and O&M of irrigation and drainage infrastructure will considerably increase up to the levels that allow to improve basin and national infrastructure up to the proper standard, providing sustainable irrigated land use over the long period; and
    - The efficiency of irrigation systems will increase up to 0.75, the level that was achieved in the new-developed irrigation scheme in the Hungry Steppe.

Improving on-farm land and water use will be aimed at raising land and water productivity aimed and saving water resources, as well as:

- It is expected that farmers will participate in financing those works where investments are required by market conditions. As supposed, financing of intra-farm infrastructure will be the responsibility of private farmers;
- As a result of above measures; crop productivity and marginal profit will increase, although the overall production will be regulated by the market conditions;
- Water volumes for the environmental needs will be allocated based on the agreed water distribution mechanism; and
- It is expected that social impacts will be positive ones.

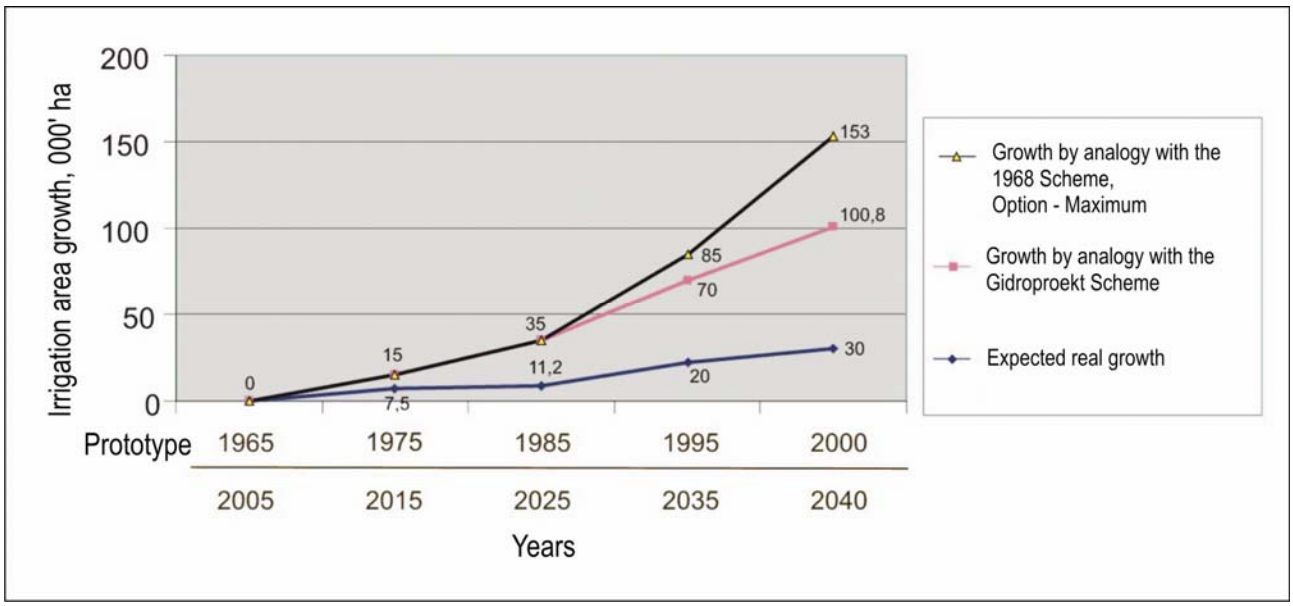
The needs of Afghanistan represent a special matter of water requirements.

In spite of non-disclosure in all official documents issued by national governments in the region, the problem of future water consumption in North Afghanistan adjacent to the Amu Darya basin arouses concern.

In 2002, the SIC ICWC has prepared the review with a synthesis of all previous and new documents concerning irrigation development in this region and the legal right of Afghanistan to water diversion from the Amu Darya River. All previous agreements between Afghanistan and the Soviet Union practically did not deal with the water-sharing issue (Agreements dated February 28, 1921; June 24, 1931; July 13, 1946; January 18, 1958; October 16, 1961; and February 6, 1968). Nevertheless, the 1965 Scheme of Water Resources Use and Protection for the Amu Darya Basin, being in force, states the volume of water diversion from the Amu Darya River, Vakhsh River and their tributaries (about 2.1 km^3/year) that corresponds to the volume of water use at the level of the 1960s. Along with water diversion from the rivers Shirintagao, Sarykul, Balkh, and Hulk, this volume of water allowed to supply water for 1,079,100 hectares of lands with available irrigation systems. Using two different methodological approaches, we also evaluated a number of options with various rates of the irrigated area growth and correspondingly water diversions from the Amu Darya River for irrigation:

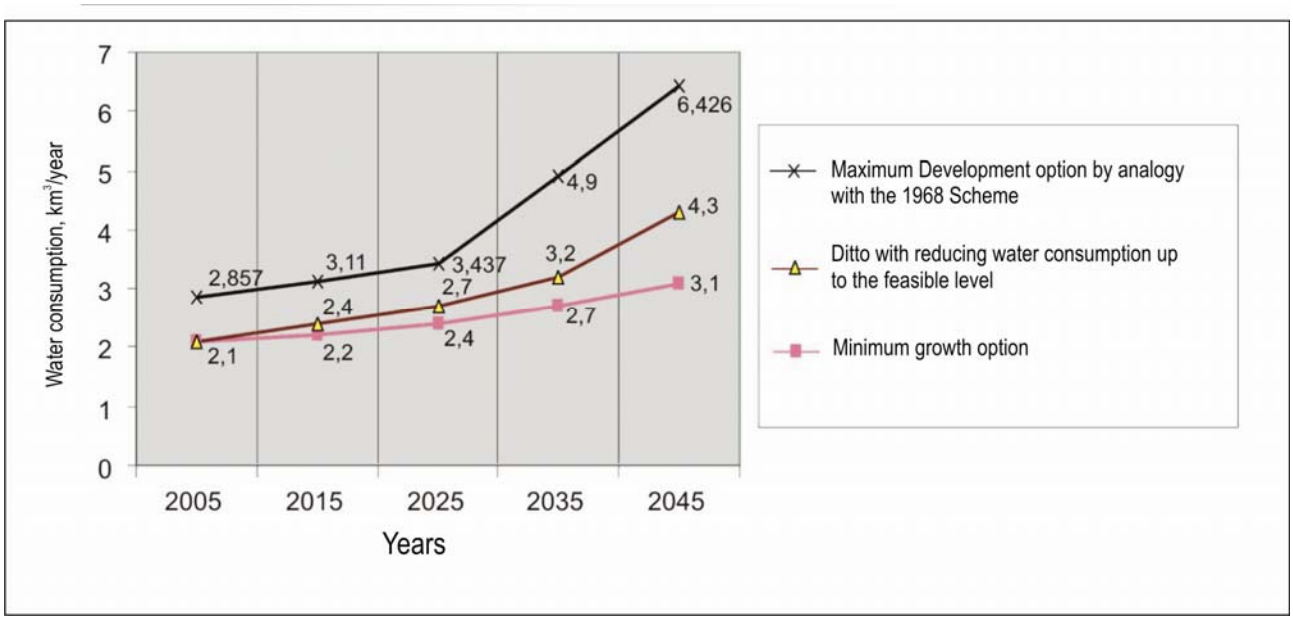
By analogy with the forecast given in the North Afghanistan Irrigation Development Plan (1968) with the initial level of 1965. Under assuming that the level of 2005 equals the level of 1965, the rates of irrigated land development and water consumption can be the following (Figures 8 and 9):

- At growth rates of irrigated areas by analogy with the 1967 Scheme – 153,000 hectares during 35 years (Fig. 8). At water consumption per unit area according to the 1967 Scheme, by 2040, water withdrawal should be increased by 3.6 km^3 (an upper curve on the Fig. 9);
- In case of the same growth rates of irrigated areas but with reducing water consumption per unit area up to 11,000 m^3/ha, additional 1.5 km^3/year of water withdrawal will be required (a middle curve on the Fig. 8).



Source: the SIC ICWC

Figure 8. An expected growth in irrigated areas in North Afghanistan



Source: the SIC ICWC

Figure 9. An expected growth in volumes of water diversion from the Amu Darya River for irrigation

The level of 5 km^3 up to 2035 was assumed in all variants of our calculations for the Amu Darya basin. Under assumption that data of forecasting up to the Year 2025 will be moved, in the same manner, toward the Year 2035, comparison of available water resources and water consumption for the optimistic variant shows the following figures of satisfying the water needs (Table 6).

Table 6

Comparison of the water balances in variants of the need in water under different socio-economic scenarios (the ASBMM) with other forecasts

Indicators	ASBMM variant		
	Optimistic	BAU	National
Irrigated farming			
Irrigated area, 000' ha	8500	8500	9400
Gross irrigation requirement, m^3/ha	9400	11500	11000
Water consumption for irrigation	79900	97750	103400
Communal water supply			
Population, million people	59.0	69.0	77.0
Water supply per capita: m^3/man; l/man/day.	0.09/250	0.11/320	0.128/350
Total water consumption	5310	7500	9856
Industry	3300	3050	3500
Other economic sectors	1500	3500	3500
Total	90000	111800	120260
Accounting Afghanistan	95000	116800	125260
Mean annual water resources	126404	119274	120556
Water supply to the Aral Sea and adjacent areas, km3	39.40	2.474	-4.704

In case of combining the variant of water consumption (the ASBMM) with Variant W1B2 of the climatic and water-economic scenario, water supply to the Aral Sea and adjacent areas would amount to 39.4 km^3 (this situation is practically non-realistic but quite desirable).

The variant "business as usual" provides the extremely unfavorable results for the Aral Sea – only 2.5 km^3 directly into the Aral Sea; and under "the national scenario," water supply to the areas adjacent to the Aral Sea is decreasing from 8 km^3 to 0! At the same time, according to all scenarios, water availability in both river basins is being formed rather different.

The situation up to 2035 will become more or less stable in the Syr Darya basin, when in all optimistic scenarios and in two scenarios that are critical according to available water resources will be the excess of water equal to 2 km^3 and 7.2 km^3 in an average year and the water deficit from 0.8 km^3 to 7.7 km^3 in a dry year. There will be water deficit in the Amu Darya basin in all years: from 4 km^3 to 9 km^3 in average years and from 12 km^3 to 19 km^3 in dry years!

Understanding the unreality of these assessments, nevertheless, it is obvious that now more attention should be paid to the Amu Darya basin where concentration of all problems (glaciers melting, increase of water consumption in Afghanistan, and possible manifestations of hydroegoism) take place.

In spite of such a proportion of future water balances and results of the optimistic variant of socio-economic development, it is necessary to revise all lines of behavior that are in use of the state and society.

The outlook (up to 2035) may be positive if the awareness of all water users will be raised at the level of joint coordinated use of water resources for the benefit of all sectors and, first of all, ecosystems and satisfying the first-priority needs of mankind that were pointed in the Millennium Development Goals: water for drinking, water for food, and water for employment.

V. What is ahead? Candidate actions

Developing the correct policy in the field of transboundary water resources management and use, at the interstate and national level, is undoubtedly the guarantee of surviving this region in the future based on own water resources and peaceful overcoming of future challenges related to satisfying the regional needs in water and electric power. The region has sufficient amounts of water and hydropower resources for achieving this objective.

The decision adopted by the Heads of Central Asian States on April 28, 2009 raises our expectations in relation to general understanding and accepting of only such approach by national governments, because any another choice presents the way of losses, confrontation, and cataclysms.

For achieving the sustainable water resources use, three baseline positions are the most substantial:

a) All riparian countries should strictly comply with the international water law, which relies on observance of rights of each riparian country located on transboundary watercourses to its agreed share, on the assumption of reasonable and fair water use without damage to neighbors. In order to prove the devotion to this principle, riparian countries should, first of all, become party to the UN Convention on the Law of the Non-navigational Uses of International Watercourses (1997) and the ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 17 March 1992). Just this action, rather than slogans concerning cooperation in water resources use and protection, and holding the conference under the sponsorship of the United Nations for discussing these issues are the most important steps that demonstrate the adherence to the international water law. Combining the principles “fair and reasonable use” and “without damage to neighbors” that correspond to the international water law can establish the frames for displaying the political will.

b) Trust of riparian countries to each other, in establishing of which becoming party to the UN Conventions would be the first contribution, with further strengthening the mutual trust by means of excluding categorical requirements and measures (as in case of operation of the Naryn Hydropower Plants Cascade) that prejudice the mutual trust. Openness of information (in particular, economic indicators of hydropower production, flow rates at transboundary gauging stations and other indicators of mutual concern) that can eliminate suspicions in the speculative nature of using the hydropower plants cascade or fraud of neighbors regarding the volume of water supply can facilitate establishing the atmosphere of trust. Uzbekistan and Kazakhstan set an example of openness and adherence to the international water law (IWL) in both mentioned directions; and its support by neighboring countries would be desirable. Objective information on the agreements regarding the principles of joint water resources use instead of unceasing disinformation (especially, being presented by some Kyrgyz academic institutions)

about multi-million expenses for maintaining the runoff formation zone would also facilitate achieving the mutual trust.

c) Renunciation of the principle "to win over to our own side" in the light of an objective assessment of strategical opportunities and prospective benefits under different scenarios of the future with the purpose of creating the common understanding of the possibility of riparian countries' surviving (taking into consideration Afghanistan as well) on the basis of available water resources and huge hydropower potential. It is possible that the ***regional scenario*** described by us is too optimistic, but use of this scenario as the guideline for decision-makers and informing about this opportunity of all stakeholders, and thus the whole society, will serve for better understanding of the need in cooperation and joint activity.

Above-mentioned baseline positions require, first of all, development (and co-ordination in the framework of the upcoming ASBP-3) of ***the regional water strategy*** based on IWRM principles that were described in Section II and take into account the need of satisfying the riparian countries in energy resources.

The regional water strategy should specify the following:

- Basic rules and procedures of the joint planning and improving management of transboundary watercourses in prospect, taking into account the above-mentioned destabilizing factors (climate change, population growth, economic development, water use by Afghanistan, etc.);
- Target levels of national water conservation and overcoming negative trends by all riparian countries;
- Institutional and engineering measures for mobilization of additional reserves such as return water use, improving of the water accounting system, widespread introduction of IWRM at the national and regional level. For this purpose, the following important steps should be made:
    - ***Development of the program for strengthening the institutional framework, tools and management methods in the Syr Darya basin –*** for improving the interaction with the hydrometeorological services in the field of rising the accuracy of water measurement and accounting (river flow rates and withdrawals), introducing the SCADA system, involving the representatives of other countries in activity of the BWOs and SIC ICWC for raising the trust to them as the interstate agencies, although they are situated on the territory of Uzbekistan; authorizing the diplomatic status of the BWOs and SIC ICWC for settling problems with visa receiving and passport control, transferring of money between riparian countries to facilitate financial contributions of all riparian countries for supporting the regional institutions.
    - Enhancing the basin management by means of involving the representatives from other economic sectors: hydropower specialists and environmentalists as the members of the Basin Water Board with the right of participating in planning of mutually acceptable regimes of water distribution and water releases from reservoirs; in monitoring of water resources with the purpose of improving the accuracy of forecasts and water resources accounting, as

well as the responsibility for reliability of information that is submitted to water management organizations and water users;

- ***Rehabilitating the system of multi-year regulation of river flows***;
- The intensification of climatic anomalies and recurrence growth of natural extreme events require co-ordinated use of all existing and future reservoirs for preventing unproductive water releases and creating the water reserves for multi-year regulation. It is necessary to conduct the simulation of river flows under various variants of changes in water availability and, using results of modeling, to suggest the mutually acceptable solutions (in the presence of good will), taking into account the possibility for build-up of the capacity of Kayrakkum Reservoir, construction of the Pskem Hydro-Scheme, and reviewing all other proposals.

Further measures for strengthening joint water management can be developed taking into consideration the following options:

- Joint management of hydropower plant cascades on the Amu Darya and Syr Darya rivers;
- Establishing the Inter-state Water and Energy Consortium.

1) ***Joint management*** is undoubtedly the best option for cooperation. Such management is practiced by France and Germany on the Rhine Cascade of Hydropower Plants. In this case, all decisions concerning river flow regulation and water releases can be implemented only based on decision of directors – representatives of all riparian countries – according the method of "two keys." Keeping in mind the possibility for multi-year regulation for the purpose of compensating abrupt river flow fluctuations that arise under conditions of climate changes, the excellent solution could be joint management of hydropower cascades with appropriate contribution of downstream riparian countries in developing of hydropower resources in upper watersheds, under conditions of their involvement on the commercial base. Further development of joint hydropower resources can provide such amounts of hydropower that, under realization of the irrigation regime and multi-year regulation, it is possible to meet the needs of all riparian countries in electric power completely and even with some excess both in winter and in summer. However, there is one doubt that is caused by the failure to maintain certain norms of the international water law, as well as commercial interests of neighbors by some riparian countries.

One high-ranked statesman said: "A country, which does not observe the international legislation, declaring transboundary waters as its ownership or encroach on the ownership of another country, can easily denounce any agreement and investments on its national territory. For example, change of power – and it is as good as lost."

However, as the Water Treaty between Pakistan and India in relation to the Indus River (in force more than 50 years) has shown, counteraction for this practice can be developed. The World Bank was the guarantor of this water treaty; and when in 2008, the dispute between India and Pakistan regarding construction of the Hydropower Plant on the Chekab River (the tributary of Indus River) has arisen, the World Bank has initiated the

independent project appraisal; and under World Bank's pressure, its decision has been executed by both countries.[13]

2) Establishing the Inter-state Water and Energy Consortium

In 1998, the Presidents of Kazakhstan and Uzbekistan suggested the quite original idea regarding establishment of the Inter-state Water and Energy Consortium capable to provide advanced mechanisms for financing and mutually profitable water-energy barter between riparian countries for satisfying the needs of Kyrgyzstan in electric power in winter. The idea consisted in separating responsibility for water resources (the ICWC) and supplying electric power (the Consortium) in the volumes, which will not be supposedly supplied under the regime of water releases from the Toktogul Reservoir established by the ICWC. Specialists of the ICWC developed the mechanism enabling the Consortium, being the financial institute that will be associated with the UDC "Energy", to receive cheaper electric power in winter from Turkmenistan (the Mariy Thermal Power Plant) and Kazakhstan (the Ekibastuz Thermal Power Plant) or gas from Uzbekistan and Turkmenistan and to supply these energy resources to Kyrgyzstan for covering its winter deficit, and in the same manner, to purchase excessive summer electric energy from Kyrgyzstan and to sell it to Russia (via Kazakhstan) or other consumers (may be, Afghanistan, China, etc.) without any interfering into water resources management conducted by the ICWC. Thus, the Inter-state Water and Energy Consortium, as the institution that manipulates financial flows for the benefit of supporting the separation of authorities in water resources management and supplying gas, electric energy, and coal on the barter base would be transformed into a very useful mechanism. Unfortunately, in the light of adaptation to new globalistic trends, some theoreticians of "water-energy resources" have transformed the idea of establishing this Consortium into the idea of creating the suprastate commercial super-institution that will manage both water resources and energy resources in Central Asia. Taking into consideration current and future prices for agricultural production and electric energy, such an approach can lead to the situation when the "Water and Energy Consortium" will turn into the commercial "operator", for which supplying water for irrigation and especially for environmental needs of disastrous areas adjacent to the Aral Sea will be unprofitable, and it will be better for this "operator" to sell electric energy abroad. In view of above considerations, the corridor "Kyrgyzstan-Tajikistan-Afghanistan-Pakistan" that is advertised by the International Financial Institutions suggests the grievous perspectives of infringement of irrigation on which well-being of more than half of the population in the region including Tajikistan and Kyrgyzstan is based.

G.N. Petrove[14] is absolutely right when he says that the serious preparatory work in the form of thorough preparation of the Feasibility Study should forego establishing the Consortium. Legal and normative aspects of Consortium activity should be considered in the Feasibility Study, as well as interrelation with existing national and regional agencies; scope of activity, forms of ownership; economic mechanism of activity, personnel policy, organizational structure and investment programs, relations with tax, customs, and other organizations. One cannot but agree with this specialist that for these purposes (the situation similar to the first proposal) many disputable issues that accrued in relations of the water sector and the energy sector should be settled:

- Economic cost of water, its value and profitability in different riparian countries;

[13] Salman M.A. Salman "Bagli had difference and its resolution process - a triumph for Indus Water Treaty", Water Policy, 10 (2008), p. 105-117

[14] G.N. Petrove, M.O. Olilov., Modern Status and Outlooks of Water Resources Use in Central Asia, Scientific Report, Ashkhabad, 2008, Pages 15-22

- Enabling environment for creating the market of services, market of water resources and electric power; and
- Cost of services related to river flow regulation (multi-year and seasonal regulation).

By the way, if in the frame of first option, “costs and incomes distribution” under O&M of water infrastructure on the rivers should be used as an economic tool, in case of the Water and Energy Consortium, and also without it, establishing of the payment for river flow regulation is the obligatory provision of sustainable interrelations between riparian countries. The key issue is what amount of flow control should be repaid. If the management company of the Toktogul Dam will accumulate and store water resources for multi-year regulation and then implement water releases with the purpose of increasing water availability for the benefit of Kazakhstan and Uzbekistan, costs of this regulation (rather than electric power) can be repaid under conditions that the amount of these water releases will exceed natural inflows into the Toktogul Reservoir. At the same time, if river flow control will be implemented for the benefit of hydropower generation, Kyrgyzstan must pay to downstream riparian country for that deficiency of water which is kept in the Toktogul Reservoir and, on the other hand, for damage caused by infringement of the normal environmental regime of the river. Such an estimate was conducted by us a few years ago; and such an approach is applied in wide scales abroad.

Unfortunately, some scientists from riparian countries that are located in upper watersheds support introducing the payment for river flow control, which is conducted by the hydropower companies in the form of accumulating water in summer for the benefit of winter water releases. Lack of understanding of these specialists that is tantamount to the situation from the famous anecdote: “Buy a ticket and go on foot” or “Kissing a hand that has given a slap in your face” – the current regime of river flow regulation causes economic losses under requiring paying for this regime! Among other measures for overcoming water deficit the following can be mentioned:

- Developing the plan of using return water, amount of which exceeded 11 km^3;
- Improving the accuracy of forecasting river flows and climatic indicators; and
- Building up of the operational model for evaluating the current and long-term plans of development and river water resources management.

At the same time, one cannot forget that, first of all, water conservation should be realized on the domestic scene, providing the basis for water security!

A chief matter of water conservation is our concern for future generations. Therefore, understanding of the necessity of saving and protecting water resources should be instilled into our children since their birth. This is the responsibility of parents, educational institutions, society, and state. Training of everybody who enters into life within the scope of the program “Water and Education” is the guarantee of future surviving. Japanese preachers of Shinto call upon: “Listen to splashes of water, sounds of water flowing in rivers; sounds of water that plays by its waves in lakes, roar of the surf, and sounds of droplets of rain and water jet from a faucet – this is God speaks with you, Nature speaks!” Let us listen to water!

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