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IWRM results in South Kyrgyzstan in terms of water productivity improvement

Many regions in the world are on the threshold of acute water shortage. The water use efficiency stays low. Efficiency of irrigation water use is 38 %. As UN estimates, the irrigation system efficiency is expected to increase by 42% (through advanced technologies and management practices) only by 2030. As a result of irrigation development, the mean annual flow withdrawal exceeds the environmentally allowable quantities in a number of river basins.

As is well known, in our region, the largest water quantity per person is in Kyrgyzstan and Tajikistan, and it is 1.5-2 times lower in Kazakhstan, Uzbekistan, and Turkmenistan.

In this context, let me quote water availability criteria as tested by the Canadian researcher Aly Shady, according to which:

- if per capita water consumption is higher than 1700 m^3/person a year in a country, there is no water shortage; - there are signs of water shortage if per capita consumption is from 1000 to 1700 m^3/person;

- if per capita consumption is less than 1000 m^3/person, there is water shortage with almost unpredictable negative consequences.

In the future, according to those criteria, despite population growth and the fact that given countries posses different water quantities per capita, needless to say about water shortage in any of the countries.

During the Soviet period, the irrigated agriculture was the basis of economic development in the republics of the Central Asian region, while the region itself was a raw materials-producing agrarian appendage of the Soviet Government. Exactly this provoked to rapid irrigated agriculture growth, which entailed new land development (irrigated area expansion by more than 1Mha over 1960 – 1980). The development of irrigation led to environmental deterioration all over the region as a result of the irretrievable diversions from river sources of huge water quantities for irrigation and the massive application of chemicals in agricultural production. As early as that time, the issue of improving water and land productivity was raised, especially on old-irrigation land. Though new-irrigation lands produced less crop yields than old-irrigation ones, the former showed better water productivity through less irrigation water inputs per unit yield.

The natural-climatic conditions in the Central Asian region and traditions made for solicitous attitude of local people to water and its use. However, with the development of large-scale irrigation, good traditions were left behind and then the myth was formed about the future inexhaustible water abundance from the transfer of a share of Siberian river flow to Central Asia. The Aral Sea started to become shallow catastrophically, the Siberian river flow transfer project disappeared, and people in Prearalie again faced a challenge of water conservation and efficient water use.

Orientation to potential water productivity may enable the region's countries to increase agricultural production almost twofold at 10% reduction of water use. One example are WUFMAS data collected from monitoring of factors contributing to crop yield formation on 220 control fields under representative for Central Asian conditions. According to the data, the annual irrigation water losses for the level "outlet to field – cotton rooting zone" average 51% throughout the region. Experience of countries producing up to 4 t of raw cotton per hectare under similar natural-climatic

conditions and at unit water inputs of no more than 5 thousand m^3 per hectare indicates to great potential of water conservation.

Many countries utilize waste water. In the Central Asian countries, waste water from industry and municipal sector in an amount of 6 km^3 a year are not used and create a load on the environment. It is important to remember that water conservation effect is not irrigation water saving only. It is proved that saving of water increases productivity of irrigated agriculture. According to WUFMAS data on water and land productivity analysis, the estimation of irrigation water use efficiency based on its unit inputs per unit agricultural production shows that the mean cotton irrigation norm "gross-field" is 7243 m^3/ha, including 2039 m^3/ha - leaching and recharge irrigation and 5204 m^3/ha - growing-season irrigation. At the mean cotton yields of 2.33 t/ha on the field, the mean weighted irrigation water inputs per unit yield are 3110 m^3/t and the water use productivity is 0.32 kg/m^3 on the field (the both indicators may vary within 1600...10340 m^3/t and 0.1...0.63 kg/m^3, respectively). For winter wheat, the mean weighted irrigation norm "gross-field" was 4575 m^3/ha. Given the mean yields of 2.23 t/ha, the irrigation water inputs are 2080 m^3/t and the water use productivity is 0.49 kg/m^3 on the field (data vary from 180 to 5750 m^3/t and from 0.17 to 5.65 kg/m^3, respectively).

Excessive water delivery to the field leads to lower land productivity since causes washout of nutrients from the soil, recharging of which is very problematic given the expensive mineral fertilizers, on the one hand, and groundwater rise and soil salinization under insufficient drainability. According to monitoring data on WUFMAS' control fields, the losses as a result of movable phosphorus washout are 65% of initial content, which it is 50% due to washout of potassium. Moreover, soil salinization increases by 51% on the average in two years.

The analysis of water losses due to organizational factors is very important. Such factors include:

• mistakes in water distribution and water management, particularly, because of poor information, including excessive water losses in channels, nonrecoverable outflows into closed sinks. As a result, huge volumes of water did not reach the Aral Sea. The regional and national experts should jointly identify those losses that amount to billions cubic meters and develop a mechanism to avoid and prevent them.

Flow formation countries are ready to provide relevant information to all regional organizations dealing with flow forecasting, climate prediction, and in order to ensure this, all the countries in the region should share financing of flow formation zone and of hydrometeorological activities.

Under market conditions, where economic mechanisms play a major role, water use efficiency and productivity and water conservation indicators at both national and regional levels will depend on charges for water resources and water use, while economic mechanisms of water conservation and of effective use will prevail over others.

In fact, people do save something, which is not for free.

As is well-known, currently the Central Asian countries practice different approaches to irrigation water charges. Thus, in Kazakhstan, the payment for 1000 m^3 of supplied water is 148,65 tenghe and the payment for every cubic meter of used surface water is 3.02 tiyn;

in Kyrgyzstan, the payment for water supply is differentiated, i.e. 30 soms per 1000 m^3 in the growing season and 10 soms per 1000 m^3 in the non-growing season (I and IV quarters);

in Tajikistan, 1 m^3 of supplied water costs 0.3 dirams.

There are no irrigation water charges in Turkmenistan and Uzbekistan.

Meanwhile, the experience of charged water use as applied in the Kyrgyz Republic demonstrates in great importance for water saving.

According to analytical data of SIC ICWC, prepared on the basis of databases processed and systematized in the SIC's Information Center under the projects "WARMIS" and "IWRM-

Fergana", after introduction of water charges (1995), provinces in Kyrgyz part of Fergana Valley started to reduce irrigation water withdrawals. For example, before introduction of charged water withdrawals (1986-1995), the annual water withdrawal was 3,7-4,7 Mm^3, while after charges were introduced, water withdrawals in provinces of Ferghana Valley amounted to only 2,67-3,68 billion m^3 (excluding withdrawal in 1998 as the most humid year). If we consider the total withdrawal for irrigation in three provinces of Kyrgyz part of Fergana Valley in five-year periods, it was 22271 Mm^3 in 1986-1990, 19655 Mm^3 in 1991-1995, and only 16987 Mm^3 in 1996-2000 - the period of charged water use. Such reduction of water withdrawals took place under constant irrigation area and minor changes in cropping patterns.

Thus, we have every reason to say that the introduction of charged water use in the Kyrgyz Republic contributed to reduced irrigation water withdrawals and the charged water use had real effect on lower water use and on water productivity improvement, to a certain extent.

Implementation in Kyrgyzstan of the policy aimed at introduction of water charges and establishment of Water User Associations contributed to reduction of water withdrawal by 30%, moreover, this takes place in water-sufficient republic. However, taking into account a need to save water to the benefit of nature, Kyrgyzstan follows a water conservation policy, implements the integrated water resources management on Aravan-Akbura canal - one of pilot canals within IWRM-Fergana project. Within the framework of resource-conservation projects, Kyrgyzstan creates demonstration plots and pilot projects, where people are trained and educated in saving water and other resources. As an example, one can site demonstration plots of the projects such as WARMAP, GEF, IWRM-Fergana, as well as demonstration plots for energy-saving under SPECA project.

To address food challenges, the Central Asian states follow a grain independence policy. In this context, grain areas, mainly, under wheat, were increased considerably at the expense of cotton, forage, vegetable and cucumber areas. Moreover, livestock productivity decreased as a result of lack of efficient forage base, poor quality of forage and feeding processes, low assimilability of forage. Production of vegetables, fruits and cucumbers meet completely local demand and is subjected to export. However, actual export of such goods does not correspond to capacities of the region due to export limitations. As a result, agricultural producers lose their income.

Food import is reduced in terms of volume and assortment. The policies followed by the states are aimed at further reduction of import and increase of food export and do not imply regional specialization.

Considerable gap between food growth rates and population growth leads to aggravation of food problems. Access of population to adequate nutrition will depend on efficiency of agricultural production and on national economic development in general.

Water is an important factor under such conditions. One major indicator of nutrition is quantity of calories. According to medical data, calorie consumption per capita should be 2700—3200 kcal. This will require adequate agricultural production to meet food demand. In order to achieve this, measures should be taken in the nearest future to strengthen agriculture, expand crop areas and, undoubtedly, all these actions will be connected with a need to develop and use water resources.

Aiming at further improvement of irrigation technique and crop yields, probably, future irrigation development will be based on the following positions. First, irrigated agriculture needs to be intensified in order to meet people's demand for food. Second, water use in irrigated agriculture should be evaluated on the basis of future advanced water-conservation technologies. At the same time, it is necessary to consider well-approved traditional water-conservation techniques. Thus, one of the ways to reduce norms in surface irrigation is a system of field-protection plants, which leads to 15—25% of irrigation water saving. Third, in the future we should rely on abrupt increase in crop yields.

Now, Mexican irrigated wheat becomes widely spread in tropical zone. This wheat can yield 10 t per hectare. It served as a basis for "green revolution" in India and solved food problem in other countries. Obviously, the world food problem cannot be solved using technical measures only. Biology plays a very big, perhaps, leading role in this respect. Fourth, by using biotechnologies and advanced irrigation techniques (for example, drip and other ways of subsoil irrigation), may be we will achieve the expected results, including provision with water resources. They refer to category of renewable resources but only to a certain extent, which depends on quantity of water diversion from sources and on water quality.

While fulfilling the task in terms of these two important for water resources aspects, one can meet mankind demand for water in order to solve the food problem.

Food growth will be ensured mainly through the increase in crop yields. Moreover, irrigation norm will decrease through advanced irrigation techniques and selection. The total irretrievable water input will increase slightly. This indicator should become stabilized; and the main effect will be reflected in the reduction of water input per 1 t of production. Therefore, the main strategic line of water sector development that solves water quantity and quality problems is the reduction of water inputs per unit production. Certainly, this should be addressed in all branches of water sector, and first of all in irrigated agriculture.

The development of integration processes between the republics is of importance. Taking into account the long-term bread-grain price forecasts, the problem related to lack of grains for food in the region can be solved through cooperation by producing grain in Kazakhstan. It is well-known that growing wheat on irrigated land under current yields is not cost-effective. Therefore, the argument that wheat self-provision is economically reasonable is not cogent. Dry wheat grown in Kazakh steppes produces better results in terms of yields and profit. By following a moderate policy of grain self-provision, based on the development of interstate cooperation and a possibility to cover bread-grain deficit from Kazakhstan, it is possible:

- to expand areas for forage crops, mainly alfalfa;
- to renew crop rotation, use alfalfa as nitrogen-fixing crop for soil fertility restoration;
- to increase production of fodder grain;
- to raise efficiency of forage base for livestock;
- to improve livestock productivity.

The regional cooperation should be based on economic benefit from production and address such areas as meat and milk production in Kazakhstan and Kyrgyzstan, grazing development and sugar beet production in Kyrgyzstan, earlier vegetable production in Turkmenistan and Uzbekistan, and fruit and cucurbits production in Tajikistan, Uzbekistan, and Turkmenistan. Hotbed farming and using film technologies for early vegetable production, canned and dry fruits production will contribute to increased export capacities.

Intra-regional cooperation will lead to reduced food import, leaving small export in the region, based on the cost-effectiveness of producing certain agricultural products in some zones.

It is clear that no one country can agree on policy, which entails considerable dependence on food import, until this country achieves long-term economic and military security.

According to human development forecasts, urban population is expected to grow, with accompanying water re-distribution. The water use priority would be provision of needed quantities of water for urban zones, industry and services. The agricultural sector will be more relying on production of high-value crops. As the world experience shows, despite the potential production benefit due to advanced technology, inevitably, water will be re-distributed from agriculture to more valuable uses in water-scarce regions. The governments of Israel, Cyprus, and Malta successfully re-employed their people in other activities, including industry, commerce, and tourism. Agriculture is limited mainly by high-value export crops and food is not produced in those countries. This is a strategy of replacing irrigated agriculture by food import compensated through urban and commerce

development (the so called import of «virtual water»).

In our region, one should recognize a need for and value of “virtual water” (water used for non-agricultural purposes, for food import) for regional food provision.

Since the collapse of USSR, transition to new economic relations was not easy and smooth in all economic sectors in the Central Asian countries. Agriculture faced such problems as lack of equipment, fertilizers, and chemicals, as well as difference between the output and input prices.

As of January 1, 2007, the area of the Kyrgyz Republic is 19995,1 thousand ha. There are 10766,4 thousand ha of agricultural land, of which: 9176,1 thousand ha -pastures; 1283,7 thousand ha - arable land, and the rest falls to other land categories.

The total irrigated area is 1020,6 thousand ha, of which 866,3 thousand ha - irrigated arable land.

There are diverse soil and hydrogeological conditions even within the boundaries of one province in Kyrgyzstan. Depending on those parameters, irrigation conditions differ between each other. Irrigation efficiency depends largely on soil, water management and irrigation technology.

The “On-farm irrigation” Project plans to improve crop yield through stable and reliable water distribution on about 120 thousand ha of irrigated area.

To track project results and see the project impact on agricultural production, a special database was developed and filled with information collected from all WUAs.

Using this database, the impact of rehabilitation in WUA, particularly crop yields before and after rehabilitation, is analyzed and assessed. Unfortunately, it is impossible to estimate increase in the crop yield only through additional water quantities. Usually, this increase is a sum of many factors, such as optimal agrotechnical dates, high-quality seeds, fertilizers, etc.

By December 31, 2007, the rehabilitation was completed in 51 WUAs. According to project implementation plan, assessment of rehabilitation impact on yields should be made at the end of the second year after work completion. Yield analysis was made in 14 WUAs, where 1 or 3 growing seasons passed after finishing of rehabilitation. The analysis results show that yields were not increased in some WUAs and for some crops after the rehabilitation. Thus, winter wheat yield was increased by 8 to 19% in half WUAs. Tobacco yield increased by 2-7% in all WUAs. Yield of cotton increased by 6-18% in 2/3 WUAs and that of corn increased by 15-20% in half WUAs.

The rehabilitation impact is assessed by ORP and invited independent company. The results of survey show WUAs that were subjected to rehabilitation and supported had higher crop yields than WUAs not supported by the project.

The survey of the independent company shows that 86% of farmed indicated to improved reliability of water supply, 82% of farmers noted reduced water losses, 88% of farmers received water in time (observance of water delivery schedules), and 91% of farmers indicated to more equitable water distribution.

For each planning zone defined by certain river reach and command irrigated area inside the republic and then for the republic in general within basin area, the following indicators and factors should be determined, analyzed and evaluated:

• potential water and land productivities - based on available data on best practices, especially in dry years;

• unit water consumption under minimum water inputs into organic production, using common technical approaches;

• causes of low production (due to land and water-related factors) and possibilities to overcome this, with definition of priority of measures to be undertaken;

• salt and water balances of planning zones, using historical data; possibility to bring these parameters to values leading to environmentally sustainable processes (minimum salt exchange between river and irrigated area and between aeration zone and groundwater, with gradual reduction of salt storage in the aeration zone and in the planning zone in general);

• possibility to use maximally return waters and utilize them directly in places close to their formation;

• possibility to use wastewater, groundwater, and water from all local sources that are not utilizable currently;

• possibility to reduce water losses caused by organizational factors in all chains of water-distribution hierarchy;

• unproductive water losses in all chains of irrigation system, first on irrigated field; estimation of these losses will help to chose less capital-intensive measures for water conservation;

• reduction of return water discharge into rivers and water bodies and improvement of water quality as a result of water conservation measures.

The main factors of low irrigation water use productivity are:

- unstable irrigation water availability in canals;
- improperly selected schemes and parameters of irrigation technology;
- low quality of field leveling and preparatory agro-technical measures.

The main indicators of low water and land use efficiency are:

- large losses to infiltration;
- large losses to discharge from irrigated fields;
- non-observance of times to carry out separate technological operations and the quality of their performance;
- low doses of fertilization or their full absence;
- insufficiently effective measures for control of weed, diseases and pest.

The main ways for improving water productivity and water conservation in the region are:

- introducing water charges in irrigated agriculture through establishing incentive step tariffs and fine sanctions per cubic meter of water used over established norms and so on;
- developing common technical approaches to rigid standardization of water consumption based on more precise norms mainly designed for meeting minimum biological needs of plants;
- creating a system of pilot water conservation projects as first-priority entities of demonstrative water use;
- introducing water rotation and other organizational measures aimed at control of water losses in field and its non-productive use (short furrows, irrigation with concentrated stream through furrow, thorough maintenance of field leveling and so on);
- introducing advanced irrigation techniques and technology;
- installing impervious membranes on canals;
- integrated and partial reconstruction (modernization) of irrigation systems.

From these positions, considering that the most losses are concentrated in field and in water distribution among new privatized farms, the established Water Users Association is the most important mechanism for regulation of water use and conservation at this level along with charged water use.