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THE IMPACT OF GLOBAL CLIMATE CHANGE ON WATER RESOURSES IN CENTRAL ASIA

Мақалада Орталық Азия аймағының су қорларына ауа райының глобальді өзгерісінің ықпалы қарастырылды. Қазіргі кезеңде халықаралық және ұлттық деңгейде ауа райының өзгеруіне бейімделу және оның зардаптарын жұмсартуына көп назар аударылуы зерттеудің мәселесі болып табылады. Орталық Азия аймағы суға байланысты тұрақтылықты маңызды өзгерістердің ұлғаюымен сипатталады.

В статье рассматривается проблема влияния глобального изменения климата на водные ресурсы региона Центральной Азии. Исследованиям вопроса адаптации к изменениям климата и смягчению их последствий в настоящее время уделяется все больше внимания как на национальном, так и на международном уровнях. Центрально-Азиатский регион характеризуется отчетливой тенденцией к увеличению серьезных изменений в стабильности, связанных с водой.

Central Asia: background information

Central Asia covers territory of five countries: Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan. It is situated in the heart of the Eurasian continent with the total area of 3,882,000 square kilometres and the population over 53 million (2004) of which more than 82 % is living in the Aral Sea basin. It borders with Afghanistan and Iran in the south, with China in the east and with Russia in the west and in the north.

The climate in the region is sharply continental, mostly arid and semi-arid. Average precipitation (concentrated in the spring and winter) is about 270 mm, varying between 600–800 mm in mountains zones and 80–150 mm in desert regions.

Social-economic development of the region has depended on water and land resources since immemorial time. Irrigated farming and livestock production formed the biggest part of welfare, but in the same time created vulnerable conditions and water limitations for ecosystems. The region started actively using irrigation in the 6–7th century B.C and still it is one of the biggest irrigation region in the world (with about 9.1 million hectares of irrigated crops). Population growth and irrigation development have significantly increased the demand for water in the region especially during the past 40 years. Actual consumptive water withdrawal in Central Asian countries varies from 20 % of available water resources (Kazakhstan, Kyrgyzstan and Tajikistan) to 80–90 % (Uzbekistan, Turkmenistan).

A specific feature of the region from a hydrological point of view is the division of its territory into three main zones:

- the zone of surface flow formation (upper watersheds in the mountain areas to the south-east);
- the zone of flow transit and its dissipation (central part);
- the delta zones (to the north-west).

Available water resources (surface and underground) have always principal impact to the economic activities in Central Asia as limiting factor for development which is competing with ecological requirements. The largest rivers over the region are mostly transboundary and they are the following: the Syrdarya and Amudarya (Afghanistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan), Chu and Talas (Kyrgyzstan and Kazakhstan), Tarim (Kyrgyzstan, Tajikistan and China), Ili (China, Kazakhstan), Irtysh (China, Kazakhstan, Russia), Ural, Ishim, Tobol (Kazakhstan, Russia).

During the last three decades of the Soviet era (1960–90), irrigated agriculture and the sectors of economy related to water management (processing of agricultural products, hydropower, construction and some others), contributed more than 50 percent to the GNP. Obtaining of independence by Central Asian countries and respective loosening of economic ties were accompanied by economic decline. This became the main cause of decline in gross national product and, particularly, agricultural production that represented large share of about 30 % in GNP [1].

Problem of Climate change in Central Asia region

Climate change adaptation and mitigation is receiving increasing attention, both nationally and internationally. Climate change caused by human activities and their impacts pose a threat to the security of individual territories and states, leading to energy, food and environmental, as well as a whole, the amount of exposure — humanitarian crises.

Many regions of the world characterized by a distinct tendency to increase or decrease the volume of river flow, which leads to a serious change in the stability of water associated with that of virtually all sectors of the economy. For example, the strategic climate change projections of the Republic of Kazakhstan for the period up to 2010–2015 and their impact on economic sectors in Kazakhstan and indicated that changes in seasonal runoff, due to ongoing and anticipated climate change must be considered in hydropower. The projected change in river flow affect the flow of water in major reservoirs [2].

Climate change is felt in changes in precipitation and increased frequency of extreme weather events, which usually leads either to increased drought or floods. As a result of climate change, mountain areas can lose a significant portion of its glaciers. This, in turn, affects the runoff and water flow in rivers, and lead to more frequent and devastating floods. In the future, with the depletion of glaciers and the loss of moisture accumulating ability, reduced river flow with a likely slowdown in self-purification ability of rivers and declining water quality in them.

Influence of climate change on water resources is particularly noticeable evident in Central Asia. In this region, the Aral Sea has historically played an important role in mitigating the cold north winds in autumn and winter, reducing the air temperature in summer. Since drying of the Aral Sea over the summer was dry and hot, and winter — cold and long.

The main indicator of climate change in Central Asia — a state of glaciers and snow cover. For example, in the Tien Shan have more than 8 thousand glaciers. Area glaciation is 8169.4 km2. Fresh water, concentrated in the mountain glaciers is estimated at 650 billion m3. During the period from 1960 to 2005 in the Pamir-Alai disappeared more than 1 thousand glaciers in the Trans-Ili Alatau — about 100. Reason for the destruction of glaciers somewhat, but chief among them — global warming.

According to the UN Environment Program (UNEP), in recent decades, there was an increase of surface air temperature by about 0.6 °C in mountainous areas — at 1.6 °C.For natural reasons, the melting of glaciers in Central Asia is the pollution of dust (for the year by the glaciers accumulates up to 20 g/m2 of dust), which is carried by dust storms from Iran, Afghanistan, China and other desert areas, and in recent years — and from the dry area Aral Sea [3].

In the world history, the Aral Sea basin is among the most ancient centers of civilization.

Amudarya and Syrdarya — two main rivers in the basin, water resources of which are allocated to arid lands irrigation and the Aral Sea with their tributaries Vakhsh, Pyandj, Surkhandarya, Kafirnigan, Zerafshan, Naryn, Chirchik, Karadarya and others form a large water system, which is included in water-resources scheme of the Aral Sea basin.

The Aral Sea basin, which geographically coincides with almost the entire area of Central Asia, is located in the heart of the Euro-Asian continent. More specifically, the Aral Sea basin covers the whole territory of Tadjikistan, Uzbekistan, the majority of Turkmenistan, three provinces of the Kyrgyz Republic (Osh, Jalalabad and Naryn), and the southern part of Kazakhstan (two provinces: Kyzyl-Orda and South Kazakh), and northern part of Afghanistan and Iran. For the purpose of this presentation, only the provinces of the first five countries within the Aral Sea Basin have been taken into consideration. This territory extends between longitudes 56o and 78o East, and latitudes 33o and 52o North, covering an area of about 1.549 million km2, of which about 0.59 million km2 are cultivable lands.

The territory of the Aral Sea Basin can be divided into two main zones: the Turan plain and the mountain zone. The Kara Kum covers the western and the northwestern parts of the Aral Sea Basin within the Turan plain and Kyzyl Kum deserts. The eastern and south-eastern parts are situated in the high mountain area of the Tien Shan and Pamir ranges. The remaining part of the basin is composed of various types of alluvial and inter-mountain valleys, dry and semi-dry steppe. Different forms of relief in all the countries have created specific conditions, which are reflected by the interrelation between water, land and populated area within the region. About 90 % of the territory of the Kyrgyz Republic and Tajikistan are occupied by mountains. This, on the one hand, creates for these two countries a «monopoly» on the formation of water within the basin and, on the other hand, a deficit of cultivable lands. The most important feature of the region is the number of oasises (Fergana Valley, Khorezm, Tashaus, Mary, Zerafshan, Tashkent — Chimkent), which cover a small part of the overall area, but since ancient times have been the focus of human activity and population due to the presence of acceptable living conditions (water, precipitation, the best soils, etc).

The majority of the territory of Kazakhstan, Turkmenistan and Uzbekistan are covered by desert (more than 50 %), and only less than 10 % is represents by mountains. Such distribution of area has created a huge potential for the development of irrigation, which requires more water resources than those countries have available. This unequal allocation of water and land were seen in Soviet times as an opportunity to reallocate the water resources for the development of newly irrigated area in lowland republics. However, in the current post Soviet period these circumstances have been transformed into a source of potential future conflicts.

The landlocked position of Central Asia within the Euro-Asian continent determines its sharply continental climate, with low and irregular precipitation. Large daily and seasonal temperature differences are characteristic of the region, with high solar radiation and relatively low humidity. Diverse terrain and altitude differences from 0 to 7,500 m above sea level lead to a great diversity of microclimate. Mountains are located in the east and southeast, which are the center for the formation of water and the origin of its flow. Although this area is often struck by humid winds, the mountains trap most of the moisture, leaving little precipitation for the other areas of the Aral Sea Basin.

The average July temperature on the lower elevations, in valley areas and desert, deviates from 26oC in the north to 30oC in the south, with maximum temperature up to 45–50oC. The average January temperature records are up to 0oC in the south to -8oC in the north with absolute minimum up to -38oC. The annual precipitation in the lowland and valleys is between 80–200 mm, concentrated in the winter and spring, while in

the foothills precipitation is between 300–400 mm, and on the southern and south-western sides of the mountain ranges between 600–800 mm.

Climate in the region has specific zones of variation accordingly to geographic and geomorphologic conditions, which define the difference in water demands for irrigation. Big differences in air humidity in summer time between the old oasis's and newly irrigated area (50–60 % and 20–30 %) cause significantly larger water demands in former desert (now under irrigation) in comparison with oasis's. The second factor especially affecting agricultural production is the instability of spring weather, which deviates in temperature, precipitation and even late frosts (sometimes in the beginning of May) and hail (in June, which sometimes destroys emerging cotton plants and vegetables over big areas) [4].

Thus, in Central Asia is becoming a noticeable increase in the duration of heat stress (drought). The effects of climate change are expressed by increasing the number and power of weather and climate anomalies. Their number in the past 20 years has increased by 40 %. The ongoing changes in the climate system in the region and affect the ecosystem, and economic activity, primarily in areas related to the use of water and land resources.

With climate change raises a number of issues that relate, for example, investment policy in hydropower. Reducing the area of glaciers and snow cover in mountain areas over time, lead to shortages of water in the plain areas, changes in runoff, respectively, putting forward new demands on the regime of hydropower potential of transboundary rivers and sustainability of the irrigated areas of neighbouring states. The high degree of risk of economic losses from the effects of climate change on water resources calls for urgent coordinated regional and national adaptation of interstate water management, develop on its basis of the integrated management of transboundary rivers in Central Asia [5].

The climate change is a process characterized by a multitude of risks and, in particular related to the degree, time and nature of these changes affecting the management of water resources in transboundary river basins and on the stability of interstate water use.

High vulnerability to transboundary river basins exposed to hydropower, irrigation and water supply. Given that between them there is the competitive nature of water; reducing water content of rivers can lead to conflict situations. Therefore, the adaptation process of water management at regional or basin level, climate change implies, above all, the agreed policy of water use and development of hydropower resources. Many river basins in Central Asia are in a state of water deficit, and assessment of climate vulnerability, for investment projects is necessary to determine the likely level of risk and measures through which it can be reduced or eliminated [6]. Identification of objects in the zone of risk, evaluation of sources and causes of vulnerability are important steps in the pre-training. Unfortunately, there is still no universal methodology for this assessment in this regard; CSDs should be designed for each specific object of a transboundary river basin.

Features of the use of water resources of transboundary rivers, caused by the natural geographic and economic-economic conditions of the river basin, and competing national interests pose specific challenges to management.

In this regard, adaptation requires an integrated approach, based on the principle of basin water resources of rivers and considering the peculiarities of each country, the nature of economic integration of the basin. Effective and long-term goals of the majority of adaptation measures in the basins of transboundary rivers, of course, requires intergovernmental coordination and cooperation.

Political, legislative and institutional structures at national and regional levels should work together to support adaptation to climate change. This should hold also at the basin level, which will require more effective international cooperation and appropriate mechanisms for its coordination.

To monitor the water situation, as well as support for simulation of the vulnerability of water resources due to climate change, on which the development priorities of water policy, strategies and plans for the development and operation of water facilities to meet the needs of the parties to the media. Information on water resources must support the understanding of the necessity of interaction between the river basin and water users (agriculture, industry, hydropower, etc.).

Conclusions and suggestions

Influence of climate change on water resources depends not only on changes in the volume, timing and quality of surface runoff, but also on the characteristics of the water system, varying impacts on this system:

- Technical condition of the water system;
- Timeliness of repairs and reconstruction;
- Sufficient funds for their conduct;

- The development of water-and energy-saving technologies;
- Improving the management systems;
- Staffing, scientific and technical support, etc.

Complex (integrated) water management should improve the capacity of water users to adapt to climate change and mitigation.

Climate change significantly affects the water resources situation in Central Asia. Hydropower and agriculture in this region are particularly sensitive to climate change because they have a direct impact on river runoff and, consequently, the development of hydropower and agricultural production.

Reducing the negative effects of climate change impacts on the region or a single economic sector depends on the degree of preparedness at regional and national levels of the opportunities and reduce the likelihood of economic damages.

In this regard, investment projects should include such steps as assessing the current situation, developing adaptation strategies for water resources management, the draft new measures to protect against floods to climate change, the definition of further actions to improve scenarios of regional climate change and its impact on model water, that is to be executed climatic vulnerability assessment project.

Taking into account the high vulnerability of water resources in the process of climate change impacts and related food, energy and environmental security, the growing need for water resources, to solve adaptive problems must be more involved in international financial development institutions.

For an objective assessment of the costs of implementing adaptation measures and risk reduction, we need to increase research on forecasting and monitoring of climate change, seeing them as an essential pre-investment phase of the training projects related to water use in various industries.

For the Republic of Kazakhstan, the transition to sustainable development is a defining necessity in the occurrence of Republic of Kazakhstan in 50 competitive in the world, in accordance with the Address of the President of the Republic of Kazakhstan. The UNDP / MEP provides assistance in the implementation of the Concept of transition of Kazakhstan to Sustainable Development for 2007–2024, approved by Presidential Decree of November 14, 2006 N 216 [7].

Currently in the process of transition to sustainable development of the position of the Government of Kazakhstan to implement the commitments following the ratification of the Kyoto Protocol to the UNFCCC requires a radical revision of models of economic growth in Kazakhstan, which is mainly due to the increase in commodity prices on world markets and heavy reliance natural resources and without the need to transition to a low carbon development. Following the ratification in April 2009, Mr. Kyoto Protocol, Kazakhstan has actively joined the global movement to prevent global climate change and began to work actively to meet the requirements of the UNFCCC and the Kyoto Protocol at the national level.

- Climate change in Central Asia will manifest itself as:
- Fever the changed nature of rainfall;
- Increased aridity;
- Increased frequency of extreme weather events and etc.

All this will be accompanied by increased frequency and intensity, in particular, floods, droughts, landslides, melting glaciers and landslides. Until not be implemented timely, coordinated and sustainable adaptation measures is likely that the country will suffer considerable economic damage, will face a humanitarian stress and environmental degradation as a result of climate change.

Having committed themselves to reducing greenhouse gas emissions, the Government will actively promote a policy of adaptation and mitigation of the impact of climate change on key sectors of the economy. Joint project of UNDP facilitate the process of preparing the National Program on Adaptation to Climate Change.

References

1. Interstate Commission for Water Coordination of Central Asia http://www.icwc-aral.uz/index.htm
2. Strategy of Kazakhstan to prevent climate change http://www.climate.kz
3. The Regional Impacts of Climate Change. An Assessment of Vulnerability / Edited by R.T.Watson, M.C.Zinyowera, R.H.Moss. — Cambridge: University Press, 1998. — 517 pp.
4. Coordination Center on Climate Change http://www.climate.kz/rus/
5. *Agaltseva N.A., Pak A.V.* Evaluation and forecasting of the water availability on the rivers of Central Asia with the account of possible climate change, Espoo, Finland. 1998. Proceedings of the Second International Conference, volume 2. P. 940–946.
6. *Jasinski V.A., Mironenko A.P., Sarsembekov T.T.* Investment risks associated with the influence of global climate change on water resources of Central Asian // Eurasian Economic Integration, № 1 (6), February 2010.

7. On the Concept of transition of the Republic of Kazakhstan to Sustainable Development for 2007–2024. Decree of the President of the Republic of Kazakhstan dated 14 November 2006 N 216 // Kazakhstan Pravda on November 16, 2006. — N 249 (25220) — November 18, 2006. — N 251.

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XIX Ғ. СОҢЫ МЕН XX Ғ. БАСЫНДАҒЫ ҚАЗАҚСТАННЫҢ ДАЛАЛЫҚ ОБЛЫСТАРЫН ЗЕРТТЕГЕН Ф.А. ЩЕРБИНА ЭКСПЕДИЦИЯСЫ НӘТИЖЕСІНДЕ ЖИНАҚТАЛҒАН МӘЛІМЕТТЕРДІ ӨҢДЕУДІҢ ӘДІСТЕМЕСІ ЖӨНІНДЕ

В статье анализируется методика обработки материалов Ф.А.Щербины по исследованию степных областей Казахстана конца XIX – начала XX вв. Автор свидетельствует, что «Материалы по киргизскому (казахскому) землепользованию...» ранее не подвергались комплексному научному анализу, а также показывает современную практическую значимость данного материала как источника.

In this article the author analyzes the method of processing materials of F.A.Scherbyn for research steppe areas of Kazakhstan of the end of XIX – beginning of XX centuries. The author suggests that «the Materials on the Kirgiz (Kazakh) Land... «had not previously been subjected to complex scientific analysis as well as contemporary shows the practical value of this material as a source.

Жалпы алғанда қандай да болмасын статистикалық зерттеулер алдын ала ұйымдастырылады. Оның ең алдымен арнайы нұсқауы, бағдарламасы қабылданады. Бұл бағдарламада зерттеудің мақсаты мен міндеті, зерттеу қажет объектілер нақты мәселе ретінде қойылады. Осы бағдарламаларға негізделіп арнайы сауалнамалар, анкеталар, карточкалар жасалады. Байқаудың бағдарламасын жасау — жауапты және күрделі іс. Ол байқаудың алдына қойған міндеттің бәріне жауап бере алатындай болуы керек. Мысалы, халық санағының бағдарламасы халық шаруашылығын дамытудың келешегіне керек деректер жиналуын қамтамасыз етуі керек [1; 15].

Әлеуметтік-экономикалық тарих саласында бюджеттік зерттеулердің нұсқаулары құнды материал болып табылады. Бюджеттік статистика тарихи зерттеулерде кеңінен қолданылады. Далалық өлкедегі қазақ шаруашылығының бір бөлігінің бюджеттік зерттеуге ие болғандығы бізге белгілі. Қазақ шаруашылығының бюджетін құру 1896–1903 жылдар аралығындағы белгілі статист Ф.А.Щербина басқаруымен далалық облыстарды зерттеуге байланысты жүргізілген экспедиция жұмысында көрініс алған. Экспедиция қызметкерлерінің тұжырымдарының барлығы 13-томдық «Материалы по киргизскому землепользованию, собранные и разработанные экспедицией по исследованию степных областей» басылымына енген. Соңғы том «Свод материалов по киргизскому землепользованию, собранных и разработанных экспедицией по исследованию степных областей» бюджет мәселесіне арналды. 1906 жылы Петербургте жарық көрді. Бұл том негізінен кестелерден және Ф.А.Щербина жазған кішігірім кіріспе мен қаржы кестелеріне арналған қосымша мәліметтерден тұрған. Бюджеттік кестелер және оларға талдау басылымның жекелеген томдарында бар, дегенмен, Ф.А.Щербина пікірі бойынша, көбінесе бір типтегі бюджет алынған. Мұндай бюджеттік көрсеткіштің құндылығының қанша шамада екені, әрине, түсінікті. Ал арнайы томда қазақ шаруашылығына қатысты барлық бюджеттік зерттеуді талдауға мүмкіндік беретін әр типті бюджет берілген [2, 172].

XIX ғасырдың соңы мен XX ғасырдың басындағы біз қарастырып отырған экспедицияның бағдарламасына тоқталар болсақ, 1896–1903 жж. Ф.А.Щербина экспедициясының бағдарламасы жалпы 17 тараудан, 93 кішігірім қарастырылатын мәселелерден тұрады. Негізгі 17 тарауында: рулық бастама, шаруашылық ауылдардың тарихы, жерді пайдалану формасы, мал шаруашылығы, пішен шабу, жер өңдеу, бақташылық және бау егіп-өсіру, орман және тоғайлы жерлер, жерді жалға беру (аренда), өнеркәсіп және жалақы, алым салық және борышы, қырғыз отбасының ерекшелігі, ортақ шаруашылық істер, сауда, несие (кредит), халықтың қажеттілігі, табиғи-жаратылыс жағдайы қарастырылуы қажет етеді [3].