

Against the background of global climate changes, the current ecological situation of Azerbaijan's water resources and the directions of efficient use

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ABSTRACT

State of the problem. The article describes the full range of hydrological threats related to the limitation and pollution of the water resources of the Republic of Azerbaijan. It is noted that the consequences of year-by-year aggravation of hydrological threats are the increase of conflicts with neighboring states, the development of new centers of ecological instability, the republic's socio-economic development programs are not fully implemented in the regions. It is known that the main features of Azerbaijan's water resources are their limitation, uneven distribution, approximately 70% of surface water resources are formed outside the country's borders and are seriously polluted when entering the country. The total water reserve of Azerbaijan is 35 billion cubic meters, of which 5 billion cubic meters is underground water. River water resources of the republic are 30.0 billion cubic meters, of which 10.0 billion cubic meters are local waters.

Research object. Azerbaijan's water resources, their modern ecological condition and directions for effective use.

The purpose of the study. Based on the long-term observation data and climate forecasts of Azerbaijan, it is to show the scarcity of fresh water resources, the potential to be significantly affected by climate change, and the directions of efficient use. However, the ability to quantify future changes with hydrological changes and their impacts on systems and sectors is limited by uncertainty at all stages of the assessment process. Uncertainty arises from different socio-economic development scenarios, given different climate model forecasts, reduction of climate impacts to local and regional scales, impact assessment. In accordance with the UN Sustainable Development Goals, it is important to study its effects in the study area within the framework of climate action.

Methodology. Generalization, statistical, systematic analysis and comparison methods were used in the preparation of the article.

Scientific novelty of the research. Against the background of modern climate change, the ecological situation of Azerbaijan's fresh water sources is analyzed and the characteristics of the use of water in various economic fields, the situation of pollution of transit river waters with industrial and domestic sewage of neighboring countries, and the harmful effects of their use on human health and environmental components are emphasized.

Research results. In the article, the improvement of the national strategy in the implementation of the ecological-geographical assessment of water bodies in Azerbaijan, the implementation of projects supported by various international organizations, the application of river basin management plans to a larger number of rivers and the improvement of legislation for the purpose of protection, the implementation of international cooperation are among the necessary steps.

Keywords: *water resources, river waters, pollution, climate change, environmental responsibility, health, management, climate action goal.*

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Introduction. Currently, fresh water is one of the most valuable natural resources and the most intensively consumed resource in the entire global economy [19]. In general, the total global consumption of fresh water is 1000 times greater than the consumption of all other types of industrial raw materials: in one day, the world consumes a volume of water equal to the annual production of all types of minerals.

Determining water as a normal economic resource has certain grounds, because water is a resource whose price can be calculated, its volume and demand can be quantified [1, 21]. When determining the price of water as an economic resource, there are non-economic problems, including the specificity of

a given economic benefit [4], the mass and consistency of its consumption, and the complete absence of substitute goods or substitutes [7].

These factors determine the spectrum of prospects for the development of the water market and determine the boundaries that shape the effective demand and supply of existing water resources [15]. If the current growth rate of water consumption is maintained in the process of socio-economic development, the water problem will emerge as a global problem [10]. This will affect the rights of every person to water, environmental and national security, investment characteristics in relevant sectors of the economy, trans boundary regulation of water resour-

ces [8], management of international water basins, etc. Meanwhile, subsidies for urban, industrial and agricultural water supply, sanitation and treatment do not allow the price of water to be taken as an absolute indicator of its value as an economic resource alone [23].

Decreasing the quantity and quality of water as a component of any ecosystem has a serious negative impact on the environment [16]. Exceeding the environment's natural capacity for self-cleaning and absorption leads to loss of biodiversity, damage to vital systems, damage to natural food sources, and other costs [24]. The total damage to the environment caused by water pollution must be considered in two aspects: quality and quantity, both of which have equal socio-medical importance [25].

The state of water resources directly responds to changes in air temperature and precipitation and their extreme manifestations. Azerbaijan has been experiencing a shortage of water resources for the last 30-40 years, and according to forecasts, the country may face a significant shortage of water resources by 2040 [3]. Since almost all sectors of the economy depend on water, there may be a decrease in GDP by 2050 due to its lack in regions of the country [2].

One of the causes of land degradation and desertification is the extensive use of water resources for irrigation. Unsustainable irrigation canals and outdated water supply infrastructure that require large-scale reconstruction are also factors that lead to inefficient use of water resources and land degradation [5]. This has resulted in an ecological disaster, loss of biodiversity, reduction of fish stocks, and a negative impact on the welfare of the local population.

As we mentioned above, Azerbaijan is one of the countries with scarce water resources. 62 percent of the total water resources of the South Caucasus belong to Georgia, 28 percent to Armenia and only 10 percent to Azerbaijan [6]. Azerbaijan's water problems arise from a combination of its geographical, climatic, economic and management factors. The semi-desert and arid desert climate of a large area of the country, together with limited water resources, pose significant challenges for sustainable water management. Kura-Araz lowland, Arazboyu plains of Nakhchivan, Jeyranchol-Acinohur, etc. are located in the arid region of the country, so there is a chronic water shortage. Limited water resources are aggravated by the presence of large semi-desert areas and the fact that Azerbaijan shares water resources with neighboring countries [9].

It is known that agriculture is one of the main sectors of the national economy of Azerbaijan and is highly dependent on irrigation. The use of inefficient irrigation methods, including outdated infrastructure and equipment, leads to excessive water consumption, which leads to wastage and depletion of water resources. The lack of comprehensive management

of water resources leads to their uneven distribution and over-exploitation.

1. Modern ecological situation of fresh water resources of Azerbaijan.

In addition, Azerbaijan also suffers from the effects of frequent natural destructive weather and climate events, which increase the likelihood of natural disasters (floods, inundations, landslides) if appropriate measures are not taken, and negatively affect the quality and quantity of water, threatens the ability to manage water resources safely [11].

One of the most important problems of Azerbaijan is water pollution. According to environmental pollution monitoring data, the main water polluters are mainly industrial, agricultural and utility enterprises of Armenia and Georgia, as well as Azerbaijan. In periods of low water, the increase in salinity and the concentration of pollutants leads to the deterioration of the quality of surface water and the pollution of underground water. If we take into account that groundwater with a mineralization of more than 3.0 g/l is distributed in more than 40% of the territory of the republic, the degree of loading into aquifers can be estimated as increased. Aquifers in the saline soils of Kura-Araz lowland are under medium load. The chemicalization of agricultural production and the discharge of waste water into sewers without treatment lead to the pollution of water resources. In addition, in some agricultural regions of the republic, the surface drainage network and drainage systems are in an unsatisfactory condition, and their timely treatment results in an intensive rise in the level of groundwater, which increases the area of salinized and re-salinated areas [13].

The main water resources of the country are formed outside its territory and enter the republic in a highly polluted form. Up to 700 million m³ of dirty water is discharged into the Kura River alone from the territory of the neighboring republics of Georgia and Armenia, which causes significant ecological stress.

Considering that up to 80% of Azerbaijan's drinking water supply is provided by the waters of the Kura river basin, the deterioration of the quality of these waters poses a threat to the health of the population of the republic [12]. The environmental situation in the Kura river basin, which provides drinking water to most of the republic's settlements located along the Kura river, including the city of Baku, is becoming more and more complicated [14].

In the conditions of the limited water resources of Azerbaijan and the fact that more than 70% of the water flow of the river basin is formed in the territories of Turkey, Iran, Georgia, and Armenia, the ongoing transboundary pollution of the Kura and Araz waters sharply worsens the situation of uninterrupted supply of fresh water to the population's needs, and

various sectors of the national economy has a negative impact on development.

Rivers entering Azerbaijan bring water with a content of pollutants higher than the established norm. On average, about 350 million cubic meters of polluted water and 330 million cubic meters of polluted water containing heavy metals, phenols and oil products are discharged from the territory of Armenia into the Kura and Araz river basins. Petroleum products, phenols, surfactants, pesticides, and heavy metals are found more often in waters coming from the territory of Georgia. These, in turn, cause serious damage to the health of the people who use that water, and create problems for reserves and wetlands that are fed by these waters.

Araz, Okchuchay, Arpachay and other rivers are also subject to strong anthropogenic influence from the territory of Armenia. Copper, molybdenum and other heavy metals in the waters of the Araz and Okchu rivers are a hundred times higher than the norm. As a result, microflora and fauna disappear in river waters, the process of self-cleaning stops, and the river basin becomes a "dead zone". Considering that 80% of the population uses polluted river water for drinking and agricultural purposes, then one can imagine the threat to human health and the ecological system as a whole [17].

The greatest damage from the Kura and Araz rivers affects the population living in the Kura-Araz plain. Most of the population of Azerbaijan lives in the Kura-Araz plain, and they get water from the Kura and Araz rivers for drinking and irrigation purposes. The Kura and Araz rivers are currently more polluted, and therefore there is a need for more thorough water treatment or the use of alternative sources. The government's policy in this area is to restore and improve the provision of drinking water and sewage systems to the population, and concrete action plans are currently being developed and implemented.

The general situation of water supply and sanitation in Azerbaijan is characterized by irregular water supply and poor quality of water received by consumers. This is due to limited access to water sources of appropriate quality and quantity.

The population living in rural areas is not in a good situation as they use water directly from rivers, canals and springs. Most rural settlements do not have drinking water or wastewater treatment.

There is a need to determine the adequacy of Azerbaijan's water sources both in terms of quality and quantity. The most cost-effective solution to the problems of polluted Kura and Araz is to use alternative sources (rich water resources of Karabakh and Eastern Zangezur), purify drinking water, reduce pollution and provide rural areas with sufficient underground water supply.

As is known, the Kura River, the main water artery of Azerbaijan, is the only source that provides drinking water to the majority of the country's population. Of particular concern is its transboundary pollution, which sometimes reaches catastrophic levels. In order to ensure the safety of the population and control the quality of water entering the territory of the republic, the government of Azerbaijan has allocated the necessary funds for the purchase of equipment for monitoring transboundary rivers in the border areas.

In order to check the quality of water at the points starting from the border with Georgia, the relevant departments of the Ministry of Ecology and Natural Resources of the republic take samples three times a month and determine the hydrochemical and physical indicators of water properties. The presence of pollutants such as oil, oil products, phenols, pesticides, heavy metals in Kura water up to 10 times higher than the sanitary-hygienic norms is an indicator of how serious the ecological situation is.

Groundwater in the territory of the Republic is not subject to domestic, industrial and agricultural pollution. The main reason for the pollution of municipal areas is the lack or limited development of sewage network and treatment facilities in most populated areas.

2. Directions for efficient use of water resources.

Global climate changes primarily cause annual reduction of water resources. This effect did not bypass Azerbaijan and led to a decrease of water resources by more than 15%. The conducted analyzes show that if the Paris climate agreement is not fulfilled and the temperature rises by 4-5 degrees, Azerbaijan's water resources may decrease by 40-50% by the end of the century.

Supporting vulnerable regions will directly contribute not only to Goal 13 but also to the other SDGs. It is still possible, with strong political will, increased investment, and using existing technology, to limit the increase in global mean temperature to two degrees Celsius above pre-industrial levels, aiming at 1.5°C, but this requires urgent and ambitious collective action [18].

The International Natural Resources Institute (WRI) predicts that by 2040, one fifth of the world's countries will have water problems. Thus, climate change disrupts the rainfall cycle and population growth increases the demand for water. According to the report of the International Institute of Natural Resources, Azerbaijan is among the countries with the highest risk of drought. Azerbaijan ranks 18th among 33 countries. The problem is that, although the country has 7-8 times more water than it needs, the demand for drinking and household water is not met. The main reason for this is that there are too many water losses in the country.

According to the standard set by the World Health Organization (WHO), the daily drinking and household water requirement per person is 450 liters. According to international standards, the population of Azerbaijan should be provided with 1.6 billion

cubic meters of drinking and domestic water per year. Water supply in Azerbaijan is 5.3 times less, i.e. 306 million cubic meters. This means 83 liters of water per person per day, which is 5.3 times less than the international norm (Figure 1).

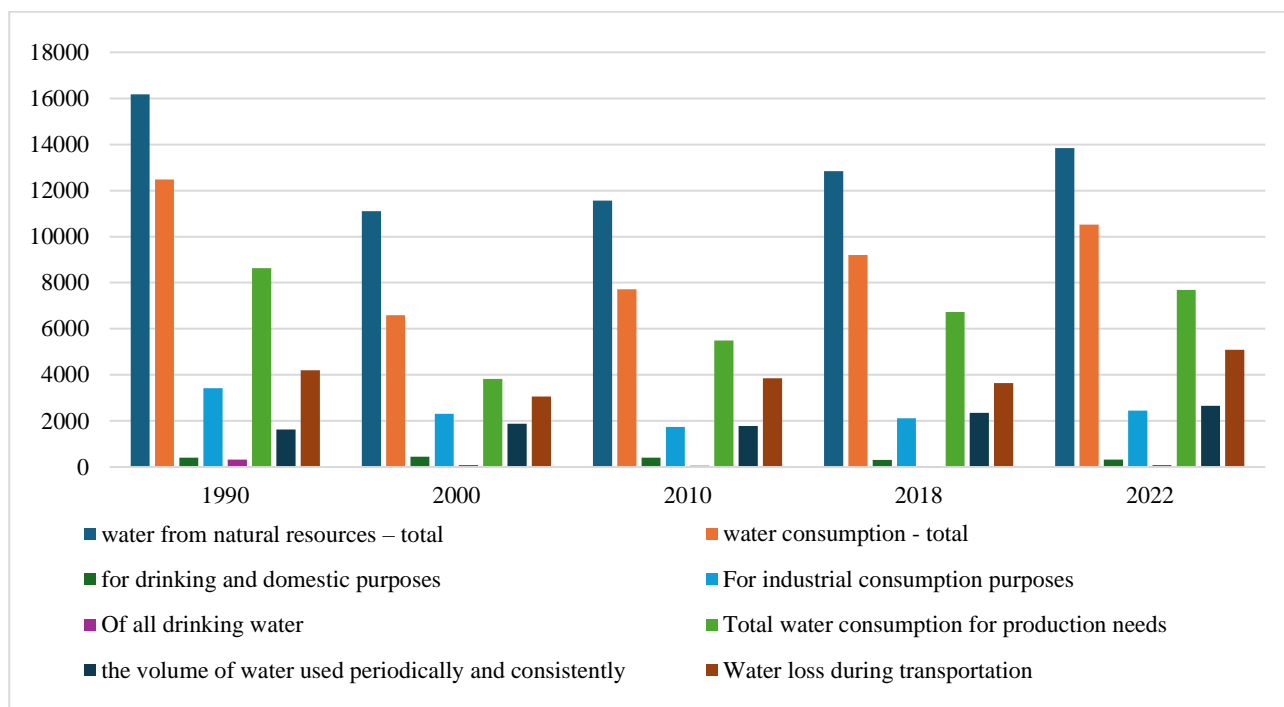


Fig. 1. Water supply (the volume of water is given in million cubic meters), The diagram was prepared based on the information of KONEK SC and the Water Reclamation and Water Management Agency

After climate changes in recent years, water resources have decreased sharply and will be only 17 billion cubic meters in 2023. 4.8 billion cubic meters of it was formed in the country itself, and the rest in the territory of neighboring states. Therefore, the creation of new water sources is required, and the improvement of waste water treatment is considered one of the priority areas of the policy.

"Electronic water management" information system-EcoPortal was created by the decree of the President of the Republic of Azerbaijan dated February 13, 2021, with the aim of assessing Azerbaijan's water resources, organizing efficient use of water, and organizing water accounting, monitoring and management system effectively and efficiently. Technical support in the preparation of the Ecoportal project is organized by the European Environment Agency on the basis of the "Principles and Practices of the Joint Environmental Information System" project in the Eastern Partnership countries [20].

According to the statistics of the State Statistical Committee of Azerbaijan on water from natural sources, its consumption and loss, Azerbaijan ranks first in the Commonwealth of Independent States with 28% water loss. Since 2000, annual renewable water resources in our country have decreased by more than 30%. During that period, the population

increased by 24%, and the volume of water withdrawals from natural water sources increased by 15%. Although 80% of the consumed water is taken from surface water sources, the use of underground water has increased four times in the last 20 years. More than 90% of the water taken from various sources was used in agriculture. In agriculture, the application of flood irrigation, the lack of concrete linings in most canals and similar problems lead to the loss of more than 33% of the water taken. Failure to carry out significant improvement works in this area is one of the main reasons that exacerbates the water problem.

At the same time, only 51% of the population in our country is connected to the water supply system. The remaining 49% try to meet their water needs within their own means. This indicator lags behind the European average and is far from the UN goal of "safe and equal water for all by 2030". Water consumption per person in households is a little more than 300 liters, which is more than in previous years. The expansion of the water supply system, related works are being done in connection with paid water supply - investments in water supply have shown an increase of approximately 10%. The main problem in water supply continues to be losses during transportation. Even the percentage indicator is 42.7% higher

than the agricultural sector [22].

Protection of water resources from pollution, improvement of the quality of surface and underground water in Azerbaijan is one of the main goals of the state policy in the field of water management. A country's ability to mitigate and adapt to climate change impacts is limited by the sustainable use of appropriate technologies and multiple management criteria, as well as economic efficiency. Management strategies that adapt to climate change require an appropriate monitoring network. Improving the national strategy, implementing projects supported by various international organizations, applying river basin management plans to a larger number of rivers and improving legislation for the purpose of protection is one of the necessary steps in the implementation of the ecological-geographic assessment of water basins in our country.

Taking into account that agriculture is the most used sector of water resources, the main measure that is important to implement in this field in our country is the adoption of flood irrigation and the expansion of modern water systems in a mass manner.

Two ways to eliminate the water shortage in the republic have been identified: reducing the load on water resources and increasing fresh water resources. The first way envisages the implementation of comprehensive measures to reduce the speed of development of water-intensive industries and to apply modern water-saving technologies in industry, agriculture and communal services. The second involves increasing freshwater resources by improving interstate water relations, regulating the flow of rivers, using underground freshwater resources, desalinizing saline and brackish waters, artificially increasing precipitation, and redistributing water resource areas.

Hydrochemical observations of the ecological condition of surface waters are carried out by the National Monitoring Service of the Ministry of Ecology and Natural Resources. Monitoring stations are established on Kura and Araz rivers and other transit rivers, and every year more than 1000 water samples are taken and analyzed, their chemical analysis is carried out to determine polluting components.

As a result of the analysis, it is determined that the highest level of mineralization and pollution in river waters is observed in the middle flow of transit rivers, in the points entering the territory of Azerbaijan from the border of Armenia and Georgia, which poses a serious threat to the health and living environment of the population. This is the result of intensive pollution of those rivers with industrial and domestic sewage in the territory of Armenia and Georgia.

The result. The regulation of the use and protection of water resources is carried out by determining the standards of water use and waste water discharge (permits for special water use, water use limits, norms for the maximum allowable discharge of pollutants into the natural environment and general sewage systems). Monitoring of sources of wastewater discharge into water bodies, determination of restrictions on land use of water courses, underground water deposits along the Caspian coast and in water protection zones, application of administrative measures and economic mechanisms for violations of laws, collection of fines for pollution of water resources, tax, credit and other concessions purchase, receiving monetary compensation for damage caused as a result of damage or destruction of natural objects, applying economic sanctions to water users for excess water consumption are considered ways of efficient use and protection of water resources.

We would like to note that certain projects in the field of water problems are being implemented within the Eastern Partnership program of the European Union. In this direction, management plans for various river basins and the Electronic water management system mentioned above have been created, which are commendable cases.

2024 has been declared the "Year of Solidarity for the Green World" in Azerbaijan. At the same time, the UN Climate Change Conference (COP29) will be held in Baku in November 2024. The main purpose of such measures is to combat problems such as climate change, global warming, water shortage, transition to clean energy sources as soon as possible, etc. By hosting such events, Azerbaijan shows that it is not indifferent to environmental issues.

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Сучасний екологічний стан водних ресурсів Азербайджану та напрямки їх ефективного використання на тлі глобальних змін клімату

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У статті описано весь спектр гідрологічних загроз, пов'язаних з обмеженням і забрудненням водних ресурсів Азербайджанської Республіки. Зазначається, що наслідками щорічного загострення гідрологічних загроз є зростання конфліктів із сусідніми державами, розвиток нових осередків екологічної нестабільності, в регіонах не в повному обсязі виконуються програми соціально-економічного розвитку республіки. Відомо, що головними особливостями водних ресурсів Азербайджану є їх обмеженість, нерівномірний розподіл, приблизно 70% ресурсів поверхневих вод утворюються за межами країни і при надходженні в країну сильно забруднюються. Загальні запаси води Азербайджану становлять 35 млрд м³, з них 5 млрд м³ – підземні води. Річкові водні ресурси республіки становлять 30,0 млрд м³, з них місцеві води – 10,0 млрд м³. Базуючись на даних довгострокових спостережень і кліматичних прогнозах Азербайджану, показано дефіцит ресурсів прісної води, потенціал істотного впливу зміни клімату та напрями ефективного використання. Проте здатність кількісно визначити майбутні зміни гідрологічних змін та їх вплив на системи та сектори обмежена невизначеністю на всіх етапах процесу оцінки. Невизначеність виникає через різні сценарії соціально-економічного розвитку, враховуючи різні прогнози кліматичних моделей, зниження кліматичних впливів до локальних і регіональних масштабів, оцінку впливу. Відповідно до Цілей сталого розвитку ООН, важливо вивчати його вплив на досліджувану територію в рамках кліматичних заходів. На тлі сучасних кліматичних змін аналізується екологічна ситуація джерел прісної води Азербайджану та особливості використання води в різних сферах економіки, ситуація із забрудненням транзитних річкових вод промисловими та побутовими стоками сусідніх країн, а також наголошено на шкідливому впливі їх використання на здоров'я людини та компоненти навколишнього середовища. У статті розглянуто вдосконалення національної стратегії у впровадженні еколого-географічної оцінки водних об'єктів в Азербайджані, реалізація проектів, підтриманих різними міжнародними організаціями, застосування планів управління річковими басейнами до більшої кількості річок та удосконалення законодавства з метою захисту, здійснення міжнародного співробітництва є одними з необхідних кроків.

Ключові слова: водні ресурси, річкові води, забруднення, зміна клімату, екологічна відповідальність, здоров'я, управління, ціль кліматичних дій.

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