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Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

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ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
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NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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ASSESSMENT OF THE IMPACT OF ANTHROPOGENIC FACTORS WATER RESOURCES OF KAZAKHSTAN

Abstract. Water is one of the most important natural resources that support the ecosystem and the daily lives of people. Water resources are considered renewable, how fast are they recovering and to what extent is their scarcity threatening the earth's ecosystem? The article describes the current state of water resources in the world in general and in the Republic of Kazakhstan in particular. Explicit reference was made to the challenges posed by recovering of fresh water. Main areas to increase the available of fresh water capacity with detailed description. The structure of the strategic management of the water resources presented.

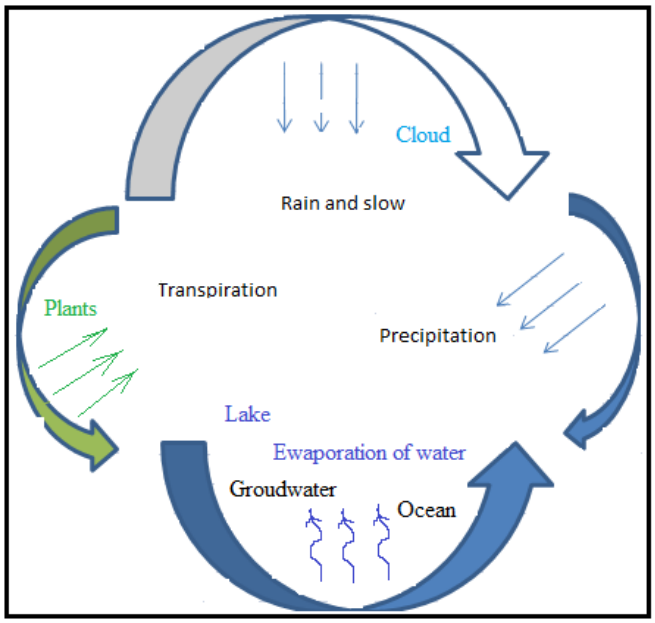
Key words: water resource, fresh water, groundwater, pollution, anthropogenic changes of environment, water resources management.

Introduction. Water is a tremendous value, a national treasure. The decision of all the most actual ecological and hydrogeoecological problems depends on the state of water resources. This is due to the unique properties of water, its presence in all spheres of the Earth, its important role in the physical, chemical, biological and geological processes that form these areas, and, finally, its irreplaceability in all kinds of human life. Any changes in the environment affect water resources [1], and, vice versa, changes in the quantity, regime and quality of water - one of the main factors of environmental transformation. To date, a number of complex and acute problems have accumulated in the use and protection of water resources of the Republic of Kazakhstan. The main reason for their occurrence is the mismatch of the economic mechanism, financial capacity and management system of water use and protection of the modern economic system.

Seas and oceans comprise over 96% of the hydrosphere, about 2% - groundwater, about 2% - of ice and snow, about 0,02% - surface water [2]. The largest part of the earth's fresh water is about 85-90%, contained in massifs of ice in polar regions and glaciers. Fresh water is also formed in rivers and streams, fresh lakes and clouds. In general, water, continuously moving on the globe in the global hydrological cycle under the influence of solar energy, as shown in the figure below, keeps its total amount unchanged, existing in three aggregate states [3].

There are about 85,000 rivers and temporary water courses in the territory of Kazakhstan; 8,000 of them are longer than 10 km. The average area of river basin is about 30 km^2.

Many rivers belong to the internal closed basins of the Caspian and Aral Seas and Balkhash, Alakol and Teniz lakes. Only the Yertys River belongs to the basin of the Arctic ocean (Kara Sea). The higher drainage network density is registered in highlands such as Altai, Zhetysu, Alatau and Ile, and less density is registered in the areas of sandy deserts of Pre-Aral and Pre-Caspi (less than 0.03 km per km^2). The largest rivers of the country are Yertys with a length (in Kazakhstan) of 1700 km, Syr-Darya – 1400 km and Zhaiyk –1082 km. Six larger rivers of Kazakhstan have water flow rates in the ranges from 30 to 900 m^3/sec (average annual values), 7 rivers – from 50 to 100 m^3/sec and 40 rivers – from 5 to 50 m^3/sec. [4].



Global hydrological cycle

Distribution of river runoff in the territory varies. Large runoff volumes are formed in the Yertys and Balkhash-Alakol basins (73-86% of the total resources). There is almost no local runoff in the Nura-Sarysu, Yessil and Tobyl-Torgai basins in the years of low water. The river runoff of the country is characterized by significant interannual variability: maximum and minimum values of an annual runoff three times the norm and two times below the norm, respectively. Alternation of groups (low water by 5-7 years and abounding in water by 1-3 years) is also common for the river runoff. Due to the climatic features of the country, up to 90% of the annual runoff accounts for spring, and up to 70% of the mountain river runoff accounts for summer periods [4].

In the formation of groundwater is of great significance climatic factors. The continentality and aridity of the climate and the extremely uneven distribution of water resources typical for the territory of Kazakhstan. The air masses coming from the Atlantic Ocean [5], from the Arctic, Siberia or Central Asia, which bring with them heat or cold, moisture or dryness, play a large role in formation the climate of the Republic.

Currently, the surface water of all rivers in Kazakhstan are estimated to total 102.3 km3/year [6], of which 57,6 km^3/year is formed in the territory of the Republic and in the neighboring countries 44,7 km^3/year.

Surface and underground waters are genetically interconnected and play an important role in economic and ecological relations of the Republic. Taking into account the high degree of vulnerability of the natural environment and industries of Kazakhstan's economy to possible changes in water supply, several factors need to be taken into account, including climatic changes in local runoff and anthropogenic reduction in runoff of transboundary. With these factors in the future, there are threats of a decrease in river flow resources in general throughout Kazakhstan and in the world as a whole [7].

To this end, there are, again, a lot of factors and environmental problems around the world, because every year, every day in large industrial areas not only surface water is polluted, but also underground [8-13]. Sources of groundwater pollution are very diverse. Pollutants can penetrate to groundwater in various ways: during the drainnage of industrial and domestic wastewater from storage, ponds, sedimentation tanks, borehole and karst funnel. The natural sources of pollution include highly mineralized (saline and brine) groundwater or sea water, which can be inserted later into fresh, uncontaminated water during the operation of water intake facilities and pumping water from wells.

For example, characteristic pollutants in water of the majority of water bodies of Russia are mineral oils, phenols, organic substances, copper, zinc, iron compounds, biogenic substances, mercury compounds, formaldehyde. The content of pesticides in surface waters, as well as polychlorinated biphenyls,

which are carcinogens that are not allowed to be dumped into water bodies is a cause and particular danger [14].

Water ecosystems are being degraded all over the world due to various environmental issues and factors. The change [15] in the geochemical cycles of elements in the system "watershed-reservoir" causes a widespread increase of mineralization and salinization of waters, increased turbidity, which entails the violation of metabolism in aquatic invertebrates and etc [14].

Every year since 1972, the United Nations has held conferences on environmental problems of the human environment [16]. One of the conference was devoted to the principles of water resources [17]. Special attention was paid to the problem of reducing the number of people with access to drinking water [18]. One [19-21] of the main subjects in the scenarios of the future was the aggravation of the shortage of fresh water. The World Bank estimates that, a significant change in the situation in the next 50 years could be no expectation: by mid-century of the XXI century already 40% of the world's population will experience increased water stress, 20% - to severely suffer from it. This bleak forecast does not take into account global climate change [22], which is likely to exacerbate the situation. Prophecies of water wars, the grand projects of the redistribution of river runoff. Measures to overcome water scarcity are actively discussed [23] not only within the borders of national economies, but also in the international aspect. Water more been a topic of debate in all the major forums of the world for the last 20 years.

We feel that anthropogenic change to the environment began since the post-industrial era, but [24] believes that it began 45 thousand years ago. Currently, worldwide attention is increasingly on increasing the greenhouse effect due to emissions of carbon dioxide, methane, nitrogen oxides and other greenhouse gases, which leads to a change in regional conditions of precipitation, an increase in the number of droughts [25], floods, storms and other adverse natural phenomena, an increase in the average global sea level, a reduction in freshwater resources and, as a consequence, an increase in economic and social costs to overcome them.

Changes in the climate system lead to uncertainty in water resources management. The intergovernmental Panel on Climate Change [19] forecasts an increase of 2-4 degrees over the next 100 years. Increased temperatures will interfere on the hydrological cycle, directly increasing the evaporation of surface water sources [26].

While the global demand for food and world population is mounting rapidly [27], land potential for agriculture is steadily declining due to various soil degradation processes, one of which is soil salination [15, 28-30]. And this trend is not just in one country, but in one area, the problem is all over the world.

Potential adverse environmental impacts of increased agricultural production include unsustainable depletion and pollution caused by nitrates in groundwater [31]. As well as the depletion of soil resources associated with the excessive use of nutrients and pesticides, which leads to health problems [32].

New approaches are needed to implement proper source management and remedial measures, thus [33] developed the methods for risk assessment of groundwater flow.

In different sources [34-36] believe that a methodology and model for the application of planning and integrated water resources management [37-40] in the use and conservation of groundwater is needed.

Denmark is taking made continuous efforts to ensure the sustainable management of groundwater [41-44].

[45] offers a comprehensive approach for assessing the vulnerability of groundwater to climate change to successfully address environmental and geo-economic challenges.

To reducing the impact and restore the function of natural ecosystems of these reservoirs requires a three-level approach [46]. Such activities are costly and therefore it is necessary to costly special attention to the comprehensive programs that offer many advantages.

Based on the review of the research carried out, it can be concluded that in many countries of the world are faced with environmental and economic problems in the field of water resources. Whose main goal is correct, purposeful management and groundwater resources planning.

Accordingly, it can be considered that the study of groundwater requires an ecosystem approach [47], reflecting the processes of their interaction with the environment.

Methods. Water supply shortages, humanity is familiar almost since its inception, but its current scale where a variety of water sources each year selected more than 4,000 km3 of water, by weight an order of magnitude more than other natural resources in the aggregate; in the process of economic activity uses

much more water-9000 km^3 [48], returning to the global hydrosphere annually 2000 km^3 of wastewater. No wonder that almost all the rivers of the world are polluted to some extent, not counting the upper layers of groundwater. According to [49], about 17 thousand km^3 of water is currently polluted, which is half of the maximum estimate of its available volume for use.

In the conditions of anthropocentrism, the depletion of fresh water resources has a dual nature, associated with both the intensive melting of glaciers of mountain countries in the conditions of global warming, and with global pollution of the environment and the hydrosphere as a whole.

The relationship between underground and surface runoff is based on a known water balance equation [50].

Consequently, the ratio of fresh and polluted water is determined by the balance equation reflecting the law of conservation,

$$Q_{(t=0)} = Q(t)_{\text{пв}} + Q(t)_{\text{зв}},$$

where $Q_{(t=0)}$ – initial the quantity of freshwater of the hydrosphere; $Q(t)_{\text{пв}}$, $Q(t)_{\text{зв}}$ – объемы пресной и загрязненной воды как функции времени антропоцентризма, located, in $Q_{(t=0)}$ = const, in the inverse relationship.

However, care for the environment is gaining, both around the world and in Kazakhstan. Sustainable water supply of the Republic implies harmonization of ecosystem approach to water use, dictated by environmental standards, providing both environmental protection and socio-economic development.

Taking into account the genetic relationship between surface and groundwater, it is extremely important to establish a normalized environmental potential for underground runoff in terms of its use in the exploitation of its natural resource. This is essential in the conditions of forced replacement of surface water resources with underground in the future, ensuring the preservation of biodiversity and sustainable development of Kazakhstan.

Conclusions. At the current level of study of the surface water, the standard of runoff of all the rivers of Kazakhstan is estimated at a value of 102.3 km^3/year. Consequently, the potential of the underground flow of the Republic is 51.15 km^3/year [51].

Optimization of using water resources in the sectors of economy should be based on the introduction of the water-saving technologies of the negotiable and closed water supply in all branches of industry, and a reduction in unproductive water losses during distribution.

As in other countries, and in the Republic of Kazakhstan is expected to increase the population (thousand people) [52]:

Projected population

Human settlements, people (%)	2020 year	2030 year
For the Republic, including:	18 698 400	20 585 800
Urban population	11 219 040 (60%)	13 380 770 (65%)
Rural population	7 479 360 (40%)	7 205 030 (35%)

Global climatic changes and intensification of technogenesis significantly affect the resource potential of groundwater and associated ecosystems, which leads to a deterioration of hydrogeoecological conditions in Kazakhstan. This is manifested, both in climate-driven and, above all, man-made depletion of groundwater resources, accompanied by the formation of depression pit and subterranean backwater zone, pollution of groundwater, significantly influences the natural environment and human habitat.

Climate change in arid conditions of Kazakhstan may cause a decrease in water resources, increases risks of droughts and a reduced agricultural yield, the increased incidence associated with the consumption of contaminated water, changes in the state of natural and climatic conditions of the territory of the Republic according to the degree of favorability for the population.

Groundwater depletion refers to the reduction of natural and artificial groundwater resources due to the excess of groundwater consumption over their groundwater recharge. The causes of such depletion may be deforestation, tilling of wild land, the straightening and river passing, groundwater sampling withdrawals, drainage system, etc. At the same time, depletion may be temporary (seasonal) and permanent

(due to economic activity). Technical replenishment of groundwater resources is carried out by the creation of dams, ponds, atmospheric runoff, by pumping water from pressure horizons, snowmelt delay, the use of biochemical treated wastewater, reducing evaporation, improving irrigation methods and irrigation of farmland.

Consequently, the natural resource of fresh water must be maintained, guaranteeing the necessary requirements for the sustainable functioning of the biosphere and its ecosystems, the services of mankind and its technosphere, which are provided by the resource of fresh water. Since water is needed for different purposes, functions and services, water management must therefore be ecosystem-based and integrated, taking into account both the demand for the resource and the threats to its conservation from pollution and depletion.

All this requires integrated management decisions [53] to prevent these negative phenomena through an ecosystem approach.

An integrated approach to water resources management, which many countries, including Kazakhstan, have introduced into their national policies, is the basis for groundwater management in the Republic.

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ҚАЗАҚСТАННЫҢ РЕСУРСТАРЫНА АНТРОПОГЕНДІК ФАКТОРЛАРДЫҢ ӘСЕРІН БАҒАЛАУ

Аннотация. Су экожүйені және адамдардың күнделікті өмірін сүйемелдейтін маңызды табиғи ресурстардың бірі болып табылады. Су ресурстары жаңартылатын болып табылады, дегенмен олар қаншалықты тез жаңартылады және олардың жетіспеушілігі жердің экожүйесіне қауіп төндіре ме? Мақалада су ресурстарының әлемдегі және атап айтқанда Қазақстан Республикасындағы жағдайына сипаттама берілген. Тұщы судың жетіспеушілігімен байланысты мәселелер қалыптастырылды. Тұщы судың қолжетімді қорларын ұлғайту бойынша негізгі бағыттар сипатталды. Су ресурстарын стратегиялық басқару құрылымы келтірілді.

Түйін сөздер: су ресурстары, тұщы су, жерасты сулары, ластану, қоршаған ортаның антропогендік өзгерістері, су ресурстарын басқару.

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ОЦЕНКА ВЛИЯНИЯ АНТРОПОГЕННЫХ ФАКТОРОВ НА ВОДНЫЕ РЕСУРСЫ КАЗАХСТАНА

Аннотация. Вода является одним из наиболее важных природных ресурсов, которые поддерживают экосистему и повседневную жизнь людей. Водные ресурсы считаются возобновляемыми, как быстро они восстанавливаются и насколько их нехватка угрожает экосистеме земли? В статье приведена характеристика современного состояния водных ресурсов в мире в целом и в Республике Казахстане в частности. Сформулированы проблемы, связанные с нехваткой пресной воды. Подробно описаны основные направления по увеличению доступных запасов пресной воды. Представлена структура стратегического управления водными ресурсами.

Ключевые слова: водные ресурсы, пресная вода, подземные воды, загрязнение, антропогенные изменения окружающей среды, управление водными ресурсами.

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