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ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»

ЧФ «Халық»

NEWS

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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 Үлттық гылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық гылымдар сериясы» гылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрi the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруды. Web of Science зерттеушілер, авторлар, баспашилар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық гылымдар сериясы Emerging Sources Citation Index-ке енүі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық гылымдар 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.



ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халық». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халық» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халық» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мираж» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халық» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz».

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халық» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халық» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халық» offered нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

**С уважением,
Благотворительный Фонд «Халық»!**

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STUDY OF WATER REGIME OF ZHAIYK TRANSBOUNDARY RIVER IN THE CONTEXT OF ANTHROPOGENIC AND CLIMATIC CHANGES

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Abstract. The article presents trends in the hydrologic regime of the transboundary river Zhaiyk, and the in the context of anthropogenic and climatic changes. The water regime of rivers is characterized by reduction spring floods and increase the frequency of low-water runoff, especially in winter. The increase in winter runoff likely occurs as a result of climate-caused temperature and precipitation changes. Increasing average annual air temperature are evident both within seasons and from year to year between 1940 and 2019. The changes in runoff and water regime of transboundary Zhaiyk River basin have resulted in decrease in the annual and forecast reduction in river flows for future uses.

Keywords: intra-annual distribution, water regime, low water, flood runoff, runoff transformation, river Zhaiyk

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ЖАЙЫҚ ТРАНСШЕКАРАЛЫҚ ӨЗЕНІНІҢ СУЛЫЛЫҚ РЕЖИМІН АНТРОПОГЕНДІК-КЛИМАТТЫҚ ӨЗГЕРІСТЕР ЖАҒДАЙЫНДА ЗЕРТТЕУ

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Аннотация. Бұл мақалада Жайық трансшекаралық өзенінің сулылық режимінің өзгеру үрдістері және оның шартты-антропогендік өзгерістер жағдайында таралуы көрсетілген. Зерттеу жұмысы ағынды шамасының 80 жылдық уақыт кезеңіндегі мәндерін пайдалана отырып, деректерді талдаудың стандартты статистикалық әдістері негізінде жүргізілді. Ағынды параметрлерінің көпжылдық жүргісі әртүрлі су фазаларын ескере отырып, 3 уақыт кезеңінде қарастырылады. Зерттелетін өзендердің сулылық режимі көктемгі су тасқыны ағынды үлесінің азаю үдерісімен және сабалық кезеңін, әсіресе қысқы сабалық кезең ағынды үлесінің артуымен сипатталады. Қысқы

ағынды шамасының өсүі – климаттың өзгеріс жағдайында, орташа көлжылдық ауа температурасының тұрақты түрде маусым ішілік және жылдан жылға жоғарылауы нәтижесінде айқын байқалады. Инженерлік құрылыштар арқылы ағындыны реттеу түріндегі антропогендік әсер, атап айтқанда ағынды қалыптасатын (жоғарғы) аумақтағы сулылық режимді толықтай өзгеріске ұшыратқан. Жайық траншекаралық өзені алабындағы ағынды шамасы мен сулылық режимінің өзгерісіндегі анықталған процестер алдағы уақытта өзендердегі су көлемінің азауы және болашақта өзен ағындысының тұрақты түрде төмендеуі байқалатынын айтуға мүмкіндік береді.

Түйін сөздер: жылішілік таралу, сулылық режим, сабалық кезең, су тасқыны ағындысы, ағынды трансформациясы, Жайық өзені

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ИССЛЕДОВАНИЕ ВОДНОГО РЕЖИМА ТРАНСГРАНИЧНОЙ РЕКИ ЖАЙЫК В КОНТЕКСТЕ АНТРОПОГЕННО-ОБУСЛОВЛЕННЫХ КЛИМАТИЧЕСКИХ ПРЕОБРАЗОВАНИЙ

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Аннотация. В статье представлены результаты исследования по установлению тенденций изменения водного режима трансграничной реки Урал (Жайык) и ее

распределения в контексте антропогенно обусловленной трансформации водного режима. Исследования проведены на основе стандартных статистических методов анализа данных с использованием значений величин стока за 80-летний период времени. Многолетняя динамика параметров стока (1940–2019 гг.) с учетом фаз различной водности рассматриваются в 3-х временных периодах. Установлено, что водный режим исследуемых рек характеризуется тенденцией сокращения доли весеннего половодья и увеличения доли меженного стока, особенно зимнего. Увеличение зимнего стока происходит в результате климатически обусловленного изменения, проявляющегося в устойчивой тенденции увеличения среднемноголетней температуры воздуха как внутри сезонов, так и из года в год. Антропогенное воздействие в виде регулирования стока инженерными сооружениями, в частности, в зоне формирования речного стока (верховья) кардинально трансформировали водный режим. Выявленные тенденции изменения показателей величин стока и водного режима бассейна трансграничной реки Жайык позволяют утверждать о принятом характере устойчивой тенденции снижения водности рек бассейна и сокращения речного стока в будущем.

Ключевые слова: внутригодовое распределение, водный режим, межень, половодный сток, трансформация стока, река Жайык

Introduction

Previous research devoted to the water regime study (Kireyeva et al., 2018), changes in river runoff (Magritskiy et al., 2018) and intra-annual distribution of runoff (Sivokhip et al., 2020) under the conditions of modern runoff formation, has found changes in the water regime and distribution of river runoff. If we consider a more global context, changes in the hydrological cycle are reported at the regional level in the context of climate and environmental change, and is one of the 23 unresolved issues in the article (Günter et al., 2019). Studies (Botter et al., 2010) note that river flows observed downstream of regulated (constructions) structures in the watershed show lower average runoff values. In the work (Xingming Hao et al., 2008), the incorrect distribution of the water resources of the rivers leads to the negative effects in the ecosystems of the lower reaches. Thus, studies for determining trends in runoff values are of the greatest importance (Gumus et al., 2022).

In view of this, the need to have knowledge of the current state, trends of change and distribution of river flow becomes the most relevant, especially for the transboundary watercourses.

The most difficult task is to determine changes and distribution of runoff values in the context of climatic and anthropogenic impact factors. In most cases (Galperin, 2020), calculations of the river flow distribution and impacts, a series of observations are taken and, divided into 2 periods: “conditionally natural”, meaning climatic and “anthropogenic”.

However, many studies do not properly pay attention to the fact that river receives runoff at all stages and, in the same accepted conditional periods is under the certain climatic influence and with more or less degree (share) of influence in a certain river basin and in its various climatic regions of location.

Global warming is an obvious reality. Already at the beginning of the 20th century, there were trends in increase in the value of surface air temperature. At the same time, the clear significant warming began in the first half of the 1970s (Drozdov, 1992). The greatest changes in air temperature occurred in parts of the continents between 40° and 70° N. latitude.

(Dolgikh, 1999). Kazakhstan is also located in this sector of Eurasia.

In Kazakhstan, the increase in air temperature is more intense than the average for the planet (Galperin, 2012).

The second half of the 20th and early 21st centuries is characterized by directed climatic changes. This is reflected in the factors of river runoff formation and their hydrological regime. The main factors in the formation of runoff, which are most subjected to changes, in contrast to the relief, geological structure, nature of water sources are meteorological characteristics such as air temperature and precipitation. In addition, the assessment of modern changes in climatic characteristics makes it possible to assess river runoff in relation to those changes. Under the conditions of climate change, the uneven distribution of water resources across the territory of Kazakhstan, including in the western part of the country is getting worse (Dostai, 2014; Medeu, 2015; Shiklomanov, 2008).

While the problem of global climate change and its consequences has been analyzed in detail by scientists, the changes in the hydrological regime of rivers, in particular the rivers of Kazakhstan have not remained unnoticed.

The hydrological regime of rivers is quite sensitive to climatic fluctuations; therefore, studies of the hydrological regime characteristics, as well as their changes, in addition to practical interest from various economy sectors that are associated with the use of rivers are of great importance for hydrologic science.

The object of the present study is the Zhaiyk River, located in the center of the Eurasian continent and, conditionally dividing Europe and Asia. This watercourse originates in the southern spurs of Ural Mountains at the altitude of 640 m above sea level and flows into the Caspian Sea. The length of the river is 2534 km with a catchment area of 231,000 km². The Zhaiyk River is transboundary watercourse that flows through the territory of 2 countries: Russia (1450 km) and Kazakhstan (1084 km). The Zhaiyk-Caspian water economy basin is located in the Northern Hemisphere, at middle geographical latitudes. Significant distance of territories from the oceans and high mountain systems determines the continental climate (Alimkulov, 2019).

Catchment area and its length is one of the largest rivers in Europe and is the main river of the Caspian region in the Republic of Kazakhstan (figure 1).

Lower reaches of the transboundary river Zhaiyk are found in Kazakhstan. The largest tributary of the Zhaiyk River in terms of water content is the Sakmara River (Russia). Its average water content is almost 1.5 times higher than the water content of Zhaiyk itself. The main source of river is snow reserves from the cold period of the year; the share of rain runoff is insignificant. According to the conditions of the water regime, up to 90 % or more of the runoff occurs in the spring, which is actually the predominant one.

In addition, depending on the conditions of the year, more than 80 % of the river runoff is formed on the territory of the neighboring country (Russia), which is 325 m³/s or 9.29 km³ per year.

In the territory of Russia (upper reaches) 1,649 water economic constructions have been built with a useful capacity of 3,948 million m³ or 3.9 km³ per year, and the total accumulated volume of water in reservoirs far exceeds their useful capacity.

In the territory of Kazakhstan (downstream) there are 2 reservoirs of long-term regulation with a useful volume of 480 million m³ and 36 small reservoirs, of which only 12 reservoirs with a capacity of 10 million m³. For this reason, the Zhaiyk transboundary river and its water regime is completely regulated by engineering structures, located mainly in Russia.

Thus, the *observed dynamics* of the transboundary runoff of Zhaiyk River is integral indicator of water economy activities in the upper reaches of the basin.

In recent decades, the intra-annual runoff of the transboundary river and its redistribution over time has undergone significant transformations, and the water regime has also changed.

Research to identify patterns of intra-annual distribution of river flow and changes in the water regime, from the point of view of applied hydrology, is of great practical importance, focused on the ensuring and rational (efficient) use of available resources.

Under natural climatic conditions, the distribution of river runoff during the year season has a certain regular feature and depends mainly on the source of supply of the catchment part of the basin and on the influence of the ratio of hydrometeorological elements in the form of climatic factors of runoff formation. Thus, the duration of the flood runoff varies by the year seasons and is not the same everywhere. This pattern, of course, complicates the use of water resources.

At the same time, under the conditions of the anthropogenic factor, hydraulic and other water economic structures determine the direct impact to the processes through engineering regulation and redistribution of river flow in time and space.

In other words, the entire catchment area of transboundary Zhaiyk River basin, with some exceptions, one way or another, belongs to the territories of economic development or is under the influence of any other type of anthropogenic activity that has a certain or indirect pressure to water resources, which significantly reduces water supply and disturbance of surface runoff (Fig. 1).

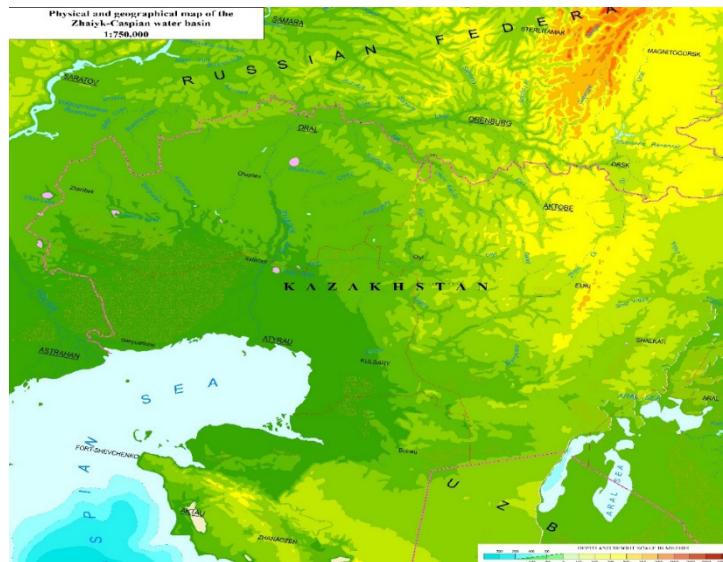


Figure 1. Basin of the transboundary river Zhaiyk

The purpose of the present studies is to determine the trend of changes in the water regime and distribution of the transboundary Zhaiyk River runoff, as well as modern transformation of runoff values in the water regime in terms of climatic and anthropogenic factors affecting the river runoff formation.

Materials and methods

The study of the water regime and intra-annual distribution of runoff and their quantitative characteristics are based on statistical methods of analyzing of the observed data of the river runoff values and representative hydrometeorological elements of the considered basin (air temperature and precipitation). According to the characteristic condition of the studied object water regime, the following phases were considered: winter low water, summer-autumn low water and floods, as well as annual values of flood volumes, maximum runoff and duration of flood runoff.

When reconstructing the discharge using runoff observation data for more than 6 years, the method of hydrological analogy was used along with, the relationship between runoff and meteorological elements, primarily precipitation. The analogue point, the main criterion is the synchronism in the fluctuations of the river runoff of the calculated cross-section and analogue cross-section which is expressed through the coefficient of pair or multiple correlation (MSN, 2006; Vladimirov, 1990).

The series of annual runoff for the period 1940–2019 were reconstructed. When restoring the series of annual runoff, all information on the state at hydrological gaging station, on water management measures upstream of the measurement cross-section which affected the regime of water flow in the river was taken into account. The change in the runoff formed on the territory of the Republic of Kazakhstan was observed mainly since 1975, not counting the runoff of the large transit river Zhaiyk, which was subjected to change since 1957–1958 on the territory of the Russian Federation (in connection with the construction of the Irikliksiy reservoir with a useful capacity of 2,160 million m³) (Arystambekova et al., 2017). Reconstruction of the natural value of the annual runoff of Elek River - Aktobe city and Elek River -Shelek village was made from 1975 to 2019, taking into account the influence of Kargaly and Aktobe reservoirs. Change in the annual flow of the Zhaiyk River-Koshim village was assessed from 1957 to 2019, taking into account the influence of the Irikliksiy reservoir (Davletgaliev, 2011).

Trends in changes during flood periods use, runoff data for the flood period along the river Zhaiyk and its main tributaries was restored. Spring high water is a characteristic feature of the annual water regime of the flat rivers of Kazakhstan due to the rapid melting of the snow accumulated during the winter. By the relatively short duration of floods, the runoff for this period makes up to 80–90 % of the annual runoff (Arystambekova et al., 2019; Arystambekova et al., 2017). Therefore, there is a close relationship between the flood runoff and the annual runoff, and the annual runoff of this river can be taken as the main analogue for restoring the spring runoff.

Certain conditions are accepted into the calculated statistical data within the frames of 3 temporary transition periods of the runoff regime, which could most sensitively react to the various influencing factors and contribute to the identification of certain patterns in certain changes: 1) from 1948 to 1973 - undisturbed (natural) runoff regime ; 2) from 1974 to 1998 - anthropogenically disturbed runoff regime with moderate climate change; 3) from 1999 to 2019 - anthropogenically disturbed runoff regime with significant climate change.

To achieve the goals of the research and identify the features of changes, the runoff values were reconstructed, including the phases of the water regime for the undisturbed (natural) period of time with duration of 80 years of statistical series (1940–2019) so that the simulated runoff values would exclude anthropogenic impact factor in analytical processing of results.

Results and discussion

Based on the observed (actual) data for the flood runoff, a statistical analysis of the data was carried out to identify trends in their changes: by the values of the runoff volumes, maximum flow rate and duration of the flood runoff. Statistical analysis of the data shows that since the 1970s there has been decrease in both - flood volumes and maximum discharges.

However, in the duration of the flood runoff in recent years, some increase in time has been recorded. This could be a transformation of the water regime of the transboundary Zhaiyk River due to the impact of hydraulic structures (reservoirs), however, this trend is also observed in the other studied rivers of the basin that do not have regulatory reservoirs (structures). These trends in the change and intra-annual distribution of flood runoff are explained by climatic factors of influence (Fig. 2).

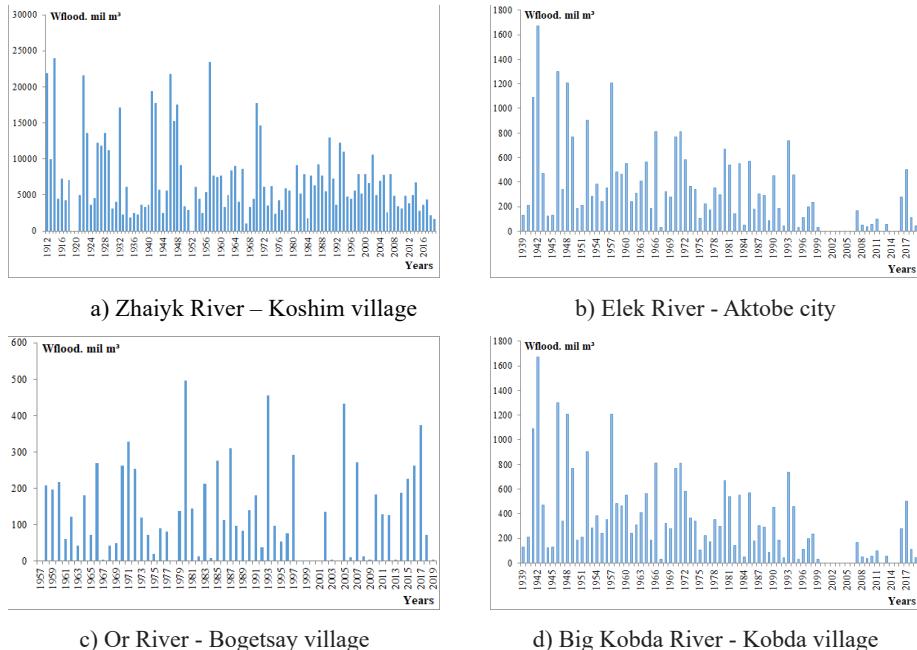
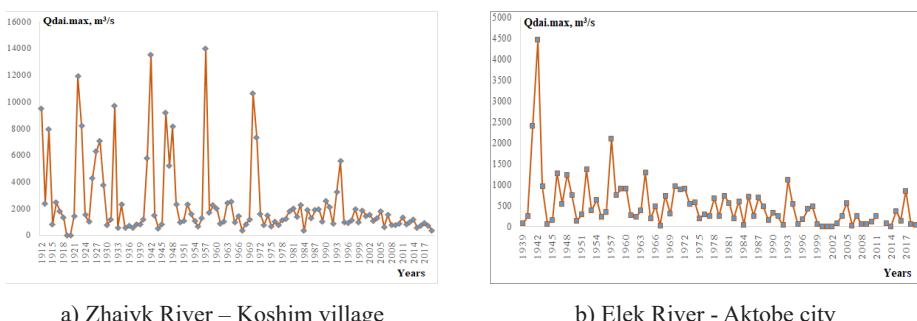


Figure 2.1. Annual flood volumes of the main hydrological posts of the Zhaiyk river basin, mill m³



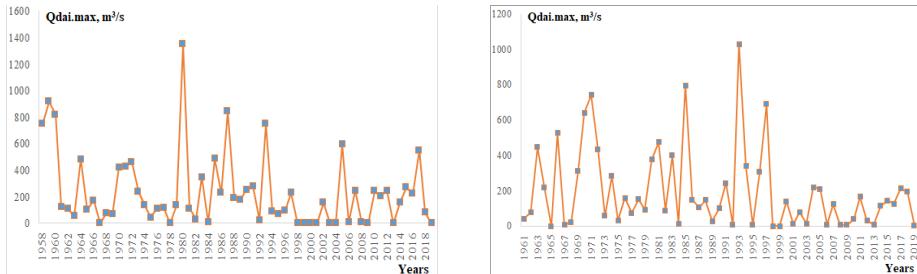


Figure 2.2. Maximum discharges of the main hydrological posts of the Zhaiyk river basin, m^3/s

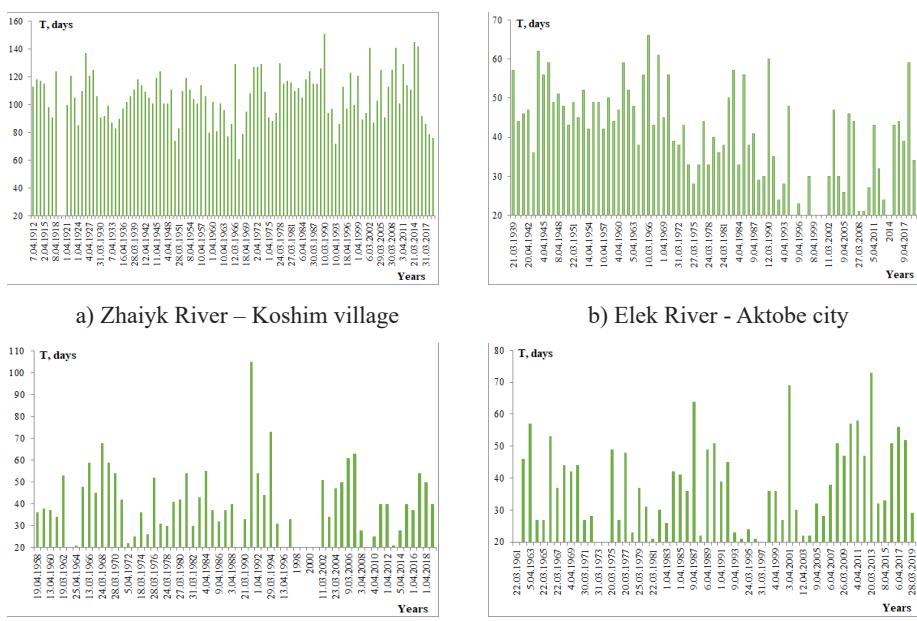


Figure 2.3. The duration of floods of the main hydrological posts of the

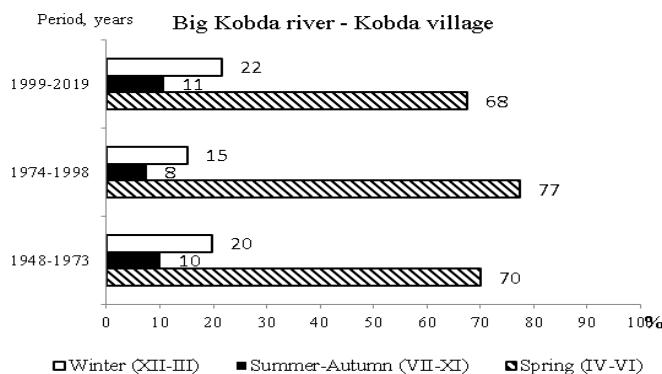
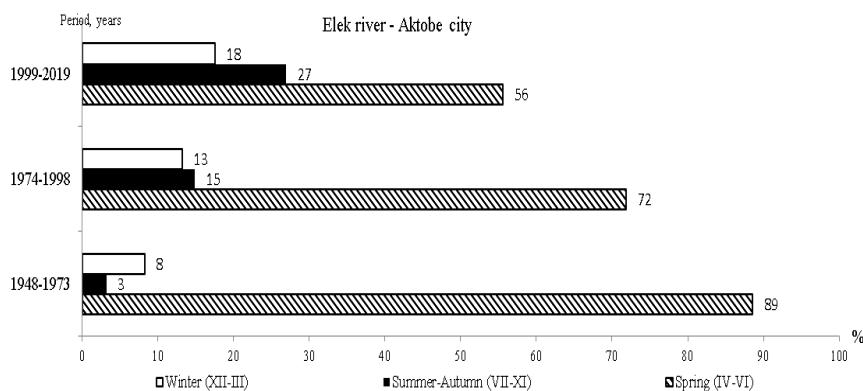
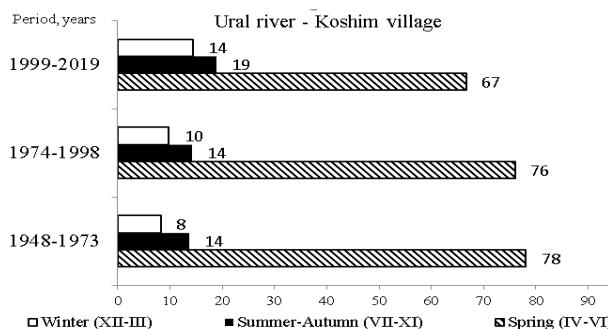
Zhaiyk river basin, days

The dynamics of changes in the intra-annual distribution of the runoff of the transboundary Zhaiyk River and its main tributaries in the limits of Kazakhstan over the long period of time is illustrated (Fig. 3).

The determined characteristic periods - so-called phases of the water regime in statistical data are associated with hydrological phenomena on watercourses in the form of seasonal or long-term fluctuations in runoff, respectively, in the work they do not strictly coincide with the calendar seasons of the year.

Based on that, for the studied object was chosen the spring phase of the water regime April to June (spring, IV-VI), this is the season of the spring flood. The summer-autumn season

is from July to November (summer-autumn, VII-XI), in this period there is a low flow. The winter season is from December to March (winter, XII-III), since in this period of time the ice phenomena is observed on the rivers.



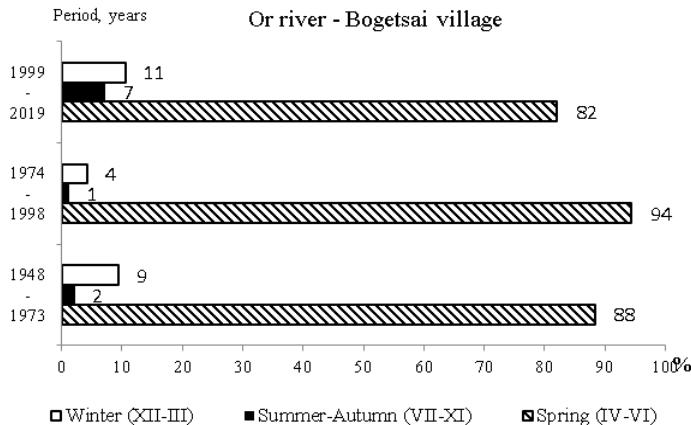


Figure. 3. Change in the share of river runoff by seasons

A comparative analysis of statistical data of monitoring sites in the frames of transitional periods of runoff, it can be observed the following: 1). Transboundary river Zhaiyk – Koshim village, the share of winter and summer-autumn runoff increased linearly by 6.0 % and 6.4 %, respectively, but the share of spring runoff decreased by 12.4 %.

2). Elek River - Aktobe, the share of spring runoff for the entire period under review decreased by 23.1 %, while the share of winter and summer-autumn runoff increased by 7.6 % and 15.6 %, respectively; 3). Or River – Bogetsay village, share of spring runoff for the period from 1974 to 1998 compared with the previous period (1948–1973) increased by 7.4 %, the share of summer-autumn and winter runoff decreased by 1.1 % and 6.3 %, respectively. In the last period (1999–2019), compared with 1948–1973, the share of summer-autumn runoff increased by 5.3 %, the share of spring runoff decreased by 5.0 %, but the share of winter runoff remained unchanged; 4). Big Kobda River – Kobda village, share of spring runoff for the last period (1999–2019) compared to 1974–1998 decreased by 9.8 %. The share of summer-autumn and winter runoff increased by 3.1 % and 6.5 %, respectively.

The reconstructed values of natural (climatic) runoff for the entire period of research from 1940 to 2019, including flood and low water runoff, are graphically visualized in relation to 2 climatic characteristics, such as: air temperature and precipitation (*Fig. 4*)

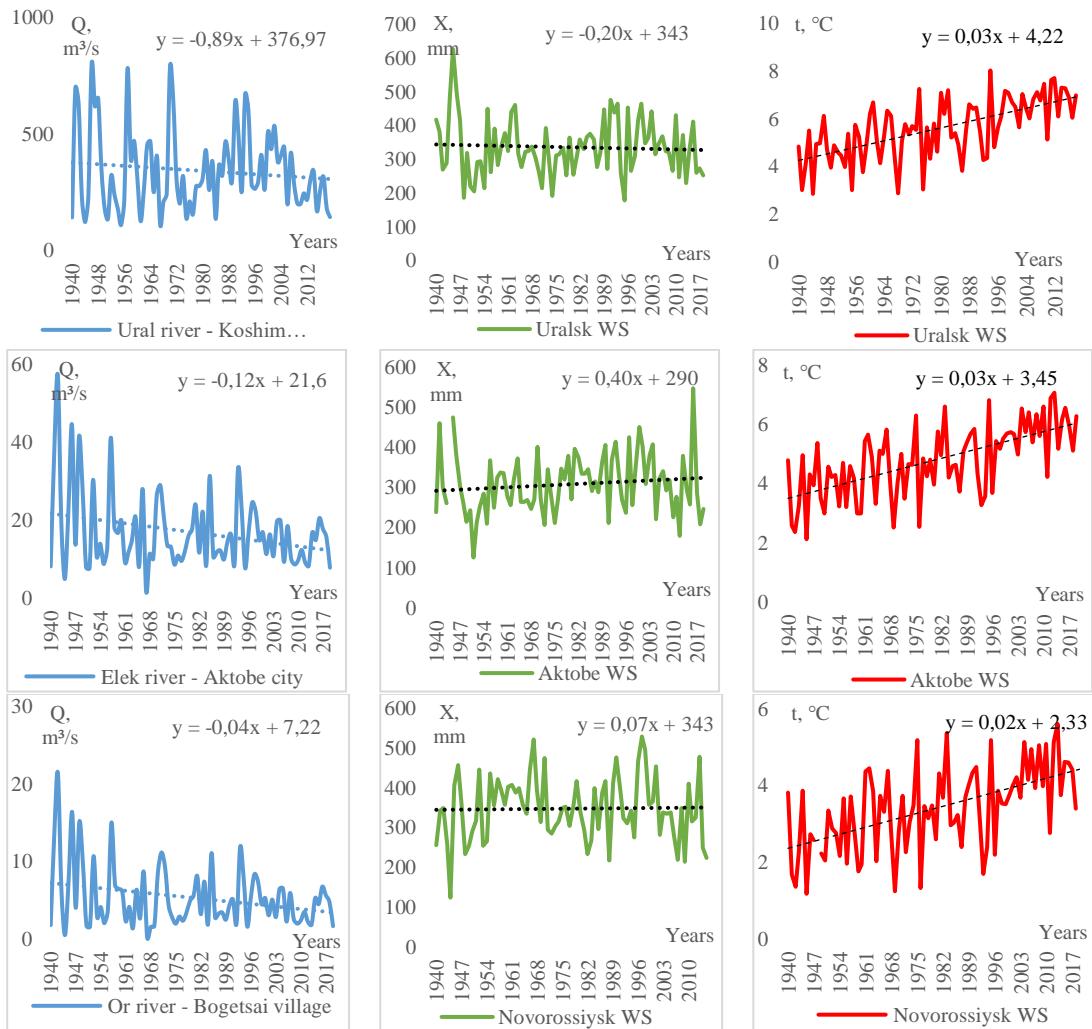


Fig. 4. Trends of changes in river flow in Zhaiyk river basin and climatic parameters

(— runoff; — rainfall; — air temperate)

Comparative statistical analysis of reveals that the trend direction of changes in precipitation tends to slightly decrease in quantitative indicators or is within the normal range, and vice versa, air temperature has clear tendency to increase.

Trends in changes in the volumes of flood runoff of the transboundary Zhaiyk River and its main tributaries in the limits of Kazakhstan are presented in Table 1.

Table 1. The trend of changes in the volume of floods of Zhaiyk river and its main tributaries.

River-hydrological station	Flood volume (observed), period, million m ³				Flood volume (reconstructed), period, million m ³			
	1940-1973	1974-2019	million m ³	%	1940-1973	1974-2019	million m ³	%
Elek - Shelek village	1150	626	-524	-45,6	1150	715	-435	-37.8
Elek - Aktobe city	537	259	-278	-51,8	537	373	-164	-30.5
Shyngyrlau - Kentubek village	123	76	-47	-38,2	123	88	-35	-28.5
Shagan - Kamennyi village	211	177	-34	-16,1	211	201	-10	-4.7
Derkul - Taskala village	21	17	-4	-19,0	21	21	0	0.0
Derkul - Beles village	104	71	-33	-31,7	104	109	5	4.6
	1940-1957 yy.	1958-2019 yy.	million m ³	%	1940-1957 yy.	1958-2019 yy.	million m ³	%
Zhaiyk - Koshim village	9740	6129	-3611	-37,1	9740	7918	-1822	-18,7
Zhaiyk - Makhambet village	8127	5323	-2804	-34,5	8127	6733	-1394	-17,2

Based on these results, the common features of climate change are expressed in increase in air temperature throughout the basin of the transboundary Zhaiyk River and statistically insignificant, multidirectional trend in annual precipitation.

Conclusions

Global and regional influence of climatic phenomena and anthropogenic factors have contributed to a significant reduction and transformation of river flow.

In the phases of the water regime and intra-annual distribution of runoff, there were shifts towards an increase in the winter and summer-autumn shares of the runoff, on the contrary, the volumes of the flood runoff decreased. A change in runoff regime and climate between 1974 and 2019 show, more frequent spring flooding, while the annual runoff decreased

to 65–75 % (with the exception of Or River).

In the regulated watercourses of the Zhaiyk River basin, the volumes of flood and maximum runoff have decreased. The dates of the beginning and end of the flood have shifted to earlier dates.

There was a transformation of the summer-autumn low water period with floods, starting after the end of the flood (in May-June) and ending after the freezing of the rivers (in November-December).

Several factors contributed to increase in the volumes of the summer-autumn low-water runoff (with the exception of the Or River), its share is 15–25 % of the annual runoff.

The summer-autumn low water phases of Zhaiyk River water regime increased in time and became longer by 14–16 days, the duration of the winter low water period decreased.

The trends of the transboundary river Zhaiyk basin, taking into account determined anthropogenic factors of influence to the climate change, allow us to state that there is a stable trend towards a decrease in the water content of the rivers in the basin and reduction in river runoff in the future.

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CONTENT

B.N. Absadykov, L.E. Sergeev, S.I. Mendaliyeva, K.T. Sherov, M.R. Sikhimbayev THE MECHANISM OF ACTION OF LUBRICATING AND COOLING TECHNOLOGICAL MEANS ON METAL REMOVAL DURING MAGNETIC ABRASIVE PROCESSING OF PARTS.....	8
© A. Begalinov, M. Shautenov, T. Almenov, B. Bektur, K. Sakhipova RESEARCH OF GRAVITY CONCENTRATION OF THE GOLD PLACER OF EASTERN KAZAKHSTAN.....	17
S.V. Gladyshev, S.B. Dyussenova, A.I. Bakhshyan, R.A. Abdulvaliev, A.I. Manapova SELECTING AND IMPROVEMENT OF A METHOD FOR PROCESSING KAOLINITE FRACTION OF BAUXITE.....	35
K.S. Dossaliyev, K. Ibragimov, K.I. Nazarov, Zh.A. Ussenkulov, F.Kh. Aubakirova COARSE-GRAINED SOILS COMPACTION AT THE EXPERIMENTAL SITE DURING THE CONSTRUCTION OF THE EARTHEN DAM.....	58
R. Izimova, G.B. Toktaganova, M.Zh. Makhambetov, G.I. Issayev, K.T. Abdraimova COMPARATIVE ECOLOGICAL ASSESSMENT OF SOIL CONDITION IN THE TERRITORY OF OIL FIELDS OF ATYRAU REGION.....	71
A.S. Madibekov, A.M. Karimov, L.T. Ismukhanova, A.O. Zhadi, K.M. Bolatov MARKAKOL LAKE LEVEL REGIME AS INDICATOR OF CLIMATE CHANGE.....	82
E.K. Merekeyeva, F.K. Nurbayeva, G.I. Zhiyenbayeva, P.S. Sundetova, S.M. Cherkeshova TECTONICS OF THE ZHAZGURLINSKY DEPRESSION OF SOUTHERN MANGYSHLAK.....	95
A.V. MITROFANOV, G.G. ABDULLINA, G.K. AHMEDYANOVA, D.G. Aigozhina, D.N. Kabylkaiyr STOCHASTIC MODEL OF HYDROTRANSPORTATION OF DISPERSED ORE MATERIALS IN VERTICAL PIPELINES.....	107
A. Musakulkyzy, A.S. Madibekov, L.T. Ismukhanova, K.M. Bolatov INTEGRAL ASSESSMENT OF THE WATER QUALITY OF THE MARKAKOL LAKE IN KAZAKHSTAN PART OF WESTERN ALTAI.....	119
L. Nurmaganbetova, A. Abilgaziyeva, S. Buktybayeva, A. Karimova, Zh. Shayakhmetova GEOCHEMICAL CHARACTERISTICS OF THE OIL OF THE EASTERN SIDE OF THE CASPIAN BASIN ACCORDING TO THE STUDY OF CARBON ISOTOPES AND BIOMARKERS.....	133

O.V. Rozhkova, D.M.-K. Ibraimova, K.B. Musabekov, V.I. Rozhkov, M.T. Ermekov DEVELOPMENT OF ANHYDROUS DRILLING FLUIDS BASED ON TAGAN DEPOSIT'S SUPERHYDROPHOBIC CLAY FOR DRILLING OIL WELLS AT THE KUMKOL FIELD.....	146
Zh.Zh. Smagulov, D. Snow, D.D. Arystambekova, A.M. Sailaubek, A.Z. Tairov STUDY OF WATER REGIME OF ZHAIYK TRANSCONTINENTAL RIVER IN THE CONTEXT OF ANTHROPOGENIC AND CLIMATIC CHANGES.....	164
S. Syrlybekkyzy, A. Zhidabayeva, A. Aitimova, D. Baimbetov, L. Taizhanova DEVELOPMENT AND EVALUATION OF THE EFFECTIVENESS OF NEW DESIGNS OF SOLAR DESALINATION POOLS FOR THE PRODUCTION OF FRESH WATER IN HOT CLIMATES.....	179
D.B. Shirinova, A.S. Bayramova, L.V. Huseynova, A.D. Valiyeva WATER PURIFICATION WITH AN ADSORBENT BASED ON CARBONATE SLUDGE.....	196
B. Orazbayev, A. Zhiyenbek, G. Uskenbayeva, Zh. Abdugulova, L. Rzayeva MODELING AND OPTIMIZATION OF OIL PRODUCTION PROCESSES FOR REGULATION OF OIL WELL FUND.....	205

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