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ASSESSMENT OF IRRIGATED AGRICULTURE AVAILABILITY DUE TO GROUNDWATER DEPOSITS EXPLORED FOR LAND IRRIGATION IN SOUTHERN AND EASTERN KAZAKHSTAN

Abstract. This article analyzes the current state of water supply for irrigated lands and examines the potential use of explored groundwater deposits for irrigation purposes. Irrigated agriculture remains one of the most effective forms of agricultural production, enabling increased yields of grain and vegetable crops regardless of precipitation levels. However, a major issue in Kazakhstan's agricultural water use is the significant loss of water resources. The regions of Kazakhstan can be categorized into three groups based on their level of dependence on transboundary surface water inflow: the first group includes areas with high dependency, the second group with moderate dependency, and the third group consists of regions independent of external water sources. For each groundwater deposit identified for irrigation, the design irrigation area was calculated using the average hydromodule value. The greatest potential for irrigation using groundwater is found in the southern regions of Kazakhstan.

Keywords: groundwater deposits, water supply for irrigated lands, Southern and Eastern Kazakhstan.

Introduction. In the current century, the scarcity of surface water resources has forced many states to make greater use of groundwater for various purposes, including land irrigation. At the same time, fresh groundwater is used primarily for domestic and drinking water supply to the population.

Currently, the regions of Central Asia, including Kazakhstan, are already experiencing a deficit of water resources. According to experts' estimates, natural water resources of surface waters formed on the territory of Kazakhstan and neighboring countries are decreasing every year due to wide use, which entails difficulties in providing the necessary volumes of fresh water for the needs of the agrarian sector of the country [1, 2].

Integrated approaches to water resources management, combining groundwater and surface water, can significantly reduce human vulnerability to extreme climatic events and changes, and contribute to strengthening water and food security. According to expert estimates, conjunctive use of groundwater and surface water, where surface water is used for irrigation and water supply during wet periods and groundwater during drought periods, is of paramount importance [2].

Irrigated farming is one of the most efficient methods of agricultural production, allowing to increase production of grain and vegetable crops regardless of precipitation. Most of the territory of Kazakhstan belongs to arid zones with low precipitation [3, 4].

In the conditions of Kazakhstan land reclamation is one of the most important conditions for reducing the dependence of farming on unfavorable weather conditions and stability in the production of vegetable and gourds, technical, grain, forage crops, and, consequently, livestock products. Creation of a zone of guaranteed production of grain and fodder for livestock is the main task of irrigated lands. Along with this, it is envisaged to implement a set of measures to combat water and wind erosion of soils, integrated mechanization, electrification and chemicalization of agricultural production, creation of the necessary base and development of industrial methods of construction of irrigation systems [3].

It should be noted that in 1985 the total area of irrigated land in Kazakhstan was more than 3.2 million hectares, including the area of estuaries was about 900 thousand hectares. More than 96% of irrigated lands were developed. Due to salinization or conversion, 87 thousand ha, or less than 4%, were not used. Irrigated lands were available in 17 out of 19 regions of the Kazakh SSR, except for Mangyshlak and Turgai regions. The largest areas of irrigated lands were in Chimkent region – 483.0 thousand ha, in Almaty region – 349.7 thousand ha, in Taldy-Korgan region – 306.6 thousand ha, in Kyzylorda region – 287.3 thousand ha, in Zhambyl region – 216.8 thousand ha and in Semipalatinsk region – 124.7 thousand ha. Annual water withdrawal for irrigation alone was 23.4 billion cubic meters. Irrigated lands were irrigated on the area of 2.2 million ha. Irrigation by sprinkling machines was carried out on the area of almost 700 thousand ha [5].

Materials and Methods. In 2022 in Kazakhstan irrigated lands occupied an area of 2.2 million ha, while only 1,557.6 thousand ha or less than 70% were used, and more than 30% were not used [3, 6]. The main reason for underutilization of irrigated lands is significant deterioration and failure of irrigation and drainage systems, accompanied by deterioration of land reclamation condition. This is due to the fact that many irrigation and drainage systems were left without organized maintenance and care on irrigation areas divided among many peasant, farmer and other farms. In terms of irrigation water productivity (i.e. the amount of agricultural products produced per 1 cubic meter of water used), Kazakhstan lags behind foreign countries by 6-8 times: if abroad 2.5-6.0 kg of agricultural products are produced per 1 cubic meter of water, in Kazakhstan 0.4-0.8 kg. Yields of all types of crops (cotton, sugar beet, rice, corn, vegetables, grapes) cultivated on irrigated lands in Kazakhstan are 2-4 times lower than in advanced countries.

Today, the largest areas of irrigated land are in Almaty region (with Zhetysu region) – 584.6 thousand hectares, in Turkestan region – 550.5 thousand hectares, Kyzylorda region – 254.1 thousand hectares and Zhambyl region - 230.9 thousand hectares. Among other regions, the largest irrigated massifs are located in East Kazakhstan region (with Abai region) – about 220 thousand ha (within its current boundaries) [3, 6, 7]. Irrigated agriculture in the Republic of Kazakhstan is the largest water consumer. It previously accounted for more than 70% of fresh water withdrawals. Water use in irrigated agriculture includes regular and inundative irrigation needs. Regular irrigation is sufficiently developed in the south of the Republic – these are Turkestan, Almaty (with Zhetysu region), Zhambyl and Kyzylorda regions. Inundative irrigation has also received certain development in the Republic, especially in the northern regions. Water-saving technologies are applied on the area 2.5 times less than the 1988 level – almost 280 thousand ha, or 18% of the total irrigated area. Including: sprinkling – more than 200 thousand hectares, drip irrigation – almost 80 thousand hectares.

More than 70% of regular irrigated lands are located in the basins of the Syr Darya, Shu, Talas, Ile Rivers and Lake Balkhash, belonging to South Kazakhstan, Kyzylorda, Zhambyl and Almaty regions (with Zhetisu region). Irrigated farming has existed here since ancient times and is the basis of agricultural production. The sources of irrigation of existing irrigated lands are mainly surface water. During this period, the runoffs of the Syrdarya, Arys, Keles, Assa, Talas, Shu, Ili and other rivers were practically fully utilized. Irtysh-Karaganda Canal, Big Almaty Canal were put into operation, nonsaline and partially saline lands in the basins of SyrDarya, Ili, Karatal, Shu, Talas, Tentek, Assa rivers and in the zone of Irtysh-Karaganda were fully developed. Large works were carried out in the Irtysh River basin, where the area of regular irrigation amounted to 447.0 thousand hectares, and inundative irrigation - 309.0 thousand hectares. As a result, the volume of water consumption outweighed the volume of available water resources by 25%, i.e. there was a deficit of water resources.

Due to increase of irrigated land area in all regions and water basins of Kazakhstan at the expense of saline lands, specific volume of water consumption, i.e. irrigation norm of irrigated lands has increased. At the same time, the irrigation rate of agricultural lands in comparison with the evaporation capacity of the natural system in specific water basins is 40% higher, and its value has been constantly increasing, which has led to changes in the regime of permanent and temporary watercourses of river systems; geochemical flows have increased manifold due to the involvement in the active cycle of huge masses of salts previously “buried” by nature; microclimate, soil, biological, hydrogeological and hydrological conditions have changed within the agro-landscapes and adjacent territories. As a result, technogenically disturbed agro-landscapes appeared, requiring functional-component and structural reconstruction of their restoration and normalization, and most importantly, the deficit of water resources necessary for land irrigation increased [3, 6].

According to the optimal scenario of development it is envisaged to bring all irrigated areas to 2210 thousand hectares by the end of 2040, including regular irrigation – 1800.0 thousand hectares and inundative irrigation – 410 thousand hectares to fully meet the domestic needs of the population in agricultural products and livestock fodder. In this scenario, the area of irrigated land will increase up to 40%. However, there is an acute problem of providing additional irrigated areas with water resources. And this despite the fact that the Republic has more than 17 thousand rivers, 4 thousand lakes, 2.6 thousand glaciers with a total area of about 1 million km^2 and a volume of more than 187 km^3, as well as more than 300 reservoirs, only about 3% of its territory is covered with water, and two thirds are arid zones. Most importantly, 44% of water resources of the Republic are formed in neighboring, bordering countries. Therefore, the issue of utilization of transboundary rivers is of vital importance for the Republic. For example, while the Western region of the country receives water from rivers flowing from Russia, Kyzylorda receives water from the Syr Darya from Uzbekistan. And in Zhambyl region there is the Shu which connects with the Talas River (Kyrgyzstan), in the east – the Irtysh and Ile rivers flowing from China [3, 6]. Since seven of the eight water basins are transboundary, Kazakhstan is largely dependent on the water policies of neighboring countries.

In the medium and long term, the country's water supply is expected to decrease due to a drop in river flow and an increase in water consumption. Environmentalists believe that by 2040, surface water shortages will increase in 6 of the nation's 8 water basins. International experts predict that Kazakhstan's water consumption will grow by 56% by 2040, and the deficit of water resources may reach 15 km^3 per year, i.e. about 15%. And if no urgent measures are taken, the water situation will irreversibly deteriorate by 2040. According to experts' estimates, natural water resources formed on the territory of Kazakhstan and neighboring countries are decreasing every year due to wide use, which entails difficulties in providing the necessary volumes of fresh water for the needs of the agrarian sector of the country.

One of the main problems of agricultural water consumption in Kazakhstan is significant water losses. The main share of water losses falls on inter-farm and on-farm canals. Experts have estimated that, on average, from 2020 to 2022, mainline canal transportation has lost about 20 percent of the water withdrawn. And taking into account losses in inter-farm and on-farm canals on fields aggravated by outdated irrigation methods, water losses reach 40% [5, 6].

Kazakhstan is among the countries most affected by global climate change processes on the planet. In general, Kazakhstan's climate is warming almost twice as fast as the global climate. Severe droughts are expected to occur more frequently in Kazakhstan, contributing to land degradation, desertification, leading to dust storms throughout the country. Already now about 70% of lands in Kazakhstan are at risk of moisture deficit during the growing season. At 2–3-year intervals, the country faces serious problems with drought and crop failure.

Irrigated farming may be a way out. But this requires water resources, and their availability in the future is also questionable. The situation with water availability for Kazakhstan is aggravated by the fact that the country is seriously dependent on river runoff from neighboring countries. Namely: The Republic of Kazakhstan has total river water resources of 100 cubic kilometers per year, of which 56 cubic kilometers are formed on the territory of Kazakhstan. The remaining volume of 44 cubic kilometers comes from contiguous states: China – 21 cubic kilometers, Uzbekistan – 13 cubic kilometers, Russia – 7 cubic kilometers, Kyrgyzstan – 3 cubic kilometers [4, 5, 6].

Results and Discussion. The regions of Kazakhstan can be divided into three groups according to the degree of dependence on surface water inflow from neighboring countries [2, 3, 4, 6]:

1. The first group with a high degree of dependence is the areas included in the Aral-Syrdarya, Shu-Talas and Zhaiyk-Caspian water management basin zones, which depend on water inflow from neighboring countries by 84%, 74% and 62%, respectively. This group includes Atyrau, Zhambyl, West Kazakhstan, Kyzylorda, Turkestan regions.

2. The second group with average degree of dependence is the areas included in the Balkhash-Alakol, Ertis, Tobol-Torgai water management basin zones, which depend on 41%, 23% and 5%, respectively, on water inflow from neighboring countries. This group includes Abai, Almaty, Zhetysu, East Kazakhstan, Kostanay, Pavlodar regions.

3. The third group is the areas included in the Esil and Nura-Sarysu water management basin zones, which do not depend on water inflow from neighboring states. This group includes Akmola, Karaganda, North Kazakhstan, Ulytau regions.

An important measure aimed at rational use of water resources and saving surface runoff is involvement of groundwater in economic use. Volume of groundwaters suitable for land irrigation in the republic is 7.76 km^3/year. Groundwater utilization opens up opportunities for increasing irrigated areas in the Republic of Kazakhstan and, to some extent, covering the deficit in water resources [7, 8, 9].

During the Soviet period, 0.9 million hectares were irrigated with groundwater during the implementation of the Food Program in the XI Five-Year Plan (1981-1985). During this period, exploration and preparation for exploitation of fresh and slightly saline (up to 1.5 g/l, and often up to 3.0 g/l) groundwater reserves were carried out at an accelerated pace. However, the development of explored GDs for IL has been unsatisfactory. Thus, in 1982, only 33.4% of exploitable groundwater reserves were supplied for irrigation [30].

In Kazakhstan in 2000 it was planned to irrigate 350 thousand hectares of lands. As of 1983, under irrigation of 43.07 thousand ha and supply of 7.15 m^3/s or 0.225 km^3/year of groundwater, the value of actual hydromodule was estimated at 0.165 l/s per 1 ha. Under such hydromodule for irrigation of 350 thousand hectares of lands 58 m^3/s of groundwater will be required, whereas already in 1987 170 m^3/s (5.3 km^3/year) was approved for the Republic. Thus, at that period undeveloped reserves of fresh and slightly saline (up to 2-3 g/l) groundwater could be used to plan irrigation in the area of 500 thousand ha, and this value can be considered as guaranteed. The determining factor of groundwater utilization for LI is its use during low water periods [30].

However, in 1990-2023, groundwater abstraction for irrigation and pasture watering has sharply decreased in Kazakhstan. For example, for 2023, groundwater uses for these purposes amounted to less than 140 thousand m^3/d, which corresponded to about 1% of the previously approved exploitable groundwater reserves. At present, the deposits explored for irrigation of lands on the territory of Southern and Eastern Kazakhstan are practically not used. All deposits located in the territory of South and East Kazakhstan are confined to aquifers with fresh groundwater suitable in quality for domestic and drinking water supply [7, 9, 10, 11].

It should be noted that according to the legislation of Kazakhstan, and many other countries, the use of groundwater of potable quality for needs not related to domestic and drinking water supply, as a rule, is not allowed. And only in areas where there are no necessary surface water sources, or their resources are insufficient and there are sufficient reserves of groundwater of drinking quality, it is allowed to use these waters for other purposes, including land irrigation, with the permission of authorities on regulation of water use and protection [6, 8].

For Kazakhstan, fresh groundwater of potable quality is a strategic resource and part of the main elements of environmental and water security. Republic of Kazakhstan. Additional studies are needed to assess the availability of fresh groundwater in Kazakhstan in order to obtain sufficiently justified and reliable results based on the principles of long-term use of groundwater resources primarily for domestic and drinking water supply.

The advantages of groundwater irrigation are: the possibility of receiving water directly at irrigated areas, which reduces the length of the irrigation network and increases its efficiency; water purity; frequent combination of irrigation and drainage purposes. The use of artesian self-discharging groundwater is particularly valuable because it requires no energy expenditure or this expenditure is significantly lower [4, 7, 8]. Disadvantages of groundwater use as irrigation sources are: high cost of water lifting, absence of fertilizing silt particles in water, danger of depletion of groundwater reserves, especially of drinking quality.

As for operational costs, they are higher under groundwater irrigation than under surface water irrigation. For 1 ha 400-500 kW of electric power is spent when water is lifted from wells from depths of 30 m and up to 1500-1600 kW at a depth of 100 m. In addition, to increase the irrigated area it is necessary to arrange regulating reservoirs (accumulating basins). At the same time, the experience of groundwater irrigation of vegetable crops in neighboring countries shows that the cost of construction of an irrigated area, including the construction of a closed irrigation network, storage basin with impervious cover and drilling of wells, pays for one or two years of operation [4, 8].

Analysis of the results of assessment of the degree of availability of operational groundwater reserves has shown that in all deposits explored for land irrigation on the territory of administrative regions of South and East Kazakhstan, operational reserves are fully provided with natural resources and natural reserves. Therefore, climatic changes in the groundwater level regime of individual deposits, due to low water years, will not significantly affect the values of exploitable reserves of groundwater deposits explored for irrigation. Thus, exploitable groundwater reserves of these deposts can provide certain areas for irrigation of lands after construction of irrigated massifs with construction of necessary irrigation systems adjacent to a particular deposit explored for irrigation.

The whole irrigation system is designed usually in relation to the features of the irrigated massif. Such factors as: relief, soil condition, hydrogeology, engineering geology, determine the composition, quantity and structure of irrigation system elements. Therefore, first of all, within the planned irrigation massifs it is necessary to conduct complex hydrogeological and engineering-geological studies on the scale of 1:50,000 in order to solve the following main tasks: 1) study of hydrogeological and engineering-geological conditions of the territory and their ameliorative assessment for selection and justification of composition and methods of ameliorative measures; 2) obtaining necessary design values of parameters for aeration and saturation zones used in designing irrigation and drainage system structures, as well as forecasting their operation conditions; 3) study of groundwater regime and balance and obtaining initial data for forecasting groundwater regime and water-salt balance under irrigation conditions; 4) assessment of groundwater quality and degree of its suitability for irrigation, etc.

Design irrigation areas were determined for each groundwater deposit explored for irrigation, based on the average value of the irrigation modulus that takes into account its flow rate for irrigation without taking into account losses in the irrigation network. For Central Asia and Kazakhstan, the irrigation modulus is usually in the range of 1.0-0.5 l/s per 1 ha. An average module value of 0.7 l/s per 1 ha (0.0007 m^3/s per 1 ha) was used for the calculations [3, 4].

Area calculations were made for each groundwater deposit within the administrative regions of South and East Kazakhstan. The results are presented in table.

Irrigation areas provided with exploitable reserves of groundwater deposits explored for irrigation in Southern and Eastern Kazakhstan

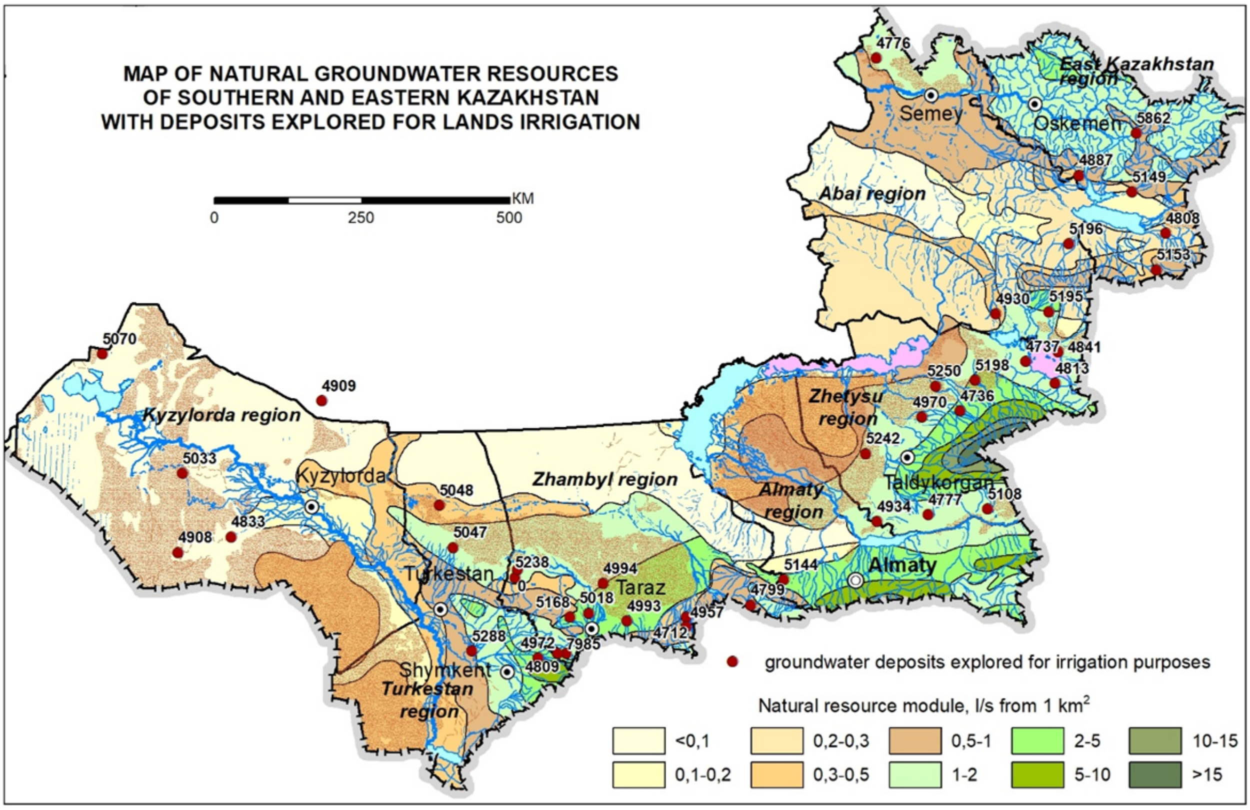
Administrative region. Cadastre GD code	Name of GD	Geological index of aquifer (complex)	Salinity, g/l	EGWR value for irrigation			Coefficient of EGWR availability $K_{availability} = Q_{availabilitu}/Q_{exploitation}$	Approximate area of groundwater irrigation, ha
				thous. m^3/day	km^3/year	m^3/s		
1	2	3	4	5	6	7	8	9
Almaty	**South Kazakhstan**							
4849	Issyk-Turgen	ap Q	0.1-0.7	583.2	0.2128	6.7500	2.29	9 642.8571
4878	Karadala	N_2 K	0.2-0.7	776.1	0.2832	8.9826	1.12	12 832.2857
4881	Karoi	ap Q_I	0.1-0.3	12.9	0.0047	0.1493	3.75	213.2857
5056	Talgar	ap Q	0.2-0.4	288.72	0.1053	3.3416	4.17	4 773.7142
5089	Uzun-Agach	ap Q_{I-II}	0.1-0.9	257	0.0938	2.9745	2.06	4 249.2857
5112	Chilik	ap Q	0.2-0.7	1341	0.4894	15.5208	1.86	22 172.5714
5144	Yuzhno-Kopinskoe	ap Q_I/ N_1	0.2-0.9	73	0.0266	0.8449	4.37	1 207.0000
Total GD, reserves, irrigated areas	7			**3331.92**	**1.2158**	**38.5637**		55 091.0000
Zhetysu								
4736	Aksu	ap Q_{I-II}	0.1-0.5	1497.5	0.5465	17.3321	1.261	24 760.1428
4737	Alakol	ap Q-alQ_{I-II}	0.2-0.4	864.7	0.3156	10.0081	2.64	14 297.2857
5250	Baskan	ap Q	0.2-0.8	259.2	0.0946	3.0000	2.06	4 285.7142
4777	Bashi	dp Q_I-ap Q_{II}	0.1-0.8	116.6	0.0425	1.3495	3.21	1 927.8571
4813	Djungar	Q_{I-II}	0.2-0.4	802.6	0.2929	9.2893	1.40	13 270.4285
5242	Karatal	Q_I/ N_2	0.8-0.9	311	0.1135	3.5995	3.83	5 142.1428
4934	Kerbulak	Q_{I-II}/ N_2	0.5-0.8	140.2	0.0511	1.6226	2.11	2 318.0000
4970	Molaly	a Q_{I-II}—ap Q_{I-II}	0.4-0.7	457.7	0.167	5.2874	1.53	7 553.4285

Continuation of the table

1	2	3	4	5	6	7	8	9
5108	Khorgos	ap Q_{I-II}-a Q	0.2-0.3	2643.9	0.965	30.6006	1.47	43 715.1428
5198	Shilikta	ap Q_{I-II}	0.2-0.6	755.1	0.2756	8.7395	1.61	12 485.0000
Total GD, reserves, irrigated areas	*10*			**7 848.6**	**2.8643**	**90.8286**		129 755.1428
Zhambyl								
5238	Akzhar	₽$_1$- ₽$_2$	0.4-0.6	43.2	0.0157	0.5000	2.09	714.2857
4712	Aspara	Q_I ap Q_{II-III}-N	0.2-0.4	129.6	0.0473	1.5000	6.78	2 142.8571
5168	Biylikol	a Q_{III}-N_2	0.3-0.7	293.7	0.1072	3.3993	1.23	4 856.1428
4799	Georgievs-koye-Talapty	a Q_{III-IV}	0.3-0.5	46.6	0.017	0.5393	1.55	770.4285
4809	Zhualyn	ap Q_{II-III}	0.2-0.5	292.1	0.1066	3.3807	2.24	4 829.5714
4957	Merken	ap Q_{II-III}	0.1-0.2	116.7	0.0425	1.3506	8.05	1 929.4285
4993	Podgornen-skoye	ap Q_{II-III}	0.2-0.8	330	0.1204	3.8194	1.54	5 456.2857
4994	Predpesko-voye	a Q-N_2	0.3-0.8	294.9	0.1076	3.4131	2.33	4 875.8571
4944	Lugovskoye	ap Q_{II-III}	0.2-0.8	500	0.1825	5.7870	3.76	8 267.1428
5018	Talas-Assin (North)	ap Q_{III-IV}- N_2	0.4-0.7	228.1	0.0832	2.6400	4.38	3 771.4285
5144	Yuzhno-Kopinskoe	ap Q_I - N_1	0.2-0.9	18.3	0.0066	0.2118	18.08	302.5714
7985	Shakpakata	C_1	0.3-0.5	0.740	0.00027	0.00856	3.50	12.2285
Total GD, reserves, irrigated areas	12			**1 793.94**	**0.6543**	**26.5497**		37 928.2285
Kyzylorda								
4833	Zhanadarya	K	1.0-2.0	21.6	0.0078	0.2500	3.52	357.1428
4908	Kuvandarya	K_2	1.3-1.4	72.5	0.0264	0.8391	2.56	1 198.7142
4909	Kyzylkum	K_2	1.6-2.0	71.5	0.026	0.8275	5.05	1 182.1428
5033	Sarybulak	K_2	1.5-3.0	21.1	0.0077	0.2442	6.10	348.8571
5070	Tolagai	₽$_2$	0.5-1.0	4.8	0.0017	0.0555	60.0	79.2857
Total GD, reserves, irrigated areas	*5*			**191.5**	**0.0696**	**2.2163**		3 166.1428
Turkestan								
5288	Bugun	Q_{II}- N_2	0.6-2.0	302.4	0.1103	3.5000	1.33	5 000.0000
4972	Michurinskoe	ap Q_{II-III}	0.5	42.9	0.0156	0.4965	5.13	709.2857
5048	Suzak	N_2- ₽$_2^{1-2}$, K_2	0.3-1.8	138.6	0.0505	1.6041	4.99	2 291.5714
5047	Suykbulak-Intymak	K_2	0.5	23.3	0.0085	0.2696	5.56	385.1428
Total GD, reserves, irrigated areas	4			**507.2**	**0.1849**	**5.8702**		8 386.0000
East Kazakhstan	**East Kazakhstan**							
4808	Dairov	a Q_{II} N_2-Q_1	0.2-0.7	667.3	0.2435	7.7233	1.38	11 033.2857
5149	Kalgutin	ap Q	0.2-0.8	45	0.0164	0.5208	4.03	744.0000
4887	Kuludzhun	ap Q	0.2-0.8	136.7	0.0498	1.5821	1.77	2 260.1428
5862	Narym	aQ_{II-III}	0.2-0.4	85.7	0.0312	0.9918	1.09	1 416.8571

End of table								
1	2	3	4	5	6	7	8	9
5153	Chilikta	apQ_{II} - N_2-Q_1	0.2-0.3	139.1	0.0505	1.6099	2.25	2 299.8571
Total GD, reserves, irrigated areas	5			**1073.8**	**0.3914**	**12.4279**		17 754.1428
Abai								
4776	Balapanovskoye	$aQ_{II-III,}$ N_2-$Q_{1,}$ ₽$_{2-3}$	0.2-0.6	85.794	0.0313	0.9929	1.25	1 418.4285
4841	Zharbulak	$apQ_{1,}$ ap $Q_{II-III,}$	0.1-0.5	1071.3	0.391	12.3993	1.86	17 713.2857
4930	Karakol	aQ-apQ	0.4-1.0	216	0.0788	2.500	1.30	3 571.4285
5195	Katynsu	aQ-apQ_{I-IV}	0.2-0.5	483.8	0.1765	5.5995	1.5	7 999.2857
5196	Kurailin	aQ-apQ $_{I-IV}$	0.3-0.8	380.12	0.1387	4.3995	1.79	6 285.0000

Deposits explored for irrigation in Southern and Eastern Kazakhstan are reflected in the Map of natural groundwater resources, which confirms a high degree of availability of exploitable reserves in the deposits with natural resources figure.



Map of natural groundwater resources of Southern and Eastern Kazakhstan with deposits explored for irrigation

Southern Kazakhstan: total area of lands for possible irrigation due to groundwater use amounted to 234,326.51 thousand ha. In the context of administrative regions, it appears as follows: in Almaty region the total area of possible irrigation by groundwater amounted to 55,091.00 ha; in Zhetysu region – 129,755.14 ha; in Zhambyl region – 7,928.23 ha; in Kyzylorda region – 3,166.14 ha, in Turkestan region – 8,386.00 ha.

Eastern Kazakhstan: the total area of lands for possible irrigation through the use of groundwater amounted to 54,741.57 ha, at that, in East Kazakhstan region the total area of possible irrigation by groundwater amounted to 17,754.14 ha; in Abai region – 36,987.43 ha.

Conclusion. The analysis of the results of the completed study allowed us to draw the following conclusions:

– studies have shown that it is possible to irrigate significant areas of land at the expense of groundwater deposits explored for land irrigation;

– an average module value of 0.7 l/s per 1 ha (0.0007 m^3/s per 1 ha) was used for the calculations;

– the largest areas of possible irrigation of lands at the expense of groundwater are confined to the territory of Southern Kazakhstan (234,326.51 ha), and among administrative regions – to the Zhetysu region (129,755.14 ha);

– on the territory of Eastern Kazakhstan, the largest areas of irrigated lands at the expense of groundwater are confined to Abai region (36,987.43 ha);

– it is possible to provide specified areas with exploitable groundwater reserves of these deposits for land irrigation after construction of irrigated massifs with construction of necessary irrigation systems adjacent to a specific deposit explored for irrigation, after studying hydrogeological and engineering-geological conditions of the territory of the selected areas and their ameliorative assessment for selection and justification of composition and methods of reclamation measures.

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ОҢТҮСТІК ЖӘНЕ ШЫҒЫС ҚАЗАҚСТАН АЙМАҒЫНДА ЖЕРДІ СУАРУ ҮШІН ЗЕРТТЕЛГЕН ЖЕРАСТЫ СУ КЕНДЕРІНІҢ СУАРМАЛЫ ШАРУАШЫЛЫҒЫНЫҢ ҚАУІПСІЗДІГІН БАҒАЛАУ

Аннотация. Суармалы жерлерді сумен қамтамасыз ету көздеріне талдау жасалып, барланған жер асты суларының кен орындарын суару үшін пайдалану мүмкіндіктері қарастырылған. Суармалы егіншілік жауын-шашын мөлшеріне қарамастан астық және көкөніс дақылдарын өндіруді арттыруға мүмкіндік беретін ауыл шаруашылығы өндірісінің тиімді әдістерінің бірі болып табылады. Қазақстандағы ауылшаруашылық суды тұтынудың негізгі проблемаларының бірі судың айтарлықтай жоғалуы болып табылады. Қазақстан аймақтарын көршілес елдерден жер үсті суларының келуіне тәуелділік дәрежесі бойынша үш топқа бөлуге болады: бірінші топ – тәуелділік дәрежесі жоғары, екінші топ – орташа тәуелділік, үшінші топ – көршілес елдерден келетін су ағынына тәуелді емес аймақтар. Суару үшін барланған жер асты суларының әрбір кен орны үшін гидромодульдің орташа жас шамасының негізінде жобалық суару алаңдары анықталды. Жер асты суларын пайдалана отырып, жерді суарудың ең үлкен аумақтары Оңтүстік Қазақстанда орналасқан.

Түйін сөздер: жер асты суларының кен орындары, суармалы жерлерді сумен қамтамасыз ету, Оңтүстік және Шығыс Қазақстан.

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ОЦЕНКА ОБЕСПЕЧЕННОСТИ ОРОШАЕМОГО ЗЕМЛЕДЕЛИЯ ЗА СЧЕТ МЕСТОРОЖДЕНИЙ ПОДЗЕМНЫХ ВОД, РАЗВЕДАННЫХ В ЮЖНОМ И ВОСТОЧНОМ КАЗАХСТАНЕ

Аннотация. Приведен анализ источников водоснабжения орошаемых земель и рассмотрены возможности использования разведанных месторождений подземных вод для орошения. Орошаемое земледелие является одним из наиболее эффективных методов ведения сельскохозяйственного производства, позволяющим увеличить производство зерновых и овощных культур независимо от количества осадков. Одной из основных проблем сельскохозяйственного водопотребления в Казахстане являются значительные потери воды. Регионы Казахстана можно разделить на три группы по степени зависимости от поступления поверхностных вод из соседних стран: первая группа с высокой степенью зависимости, вторая группа со средней степенью зависимости, третья группа – районы, не зависящие от поступления воды из соседних стран. Для каждого месторождения подземных вод, разведанного для орошения, были определены проектные площади орошения исходя из средневозрастного значения гидромодуля. Наибольшие площади возможного орошения земель с использованием подземных вод расположены в Южном Казахстане.

Ключевые слова: месторождения подземных вод, водообеспечение орошаемых земель, Южный и Восточный Казахстан.