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Analysis of hydrochemical parameters of surface water sources used for watering pastures to improve the water quality

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ABSTRACT

In pasture animal husbandry, the most accessible types of watering are surface water sources, which is limited by the degree of mineralization of water in them permissible for the livestock. The purpose of the study is to analyze the hydrochemical indicators of water sources used for watering pastures in the West Kazakhstan region to improve water quality. This region is distinguished by a wide variety of natural landscapes. Its considerable extension from north to south has led to a consistent change in the natural and geographical zones with varying degrees of availability to the surface water resources. The greatest density of these sources is observed in the steppe and dry steppe zones of the region. There are about 54 rivers of various lengths in the region, which can be used as water sources. Hydrochemical analysis of water was carried out by chemical and physicochemical methods. The absolute majority of surface water sources had weak mineralization, and the chemical composition of the water was dominated by magnesium/sodium chloride, magnesium/calcium sulfate/chloride, magnesium/calcium/sodium sulfate/chloride, and calcium/sodium chloride/sulfate types of salt composition. The conducted studies show the importance of surface water sources in the irrigation of pasture lands in the West Kazakhstan region. The presence of a small number of surface water sources on a regional scale requires careful and rational use of available water resources, as well as the development of special measures to improve water quality.

Keywords*:* Hydro-chemical indicators, Pasture, Surface water sources, Water availability, West Kazakhstan region.
Article type: Research Article.

INTRODUCTION

Access to water is crucial for livestock during the dry season in arid and semi-arid pastures (Ansari Renani *et al.* 2013). For watering, water is obtained from wells, as well as from various sources, such as rivers, springs, rain, and small reservoirs (Tugjamba *et al.* 2021; Halimani *et al.* 2021; Alwin *et al.* 2023; Gartsiyanova *et al.* 2023). The focus of our study was the influence of factors such as water quality and types of sources on the construction of an effective system of pasture watering. Good water quality is essential to ensure the quality of livestock products, and the supply of safe food. Studies (Hapke 2000; Valente Campos *et al.* 2019) indicate that the presence of toxic substances in concentrations higher than permissible in water consumed by animals can reduce the production of meat, fat, eggs, and milk, reduce fertility, and also pose a danger to animals and humans.

To determine water quality criteria for animals in Argentina, Australia, and New Zealand, the Canadian Council of Ministers of the Environment (CCME) and the Food and Agriculture Organization (FAO) set maximum permissible values based on the presence of these compounds in the surface and groundwater. Other values are based on toxicity for animal species relevant to each country, state, or region, and some directly apply the water

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quality criteria developed for human consumption to livestock (Valente Campos *et al.* 2019). The chemical composition of various reservoirs is determined by natural processes and/or anthropogenic activity within the region. Knowledge and understanding of the hydrochemical properties of water in a semi-arid climate contribute to sustainable development and effective management of available water resources. Therefore, the hydrochemical characteristics of various water sources on a regional scale are of paramount importance (Dinka *et al.* 2015). Geochemical conditions have a noticeable effect on the quality of surface waters. Hydrogeochemical studies explain the relationship of the chemical composition of water with the lithology of the aquifer for water quality. This relationship will help not only to explain the origin and distribution of dissolved components, but also to identify the factors controlling the chemical composition of surface waters. Rivers are the water bodies most susceptible to pollution, as they carry a large amount of industrial and municipal wastewater along with fertilizers in the form of runoff from agricultural land. Due to the growing problem of deterioration of river water quality, continuous monitoring of the river system is required to assess the impact of environmental factors on water quality for the proper use and sustainable development of the resource (Khan *et al.* 2017; Khan & Tian 2018; Sharma *et al.* 2022). The geochemical cycle of elements is mainly determined by rivers that carry elements separated from the soil and rocks during weathering and erosion. The total hardness of water can be associated with the presence of bicarbonates, sulfates, chlorides and nitrates, calcium, and magnesium (Sharma *et al.* 2022). Rivers are the main sources of fresh water for daily needs, industrial production, and agricultural irrigation (Stets *et al.* 2018; Jiang *et al.* 2023). The construction of small ponds that collect and store rainwater used for livestock has been one of the most common adaptive solutions in Iberian pastures. This approach is aimed at solving the problem of water scarcity, which has become especially relevant in recent decades due to the gradual increase in the number of livestock. During the rainy season, the water quality in the ponds corresponded to the needs of livestock, however, at the end of the dry season, high bacterial contamination of fecal origin was observed in many ponds with subsequent risk to animal health. Dilution with rainwater and evaporation/concentration processes were the main mechanisms determining the concentration of pollutants in pond water, while the density of livestock did not seem to have a significant effect. Scientists suggest some strategies, such as diversification of water supply sources and regular testing of water quality, which farmers could use to solve identified water quality problems (Marin Comitre *et al.* 2022). We have studied the experience of developing and implementing highly efficient technologies for watering pasture lands by the transportation of fresh surface water over considerable distances across the territory of the Republic of Kazakhstan. Canals were usually built on the territory of Kazakhstan to transfer a large amount of water to the water-scarce and waterless pasture lands. In the constructed channels, the water consumption was comparable to that of some rivers. To transfer such large volumes of water, it was necessary to build retaining dams on the rivers and create regulating reservoirs to fully utilize the water resources of river runoff (Kolodin 1981). The presence of surface waters is confirmed by the survey data of the territory of the West Kazakhstan region (Ongayev *et al.* 2022; Ongayev *et al.* 2019|). Natural pastures of Kazakhstan occupy 186.4 million ha, and irrigation of pastures is one of the main conditions for the using pasture lands in order to provide water for the grazing farm animals (Kozhanov *et al.* 2021). The uneven distribution of surface water resources across the territory of Kazakhstan creates a shortage of fresh water in a large area of pastures (Absametov & Murtazin 2021). While the water problem was of paramount importance before, nowadays, due to the intensive development of the agricultural sector, it has become even more acute and urgent. Therefore, it was important to study the available water resources and assess their potential for watering pastures, considering the qualitative characteristics of watering sources. Thus, the purpose of the study was to determine the hydrochemical parameters of water sources used for watering pastures in the West Kazakhstan region.

MATERIALS AND METHODS

Objects of the study

This study was conducted in 2018-2022. The objects under study were surface water sources at the locations of the distant pasture cattle tending in the dry-steppe, semi-desert, and desert zones of the West Kazakhstan region. The surface of this region is mainly a flat area, descending from the northeast to the southwest. Almost in the center of the Caspian lowland, the Ural River flows, which almost divides the West Kazakhstan region into two parts. On the right bank of this river, there are some rivers including Maly, Bolshoy Uzen and Aschyuzek, originating from the southern slopes of the Syrt Trans-Volga region, and the rivers such as Chizha-1, Chizha-2, and Mereke, originating from the southern spurs of the Common Syrt. In this part of the region, the outflows of the Ural River (the Kushum and Bagyrlay rivers) also present. The Uzynankaty, Shieli, Shiderti, Olenty, Konysshagyl, Karabas, Aschy, Aschysay, Shili, Utva, and Kuagash rivers flow on the left bank of the Ural River. Most of them flow down from the Ural plateau. The rivers unevenly distributed over the territory of the region, have snow nutrition, and are rapid. Hydrologically, the watercourses in the territory of the West Kazakhstan region are characterized by significant variability in the volume of annual runoff. The Ural River flows through the territory of Borili, Bayterek, Terekti, and Akzhaik districts and is a water source for the pastures in these territories. Through Kushum River, which is an ancient outflow, the Ural River provides water to the Ural-Kushum irrigation system consisting of five main channels with a total length of 510.8 km and also a network of distribution and irrigation channels with a length of 750 km (Fig. 1). This system allows watering 2,177 thousand ha of pasture lands.

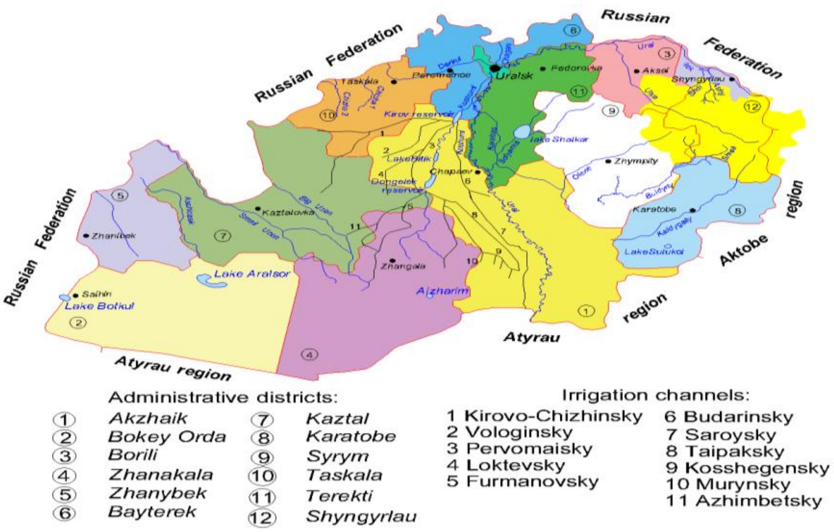

Fig. 1. Rivers and canals of the West Kazakhstan region.

The water resources of the Bolshoy Uzen and Maly Uzen rivers are the main irrigation sources for the pastures in the northwestern part of the semi-desert zone in the territory of the West Kazakhstan region. The total length of tributaries with a length of more than 10 km within the West Kazakhstan region is 144 km. The river flows through the territory of Kaztal and Zhanakala districts and is a source of irrigation for the pastures. There are 445.7 thousand ha of irrigated pastures on the Bolshoy Uzen irrigation system, and in the summer and autumn periods, the Volga water is supplied to the Bolshoy Uzen River via the Saratov main canal. The length of the Maly Uzen River within the West Kazakhstan region is 390 km, with a total length of tributaries extending more than 10 km in 209 km. The river flows through the territory of Kaztal district. There is 323.7 thousand ha of watered pastures on the Maly Uzen irrigation system. In the north of the Caspian lowland, the Kushum River flows in the right-bank part of the Ural River. The total length of all its tributaries with a length of more than 10 km is 56 km. The river flows through the territory of the Akzhaik and Zhanakala districts. In the northern part of the semi-dry zone, there are small rivers including Obshchy Syrt, Chizha-1, and Chizha-2. The length of the Chizha-1 and Chizha-2 and other rivers in the Chizha, Dyura, and Balykta lowlands, including the flooded areas, within the West Kazakhstan region is 344 km. The total length of all tributaries with a length of more than 10 km is 120 km. The water collection area, within the West Kazakhstan region, is 16,140 km^2, of which 3,500 km^2 is the water collection area of rivers, while 12,640 km^2 is the flooded areas. The Zhanibek irrigation system plays an exceptional role in the watering of pasture lands in the southern regions of the West Kazakhstan region. Water is supplied to the system by pumping a cascade of pumps from the Volga River through the Pallas irrigation system of the Volgograd region in the Russian Federation. The main and distribution channels with a total length of 160 km provide water to 480.3 thousand ha of pasture lands in the Zhanibek and Bokei Orda districts. The rivers Olenty, Buldyrty, Kaldygayty, Shiderti, Isenankaty, and Ankaty flow in the eastern part of the semi-desert zone. The length of the watercourse of these rivers is 821 km, and the water collection area is 16,740 km^2. The rivers flow through the territory of the Syrym, Akzhaik, and Karatobe districts. Despite the density of rivers in the summer, shallow reservoirs and watercourses dry up. The data of the summary characteristics of the main rivers of the region given in Table 1, are provided by the branch of the Kazhydromet Republican State Enterprise, the Ministry of Ecology and Natural Resources in the Republic of Kazakhstan with the right of Economic Management in the West Kazakhstan region.

Table 1. Hydrological characteristics of the main rivers of the West Kazakhstan region.

Water source	Length (km	Water collection area (km^2)	Water consumption (m^3/sec)			Annual flow volume (mln m^3/year)		
			2018	2019	2020	2018	2019	2020
Ural River	2,428	231,000	150	118	144	4,720	3,730	4,550
Kushum River	375	1,780	8.29	4.72	8.38	261	149	266
Chagan River	264	7,530	4.25	2.41	1.02	134	76	32.3
Derkul River	176	2,200	1.45	0.096	0.03	45.7	3.02	0.941
Utva River	290	631	1.36	0.23	0.14	42.9	7.4	4.37
Chizha-1 River	76	822	0.3	0.14	-	9.6	4.55	-
Chizha-2 River	82	1,360	1.53	0.068	0.04	48.4	2.15	1.26
Bykovka River	82	565	0.3	0.16	-	9.47	5.08	-
Olenty River	229	6,280	0.36	0.16	0.055	11.4	4.96	1.73
Shiderti River	97	1,801	0.13	0.11	0.019	4.02	3.37	0.594
Kuperankaty River	40		0.34	0.18	0.035	10.6	5.76	1.12
Bolshoy Uzen River	650	14,300	3.46	1.01	1.41	109	31.9	44.4
Maly Uzen River	638	13,200	0.42	0.82	1.18	13.3	25.7	37.2

Sampling and analysis

When addressing watering issues for pastures, it is important to ensure water quality following sanitary and epidemiological requirements. For open water sources, which are essential in providing water to the locations of distant pasture cattle tending, we evaluated the materials of laboratory hydrochemical analyses of water samples from open water sources. Three samples were taken from each of the 21 water sources. The samples were taken in places upstream of the rivers relative to the concentration of a large number of farm animals, including from the Ural River in the village of Kushum, from the Bolshoy Uzen River in the village of Zhalpaktal, from the Maly Uzen River in the village of Kaztalovka, and from the Aschyozek River in the village of Kuygenkul. Water sampling from surface water sources was carried out to determine the parameters of the hydrogen index, turbidity, total hardness, permanganate oxidizability, total water mineralization, the content of ions such as carbonate, bicarbonate, chloride, sulfate, nitrite, nitrate, ammonium, calcium, magnesium, sodium and potassium in total, and dry residue in the water. Hydrochemical analysis of water was carried out by chemical and physicochemical methods. The hydrogen index (pH) in natural waters was determined by the quantitative ratio of concentrations of carbonic acid and its ions. The determination of the ammonium, nitrite and nitrate ions was carried out by the method of assaying nitrogen-containing substances by the spectrophotometric method on the Cary-50 spectrophotometer made by Varian (Australia). The dry residue content was determined by the weight method [14].

Data analysis

The three-line Piper diagram was used as a graphical representation of chemical elements in water samples during hydrological studies. The graphs were taken into account the percentage values of six ionic groups, i.e., calcium, magnesium, and sodium cations plus potassium, as well as sulfate, chloride, and carbonate plus bicarbonate anions. When comparing the results of the analysis of water with different mineralization to obtain proportional values, the number of milligram equivalents was converted into percentage equivalents. The composition of water was described in ascending order, from low-content- to predominant- ions, first for anions, and then for cations. The data of river water hydrochemical analysis were displayed in Piper diagrams using the graphical method of the Excel Spreadsheet for Piper Diagram software. The diagrams show the degree of mineralization and the salt composition of the river water. Statistical data analysis was carried out using the Excel 2010 analysis package.

RESULTS

The water of the Ural River was slightly alkaline, and its pH was in the range of 8.01 to 8.20. The turbidity of the water varied from 0.7 to 8.52 mg L^{-1}. The total hardness of water varied from 5.2 to 5.5 meq L^{-1}, which characterizes it as medium hardness. Dry residue varied from 424 to 494 mg L^{-1}, and permanganate oxidizability from 2.6 to 8.0 mg L^{-1}. The total mineralization varied from 372 to 531 mg L^{-1} and characterizes the water as transitional from fresh to moderately fresh. According to the salt composition, the water was characterized as the magnesium/sodium bicarbonate/sulfate/chloride type (Table 2; Fig. 2).

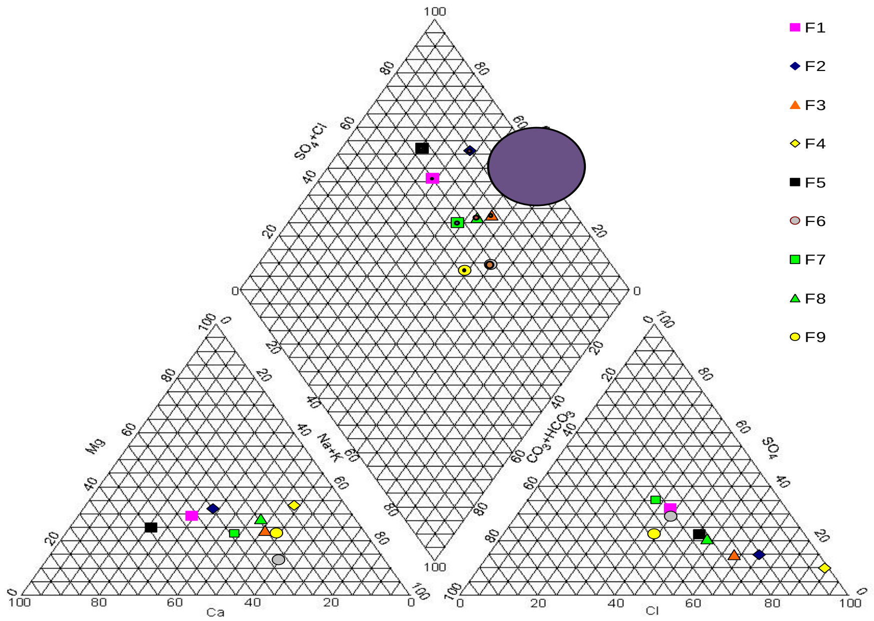

Fig. 2. Chemical characteristics of the water of the Ural River and the rivers of the right bank; Rivers including F1: Ural; F2: Bolshoy Uzen; F3: Maly Uzen; F4: Aschyuzek; F5: Kushum; F6: Chizha-2; F7: Chizha-1; F8: Mereke; F9: Bagyrlay.

The water of Bolshoy Uzen River was neutral, turbidity was 0.64 mg L^{-1}, the water was very hard in terms of total hardness, the dry residue was 999 mg L^{-1}, and permanganate oxidizability was 6.88 mg L^{-1}. According to the general mineralization, the water was slightly saline, and concerning to the salt composition, it belonged to the magnesium/sodium/calcium chloride type. The water of Maly Uzen River was of medium hardness and the dry residue was 812 mg L^{-1}. According to the general mineralization, the water was moderately fresh, andaccording to the salt composition, it belonged to the calcium/sodium chloride type. On the right bank of the Ural River, the water of the Kushum and Bagyrlay rivers was neutral, turbidity varied from 1.16 to 2.61 mg L^{-1}, in terms of total hardness it was hard (Kushum) or exhibited medium hardness (Bagyrlay), dry residue varied from 628 to 770 mg L^{-1}, and permanganate oxidizability varied from 7.60 to 13.8 mg L^{-1}. According to the general mineralization, the water was moderately fresh, and concerning to the salt composition, it belonged to the magnesium/calcium sulfate/chloride type (Kushum) and the sodium sulfate/chloride type (Bagyrlay; Fig. 2). The waters of the Chizha-1, Chizha-2, and Mereke rivers were characterized by slightly saline water in terms of total mineralization on the right bank. The water in these rivers ranged from neutral to slightly alkaline, turbidity is in the range of 2.96-7.08 mg L^{-1}, in terms of total hardness, water ranged from hard to very hard, dry residue was in the range of 1,142-1,712 mg L^{-1}, and permanganate oxidizability ranged from 8.16 to 11.44 mg L^{-1}. According to the general mineralization, the water in all rivers was slightly saline, and according to the salt composition it belonged to the calcium/sodium chloride/sulfate type (Chizha-1), calcium/sodium sulfate/chloride type (Chizha-2), or magnesium/sodium sulfate/chloride type (Mereke; Fig. 2). At the sampling point, the water of Aschyozek River was neutral, turbidity was 1.23 mg L^{-1}, very hard in terms of total hardness, the dry residue was 24,392 mg L^{-1}, and permanganate oxidizability was 11.84 mg L^{-1}. According to the general mineralization, the water was slightly salted, according to the salt composition, it belonged to the magnesium/sodium chloride type (Fig. 2). In the left bank, the water of the Utva River was characterized as neutral, turbidity was 1.10 mg L^{-1}, in terms of total hardness, it exhibited an average hardness, the dry residue was 376 mg L^{-1}, and permanganate oxidizability was 7.52 mg L^{-1}. According to the total mineralization, the water was fresh, according to the salt composition, it belonged to the calcium sulfate/bicarbonate type (Fig. 3). The waters of the Uzynankaty, Shiderti, Konysshagyl, Shieli, Aschy (Terekti district), Karabas, Shili, and

Kuagash rivers were characterized by slightly saline water in terms of total mineralization in the left bank. The water in these rivers ranged from neutral to slightly alkaline, turbidity was in the range of 0.7-18.1 mg L^{-1}, in terms of total hardness, water ranged from hard to very hard, dry residue was in the limits of 1,110-2,523 mg L^{-1}, and permanganate oxidizability equaled 6.64-18.16 mg L^{-1}. By salt composition, it belonged to the magnesium/calcium/sodium sulfate/chloride type (Uzynankaty, Shieli), calcium/sodium chloride/sulfate type (Shiderti, Kuagash), calcium/sodium chloride type (Konysshagyl), magnesium/sodium chloride type (Aschy, Shili), or calcium/magnesium/sodium chloride/sulfate type (Karabas; Fig. 3).

Table 2. Hydrochemical parameters of the studied water samples in the autumn period of 2018-2020.

Sampling location	pH	Turbidity (mg L^{-1})	NO_2^- (mg L^{-1})	NO_3^- (mg L^{-1})	NH_4^+ (mg L^{-1})	Overall hardness (meq L^{-1})	Dry residue (mg L^{-1})	Permanganate oxidizability (mg L^{-1})	Total mineralization (mg L^{-1})
Ural River	7.38	0.7	0.002	insoluble residue	0.8	5.5	494	8.0	531
Bolshoy Uzen River	7.45	0.64	0.042	insoluble residue	insoluble residue	12.5	999	6.88	1,041
Maly Uzen River	-	-	insoluble residue	8.56	-	6.8	812	-	876
Kushum River	7.38	2.61	0.002	insoluble residue	0.3	11.0	770	7.60	779
Bagyrlay River	7.13	1.16	0.039	0.1	0.4	5.3	628	13.8	655
Chizha-2 River	-	-	insoluble residue	insoluble residue	-	11.3	1,712	-	1,921
Chizha-1 River	7.26	2.96	0.073	insoluble residue	insoluble residue	10.4	1,142	8.16	1,074
Mereke River	7.61	7.08	0.086	insoluble residue	0.1	13.0	1,402	11.44	1,388
Aschyuzek River	7.43	1.23	0.017	0.6	insoluble residue	210.0	24,392	11.84	25,146
Utva River	7.1	1.10	0.002	0.1	0.1	6.2	376	7.52	420.1
Uzynankaty River	7.43	2.20	0.073	insoluble residue	0.2	15.0	1,777	9.44	1,725
Shiderti River	7.02	18.10	0.13	0.1	0.7	10.0	1,110	14.0	1,144
Konysshagyl River	7.73	0.70	0.089	insoluble residue	insoluble residue	12.5	1,450	7.2	1,382
Shieli River	7.31	1.16	0.078	0.1	0.1	11.5	1,250	6.64	1,172
Aschy river	7.85	2.84	0.035	insoluble residue	0.8	19.0	2,227	9.4	2,296
Karabas River	8.06	6.55	0.062	0.1	0.3	12.5	1,147	12.3	1,114
Shili River	7.29	1.74	0.014	0.1	1.1	17.5	2,523	13.28	2,294
Kuagash River	7.66	4.47	0.037	0.4	1.8	15.6	1,956	18.16	1,781
Olenty River	7.55	3.65	0.097	0.1	1.1	75.0	6,384	13.12	6,683
Aschy River (Chingirlau district)	7.81	2.49	0.082	0.1	0.3	70.0	3,416	13.84	3,693
Aschysai River	7.6	4.41	0.035	0.4	5.4	80.0	6,680	14.0	6,362
MPC according to SanPiN* No. 209 dated 16.03.2015	within 6-9	no more than 1.5	3.3	45.0	2.0	not more than 7.0	no more than 1,000	not more than 5.0	not normal

Note: MPC according to SanPiN*: maximum permissible concentration according to the Sanitary Rules and Regulations.

On the left bank, in terms of total mineralization, the water of the Olenty, Ascha (Chingirlau district), and Aschysai hollow were characterized by highly saline water. The water in these rivers was slightly alkaline, turbidity was in the range of 2.49-4. mg L^{-1}, the water was very hard in terms of total hardness, dry residue varied from 3,416 to 6,680 mg L^{-1}, and permanganate oxidizability ranged from 13.12 to 14.0 mg L^{-1}. According to the general mineralization, the water was strongly saline, according to the salt composition, it belonged to the magnesium/calcium/sodium sulfate/chloride type, magnesium/sodium chloride type (Ash), or sodium/magnesium/calcium chloride type (Ash).

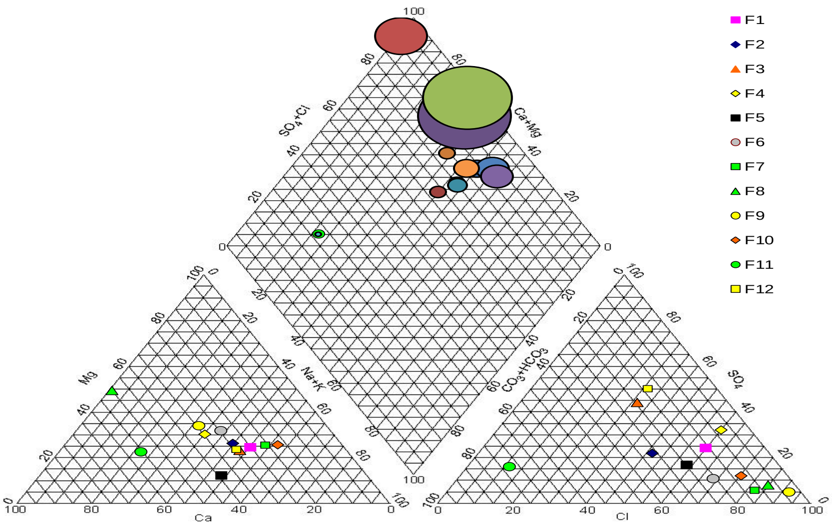

Fig. 3. Chemical characteristics of the water of the rivers on the left bank; Rivers: F1: Uzynankaty; F2: Shieli; F3: Shiderti; F4: Olenty; F5: Konysshagyl; F6: Karabas; F7: Aschy (Kamystykol); F8: Aschy (Chingirlau); F9: Aschysai; F10: Shili; F11: Utva; F12: Kuagash.

DISCUSSION

Concerning to the water sources for pastures, it is important to have information about their quality. Hydrochemical analysis of water samples makes it possible to assess the suitability of sources for watering pasture lands. Pastures that have a vast plain with abundant rainfall and a humid climate are suitable for large-scale livestock development [18]. Therefore, the analysis was carried out in the autumn period, as the most unfavorable one, since a drop in the volume of water in the springs in the summer/autumn period leads to an increase in mineralization. In research, by creating an integration model, the possibility of sustainable management of surface and groundwater is considered [19]. The interaction of forced convection caused by relief and free convection caused by salinity is investigated [20]. On the right bank of the Ural River, the density of rivers and channels was quite high, the water in these sources was suitable for watering the livestock. The western part of the region was characterized by a weak concentration of rivers and channels. The water in the few rivers of this part of the region was highly mineralized and unsuitable for livestock. On the left bank of the Ural River, watering of pastures with irrigation channels was not carried out, since the few channels available were inactive. Despite the density of rivers in the summer, shallow reservoirs and watercourses dried up. It was not possible to base the water supply on surface water sources due to the insignificant summer drought flow. In this area, the irrigation of pastures was carried out by groundwater. The expansion of the area of irrigation of pastures in the territory of the region was possible due to the maximum water filling of numerous branches in the irrigation system channels based on the Ural, Bolshoy Uzen, and Maly Uzen rivers. The fresh waters of the Ural River with a magnesium/sodium bicarbonate/sulfate/chloride composition filling the Ural-Kushum irrigation system met the sanitary requirements for water intended for livestock. Weak mineralization of water persisted for a considerable length of channels, including the most remote branches in the form of channels Ushkimpir, Atpay, and Unege located in a semi-desert zone with saline soil complexes. The Ural River also provided water to the Taipako-Aznabai irrigation system located on the left bank. The water in the Bolshoy Uzen, which provides the Bolshoy Uzen irrigation system, and the Malyy Uzen, which fills the Maloy Uzen irrigation system, also met the requirements for the irrigation water quality. By a sufficiently high level of average annual runoff volumes along the largest rivers flowing in the region, issues of ensuring irrigation of pastures were constrained by a decrease in the capacity of irrigation system channels.

CONCLUSION

In this study, an analysis of hydrochemical indicators of water sources used for watering pastures of the West Kazakhstan region was carried out, which will help to pay attention to environmental problems of water quality affecting the development of animal husbandry in Kazakhstan. Natural surface freshwater sources play an important role in the watering of pasture lands in the region. The water of most of the studied rivers meets the requirements of sanitary rules and regulations. This study was limited to the main rivers of the West Kazakhstan region. Further research may be aimed at developing measures to improve water quality in this area and analyzing the hydrochemical properties of water in the arid and semi-arid climate of other regions of Kazakhstan.

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REFERENCES

Absametov, MK & Murtazin, EZh 2021, The state and prospects of groundwater use for agriculture in Kazakhstan. In: Collection of the International Scientific and Practical Conference "Water Resources Management in the Context of Globalization" Dedicated to the 105th Anniversary of the Birth of Professor Tazhibaev L.E. Kazakh National Agrarian Research University, Almaty, pp. 105-110.

Alwin, A, Cahyono, T, Sya'ban, A & Dahlia, S 2023, Ground water quality in Ciracas sub-district, East Jakarta, Indonesia. *Caspian Journal of Environmental Sciences*, 21: 349-354.

Ansari Renani, HR, Rischkowsky, B, Mueller, JP, Momen, SMS & Moradi, S 2013, Nomadic pastoralism in Southern Iran. Pastoralism: Research, *Policy and Practice*, 3: 11, https://doi.org/10.1186/2041-7136-3-11.

Dinka, MO, Loiskandl, W & Ndambuki, JM 2015, Hydrochemical characterization of various surface water and groundwater resources available in Matahara areas, Fantalle Woreda of Oromiya region. *Journal of Hydrology: Regional Studies*, 3: 444-456, https://dx.doi.org/10.1016/j.ejrh.2015.02.007.

Galsa, A, Toth, A, Szijarto, M, Pedretti, D & Madl Szonyi, J 2022, Interaction of basin-scale topography- and salinity-driven groundwater flow in synthetic and real hydrogeological systems. *Journal of Hydrology*, 609: 127695, https:/doi.org/10.1016/j.jhydrol.2022.127695.

Gartsiyanova, K, Gencev, S, Kitev, A 2023, Transboundary river water quality as a core indicator for sustainable environmental development in Europe: A case study between republics of Bulgaria and Serbia. *Caspian Journal of Environmental Sciences,* 21: 291-300.

Halimani, T, Marandure, T, Chikwanha, OC, Molotsi, AH, Abiodun, BJ, Dzama, K & Mapive, C 2021, Smallholder sheep farmers' perceived impact of water scarcity in the dry ecozones of South Africa: Determinants and response strategies. *Climate Risk Management*, 34: 100369. https://doi.org/10.1016/j.crm.2021.100369.

Hapke, HJ 2000, Effect of drinking water on animals' health: toxicologic health risks. Deutsche Tierärztliche Wochenschrift, 107: 335-336.

Jiang, Q, Wang, B, Jin, G, Tang, H, Xu, J & Zhu, X 2023, The response patterns of riverbank to the components carried by different pollution sources in the river: Experiments and models. *Journal of Hydrology*, 617: 128903. https:/doi.org/10.1016/j.jhydrol.2022.128903.

Khan, MYA & Tian, F 2018, Understanding the potential sources and environmental impacts of dissolved and suspended organic carbon in the diversified Ramganga River, Ganges Basin, India. Proceedings of the International Association of Hydrological Sciences, 379: 61-66, http://dx.doi.org/10.5194/piahs-379-61-2018.

Khan, MYA, Gani, KM & Chakrapani, GJ 2017, Spatial and temporal variations of physicochemical and heavy metal pollution in Ramganga River – A tributary of River Ganges, India. *Environmental Earth Sciences*, 76: 231, https://link.springer.com/article/10.1007%2Fs12665-017-6547-3.

Kolodin, MV 1981, Water and Deserts. Mysl, Moscow, Russia.

Kozhanov, NN, Mirdadaev, MS, Ustabaev, TS, Ismailov, BD & Kabyl, TM 2021, Some issues of watering of pastures in Kazakhstan. In: AR, Khalikov, (ed.) Actual Problems of Science and Technology. Innovatics. Collection of scientific articles based on the materials of the VI International Scientific and Practical Conference. Nauchno-izdatel'skiy tsentr "Vestnik nauki", Ufa, 49-58.

Marin Comitre, U, Schnabel, S, Barrena Gonzalez, J, Pulido Fernandez, M 2022, Pond water quality for livestock in Southwestern Iberian rangelands. *Rangeland Ecology & Management*, 83: 31-40. https://doi.org/10.1016/j.rama.2022.03.001.

Ongayev, M, Denizbayev, S, Umbetkaliyev, N, Yesmagulova, B, Shadyarov, T & Ozhanov, G 2022, The zonality of underground water supply sources for pastures in the West Kazakhstan region. *Journal of Ecological Engineering*, 23: 56-65, https://doi.org/10.12911/22998993/150612.

Ongayev, M, Sultanova, Z, Denizbayev, S, Ozhanov, G & Abisheva, S 2019, Engineering and process infrastructure of the agro-industrial complex. *International Journal of Emerging Trends in Engineering Research*, 7: 879-885. https://doi.org/10.30534/ijeter/2019/257122019.

Rajanayaka, C, Weir, J, Kerr, T & Thomas, J 2021, Sustainable water resource management using surface-groundwater modeling: Motueka-Riwaka Plains, New Zealand. *Watershed Ecology and the Environment*, 3: 38-56, https://doi.org/10.1016/j.wsee.2021.08.001.

Sharma, MK, Kumar, P, Prajapati, P, Bhanot, K, Wadhwa, U, Tomar, G, Goyal, R, Prasad, B & Sharma, R 2022, Study of hydrochemical and geochemical characteristics and solute fluxes in Upper Ganga Basin, India. *Journal of Asian Earth Sciences*, 8: 100108, https://doi.org/10.1016/j.jaesx.2022.100108.

Stets, EG, Lee, CJ, Lytle, DA & Schock, MR 2018, Increasing chloride in rivers of the conterminous U.S. and linkages to potential corrosivity and lead action level exceedances in drinking water. *Science of the Total Environment*, 613-614: 1498-1509, https://doi.org/10.1016/j.scitotenv.2017.07.119.

Tugjamba, N, Walkerden, G & Miller, F 2021, Climate change impacts on nomadic herders' livelihoods and pastureland ecosystems: A case study from Northeast Mongolia. *Regional Environmental Change*, 21: 105, https://doi.org/10.1007/s10113-021-01829-4.

Valente Campos, S, Spry, DJ, Palhares, JCP, Jakomin Rudez, LM & Umbuzeiro, GDA 2019, Critical issues and alternatives for the establishment of chemical water quality criteria for livestock. *Regulatory Toxicology and Pharmacology*, 104: 108-114, https://doi.org/10.1016/j.yrtph.2019.03.003.

Wang, X, Zhu, J, Cao, L & Wang, S 2020, The status of foreign advanced pasture water supply technology. IOP Conference Series: Earth and Environmental Science, 525: 012063, https://doi.org/10.1088/1755-1315/525/1/012063.

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