JEE Journal of Ecological Engineering

Journal of Ecological Engineering 2022, 23(8), 56–65
https://doi.org/10.12911/22998993/150612
ISSN 2299–8993, License CC-BY 4.0

Received: 2022.05.11
Accepted: 2022.06.17
Published: 2022.07.01

The Zonality of Underground Water Supply Sources for Pastures in the West Kazakhstan Region

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ABSTRACT

The West Kazakhstan region of the Republic of Kazakhstan occupies an area equal to 151,339 km^2. In the land structure, 69.7% of the area is occupied by agricultural land. The region has great prospects for the development of the livestock industry. However, uneven territorial availability of water resources is a limiting factor in increasing the amount of livestock in the region. The purpose of the study is to monitor underground water sources in the West Kazakhstan region of the Republic of Kazakhstan to assess the zonality of their placement. The boundaries of natural and climatic zones on the territory of the region were laid over the publicly available cartographic materials on the hydrological data of the distribution of groundwater. The water source monitoring was carried out by examining their actual condition in specific geographical locations, including using remote sensing methods, with a further determination of quantitative and qualitative parameters. The paper considers the state and problems of water supply at the pastures in the natural and climatic zones of the West Kazakhstan region. The region is characterized by the use of groundwater in the water supply of pasture lands. Underground springs have a certain zonality in their location, manifest themselves at different depths corresponding to different geological horizons, and differ in a wide variation of water mineralization. In the dry steppe zone, it is recommended to use the aquiferous mid-upper quaternary alluvial, aquiferous upper Pliocene Akchagyl, and aquiferous upper cretaceous Maastricht horizons. The water sources used have depths of up to 120 meters, and the mineralization varies from 0.2 to 9.1 g/dm^3. In the semi-desert zone, the upper-quaternary aquiferous marine Khvalynsky and the lower-middle-quaternary aquiferous marine Baku-Khazar horizons are recommended. The water sources used have depths of up to 90 meters, and the mineralization varies from 0.2 to 11.8 g/dm^3. The semi-desert zone is characterized by the use of springs with depths up to 80 meters. The mineralization of water in the permeable modern Aeolian horizon is more often low (0.11–0.9 g/dm^3) and rarely brackish (1.1–9.36 g/dm^3).

Keywords: West Kazakhstan region, distant-pasture animal husbandry, pasture, water availability, water supply, shaft wells, cylindrical boreholes.

INTRODUCTION

Successful animal husbandry is closely associated with the optimal water supply of livestock. For livestock water supply, water is obtained from wells, as well as from various sources, such as rivers, pipes, springs, rain, and small dams. Farm animals have access to water directly on pastures, or they can be supplied with water at a certain distance from the pasture [Ansari-Renani et al. 2013]. In the arid regions of the globe, there is an acute shortage of freshwater supplies. Freshwater is a limiting resource on these lands, and groundwater withdrawal significantly exceeds replenishment [Glazer and Likens, 2012]. The perceptions and practices of nomadic pastoralists, supported by meteorological data, show that climate change has affected the provision of key ecosystem services, especially water availability, quality, and availability of pastures. Many shepherds now move three to four times a year due to water supply problems [Tugjamba et al. 2021].

Globally, small farmers in arid ecozones are most vulnerable to the problem of water scarcity, mainly due to the presence of numerous environmental stress factors, lack of adaptability, poor management, and little investment in the management of water resources or their absence. Most farmers, moving between water sources, used non-household water sources, collected rainwater in storage tanks, and drilled boreholes or wells to increase the availability of drinking water for their sheep [Halimani et al., 2021]. Brackish or salty groundwater in an arid environment contributes to the development and stability of internal freshwater lenses. Such lenses serve as alternative sources of freshwater for drinking, animal husbandry, and micro-oasis agriculture in several arid and semi-arid regions. Small freshwater lenses in these areas are sufficient for a short period [Rotz, 2020]. In low-water and waterless territories, one of the ways to supply animals with water is to collect meltwater and rainwater from the surrounding area [Moritz et al., 2013].

In Australia, half of the livestock production is accounted for by livestock on pastures. The development of pasture livestock depends mainly on the water supply of pastures. In Australia, pastures are common in the north and south, where the vast plain has abundant rainfall and a humid climate that is suitable for the large-scale development of animal husbandry. Australian pastures are widespread, large-scale, and highly automated. Many pastures in Australia use natural relief differences for the construction of reservoirs at high altitudes, where water is supplied through a pipeline to water terminals, which are controlled by automatic waterers for livestock. On Dutch pastures, wind pumps are used to fill the reservoir with wind energy. The tank is installed on a raised platform, and water automatically flows out of the tank. It can supply water to pastures in different directions simultaneously [Wang et al., 2020].

In global practice, considerable attention is paid to the use of irrigated pasture lands [Siebert et al., 2015]. Remote sensing (RS) methods are widely used to study the relationship between the productivity of pasture lands depending on their water supply [Chen and Wu, 2019; Gao et al., 2019; Zhang et al., 2019].

In studies in India, to combat groundwater losses, the effectiveness of reservoir replenishment was directly studied, especially in the complex fractured hydrogeology of the peninsula [Brauns et al., 2022]. By creating an integration model, the possibility of sustainable management of surface and groundwater is considered [Rajanayaka et al., 2021]. The interaction of forced convection due to relief and free convection due to salinity was studied in a real hydrological section in Hungary [Galsa et al., 2022]. The modeling of groundwater depletion was considered concerning the territory of Great Britain [Marchant and Bloomfield, 2018]. The development of a conceptual model of groundwater flow using combined hydrogeological, hydrochemical, and isotopic approaches was carried out for the territory of southern Benin [Kpegli et al., 2018].

Research and analysis of data on groundwater levels with gaps involve the creation of a time forecast model per groundwater levels for various regimes and types of groundwater [Tymkiv and Kasiyanchuk, 2019]. For groundwater in the territory of Kosovo, the groundwater level was monitored and a hydrogeological computer model designed to determine the source protection zones was created [Osmanaj et al., 2021]. Data on the assessment and mapping of groundwater quality for water supply and drinking in the semi-arid region of Algeria show the characteristics of water quality indices based on hydrochemical analysis data [Azlaoui et al., 2021]. There is a publication on the problems of groundwater zoning by various indicators [Davybida et al., 2018].

In scientific publications devoted to the problems of water supply for pasture lands in the West Kazakhstan region of the Republic of Kazakhstan, we analyzed the ratio of pasture lands and livestock by natural and climatic zones of the West Kazakhstan region [Ongayev et al., 2019]. The paper analyzes the potential of pasture lands in various natural landscape zones of the territory of the West Kazakhstan region and the degree of their workload. It presents the results of monitoring the water supply sources for pastures, hydrological indicators of surface water sources, and the degree of use of underground water sources within the dry-steppe and semi-desert zones of the West Kazakhstan region. The results of laboratory hydrochemical analyses of water samples of water supply sources of dislocations of distant-pasture animal husbandry are given.

In another paper, based on the monitoring of underground water supply sources of pastures within various zones of the region, their structural elements and technical condition are analyzed, and quantitative and qualitative parameters are presented [Ongayev et al., 2021].

These papers characterize the degree of water supply for the pasture lands of the region, demonstrating the problems related to the equipment and technical condition of watering sources.

This paper describes the conditions for the formation of the groundwater regime and the zonality of the distribution of groundwater in the region. The similarity with the above papers lies in the objects of the study and the quality indicators of water in the water supply sources in a certain area. However, in this article, we are talking about the formation of groundwater on certain geological aquifers and the zonality of their location related to natural and climatic zones in the territory of the region. The presence and indicators of water quality are confirmed by monitoring data and laboratory studies.

To date, there are 187 million hectares of pastures in Kazakhstan, of which about 81 million hectares are used, while 26 million hectares of used pastures have been degraded (these are mainly pastures located near settlements). The territory of the semi-desert zone of Kazakhstan is represented by a combination of broken and fixed sands, intermountain and swale lowlands occupied by takyrs, salt marshes, or grass and meadow associations. Here pastures occupy about 80% of the area of the zone [Nasiyev et al., 2015]. The water supply sources of pasture lands in West Kazakhstan are represented by natural water supply sources (rivers, lakes, gullies) and artificial sources in the form of irrigation and water supply channels, ponds, boreholes, and shaft wells.

Surface water resources in the locations of pasture livestock are very limited since the conditions for the formation of surface runoff are unfavorable here.

The problems of water supply for the pastures are most acute in the semi-desert zone, where a significant area of pasture land is used inefficiently due to lack of water. The problem of water supply for hayfields and pastures also continues to be acute in the dry-steppe zone of the region. In the conditions of the acutely arid climate of the region, water management measures are one of the decisive factors contributing to the further development of agriculture, its sustainability, and intensification.

The purpose of the study is to monitor underground sources of water supply in the West Kazakhstan region of the Republic of Kazakhstan to assess the zonality of their placement.

MATERIALS AND METHODS

These studies relate to the field of agriculture and water management and were conducted in 2020–2021.

The entire territory of the West Kazakhstan region belongs to the Caspian lowland in orographic terms. According to the climatic factor, the West Kazakhstan region belongs to the arid zone, where evaporation prevails over the amount of precipitation. West Kazakhstan is distinguished by a wide variety of natural landscapes.

The dry-steppe zone is located in two geomorphological areas: the Podural plateau and the Common Syrt. They are a steep-undulating plain, divided by river valleys into separate elevations (syrts). The absolute heights of these regions are in the range of 80–200 m, the maximum height equaling 250–260 m. This zone is the most moisture-rich area in the region. However, even here the humidification conditions are very tough and in most years there is not enough moisture. The annual precipitation is 280–320 mm, and 125–135 mm falls during the warm period. Stable snow cover usually lasts 120–130 days, and its height reaches 25–30 cm, water reserves in the snow equaling 75–95 mm.

The semi-desert zone occupies the pre-syrtic ledge and the northern part of the Caspian lowland. The absolute height here ranges from 50 to 100 m, the relief is flat, divided by valleys of small rivers, oriented strictly from north to south, into several watershed areas. The zone is arider than the dry-steppe zone (the geothermal coefficient (GTC) = 0.5–0.3). The duration of the period with a temperature above 10°C is 155–160 days. During this period, 100–130 mm of precipitation falls, with 240–260 mm falling per year. The frost-free period lasts for 145–155 days. The duration of the period with a stable snow cover equals 110–120 days, the average height of the snow cover is 20–25 cm, and the water reserves in the snow are 75–90 mm.

In the desert zone, the GTC ranges from 0.3 to 0.2. During the period with temperatures above 10°C, 100–120 mm of precipitation falls, with from 190 to 230 mm during the year. The frost-free period lasts for 160–180 days. The duration of the period with stable snow cover is 80–105 days, the average of the greatest decadal heights of snow cover is 10–15 cm, and the water reserves in the snow equal 40–50 mm. In the extreme south of the zone, the snow cover at a low altitude stays for 1.5–2 months. In this zone, summer precipitation is very unstable. Its amount varies dramatically over the years, and often no more than 5 mm of precipitation falls for two or three months in a row.

The considerable extent of the territory of the region from north to south has led to a consistent change of natural and geographical zones with varying degrees of availability of surface water resources.

In the dry-steppe and northern part of the semi-desert zone, the use of open natural and artificial water sources prevails for the water supply of pasture lands with distant-pasture animal husbandry, and in the rest of the territory, groundwater is mainly used.

The southwestern and northwestern parts of the semi-desert zone are characterized by a weak concentration of rivers and channels, which is associated with the natural zonality of the territories. About half of the territory of this part of the region needs water supply for pasture lands.

On the left bank of the Urals, despite the density of rivers, in the summer, small reservoirs and watercourses dry up. Due to the insignificant summer inter-soil runoff, there is no possibility to base the water supply on surface water sources.

Considerable diversity is also evident in the hydrogeological characteristics of the underground water sources under study. As a consequence, one can observe zoning in the placement of water supply sources of pasture lands of the West Kazakhstan region.

The object of the study was the underground water supply sources at the locations of the distant-pasture animal husbandry in the dry-steppe, semi-desert, and desert zones of the West Kazakhstan region of the Republic of Kazakhstan.

The study consisted of three main stages: field observation of water supply sources, search for cartographic material, and obtaining satellite images of objects, followed by an analysis of the data obtained and generalization of materials.

In the course of field studies, we monitored the water sources by examining their actual condition in specific geographical locations, including using RS methods, with a further determination of quantitative and qualitative parameters. When examining the sources of water supply, the GPS coordinates of the end wall of the intake structure were recorded, the general view was photographed, and the source parameters were determined, such as electrical supply, the flow rate of the shaft well (borehole), the depth of the well, statistical and dynamic water level, the diameter of the casing of the well, water mineralization, the technical condition of the watering point, etc.

Sampling was carried out according to the regulatory document “Nature protection. Hydrosphere. Devices and devices for the selection of primary processing and storage of natural water samples”, regulated in the Republic of Kazakhstan for sampling water from water sources. Water samples were taken in glass bottles. If the delivery of samples to the laboratory was delayed for more than 24 hours, the water samples were preserved. A total of 809 water samples were taken, including 462 samples from wells and 347 samples from boreholes.

Chemical analysis of water samples was carried out in the accredited testing center of the Science Department of the Zhangir Khan West Kazakhstan Agrarian Technical University (ZKATU) and the laboratory of the Zhaiykhydrogeology LLP.

The hydrochemical analysis of water was carried out by chemical and physicochemical methods, according to the methodological and regulatory documents approved by the Committee for Standardization, Metrology, and Certification of the Republic of Kazakhstan, including the determination of total hardness, calcium and magnesium according to the regulations “Stationary distillation desalination plants. Methods of chemical analysis of saltwater”. The dry residue content was analyzed according to the regulation “Method for determining the dry residue content”.

The dry residue content was determined by the weight method. The value of the dry residue characterizes the total content of non-volatile mineral and partially organic compounds dissolved in water. Determination of the dry residue without the addition of soda was carried out on the day of sampling. This method of determining the dry residue demonstrated somewhat overestimated results due to the hydrolysis and hygroscopicity of magnesium and calcium chlorides and the difficult recoil of crystallization water with calcium and magnesium sulfates. These disadvantages were eliminated by adding chemically pure sodium carbonate to the evaporated water. After this, chlorides, calcium, and magnesium sulfates turned into anhydrous carbonates, and from sodium salts, only sodium sulfate had crystallization water, but it was completely removed by drying the dry residue at 150–180°C.

Cartographic methods made it possible to create a map with sources of water supply. In hydrogeology, the zoning of territories was carried out according to the conditions of the formation of the groundwater regime. The conditions for the formation of groundwater in the territory of the West Kazakhstan region were determined by its belonging to the North Caspian Artesian basin of the II order of the northern part of the Caspian Artesian basin of the I order.

The actual depth of occurrence and mineralization of groundwater at the studied water sources served as a basic classification feature for the zoning of underground sources of water supply in the West Kazakhstan region.

RESULTS AND DISCUSSION

The studied territory of the West Kazakhstan region completely belongs to the province of groundwater with stable seasonal freezing of the aeration zone (II). The upper part of the aeration zone freezes to a depth of 0.6–1.0 m in winter, which determines the stable absence of groundwater supply in winter. Groundwater supply is seasonal and happens mainly in the spring due to the infiltration of snow-covered waters. During the inter-soil (summer-autumn) period, groundwater is consumed by evaporation and outflow in the transit or unloading area.

According to the conditions of formation of the groundwater regime, the dry-steppe zone belongs to zone B with insufficient water feed, where the moisture coefficient is 0.4–0.5 and is located in a poorly drained area (II-B-1), represented by the southern spurs of the Common Syrt and the western slopes of the Trans-Ural Syrts and occupying the highest hypsometric marks (Figure 1).

Semi-desert and desert zones are combined with zone B with poor water feed, where the moisture coefficient is 0.2–0.4, and belong to an almost drainless area (II-B-1). The almost drainless area is a flat, slightly undulating marine accumulative plain. Geomorphologically, this area is the Caspian Lowland, which is characterized by slight slopes of the groundwater surface (1:10,000 or less), where vertical movement prevails over horizontal movement in the upper part of the groundwater flow. In this regard, within the studied territory,

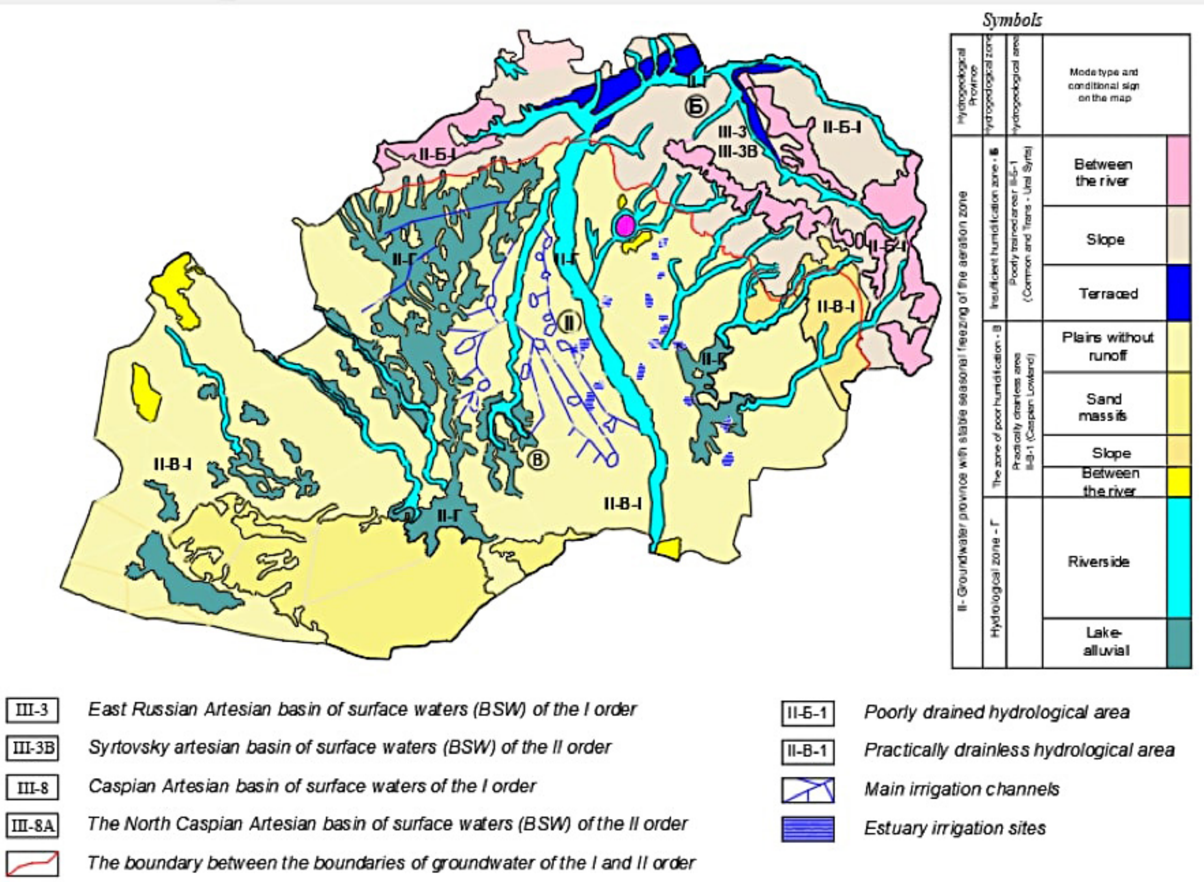

Figure 1. Map of the formation of the groundwater regime

fresh groundwater is formed in the form of lenses where there are favorable conditions for their infiltration feeding (small estuaries, etc.).

In the dry-steppe zone, there are territories of the Borili, Bayterek, and Shyngyrlau districts, most of the Terekti and Taskala districts, and the middle part of the Syrym district. Here, the most promising aquifers are the aquiferous mid-upper quaternary alluvial, aquiferous upper Pliocene Akchagyl, and aquiferous upper cretaceous Maastricht horizons (Figure 2).

In the dry-steppe zone, in the water supply sources of pastures, the water of shaft wells from the mineralization point of view is mainly fresh (0.12–1.0 g/l) or brackish (1.1–2.02 g/l), suitable for livestock water supply (Table 1). On some farms, there are wells with salt water (18.5 g/l). The flow rates of these wells are sufficient for livestock water supply (0.18–2.2 l/s). The depth of the shaft wells is 4.5–19 m. Farms also use boreholes for livestock water supply.

The mineralization of water in cylindrical wells varies from fresh (0.13–1.0 g/l) to brackish (1.1–9.1 g/l) water and is suitable for livestock. The flow rates of cylindrical wells (0.13–4.0 l/s) satisfy the need of farms for livestock water supply. The depth of the boreholes falls in the range of 15.0–120.0 m.

Vast territories of Akzhaik, Zhanybek, Zhanakala, and Karatobe districts, significant parts of the Taskala and Terekti districts, and the central and southern parts of the Syrym district are located in the semi-desert zone. The most promising aquifers are the upper-quaternary marine Khvalynsky and the lower-middle-quaternary marine Baku-Khazar aquifers.

In the vast semi-desert zone in the points of distant-pasture animal husbandry, the water in shaft wells from the mineralization point of view is mainly fresh (0.13–1.0 g/l) or brackish (1.1–8.7 g/l), suitable for livestock water supply. On some farms, there are wells with salt water (mineralization equaling 10.5–16.5 g/l). Wells with a low flow rate are available on some farms (0.01–0.09 l/s). Most farms have wells with a sufficient flow rate for livestock water supply (0.16–2.09 l/s), which satisfies the need of farms for the watering of farm animals. The depth of the shaft wells is 2.9–21.6 m.

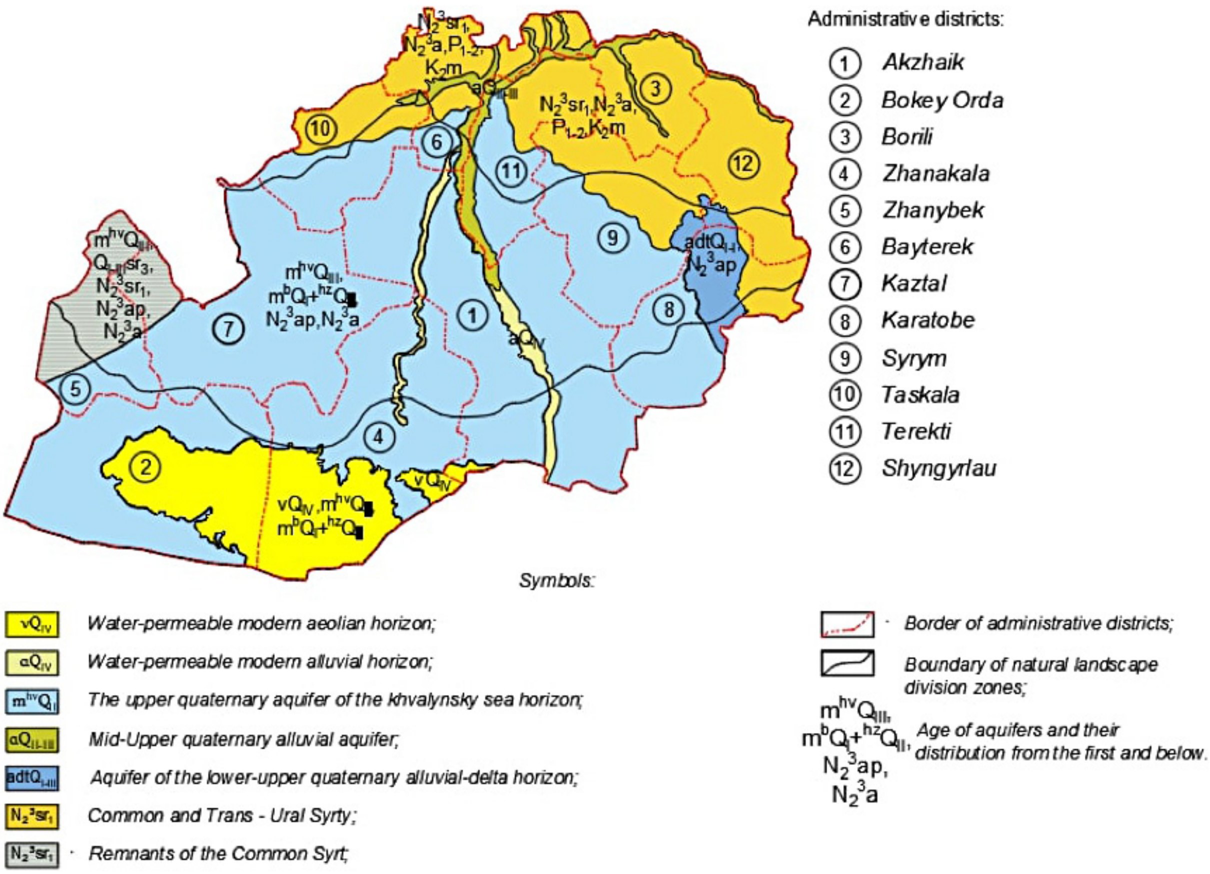

Figure 2. Zoning of the territory of the West Kazakhstan region according to hydrogeological indicators of water sources

Table 1. Information about wells and boreholes for livestock water supply by districts of the West Kazakhstan region

Zone	Districts	Wells		Boreholes	
		Depth, m	Water mineralization, g/dm³	Depth, m	Water mineralization, g/dm³
Dry steppe	Borili	5.5–6.5	0.89–10.17	15–120	0.5–9.1
	Shyngyrlau	4.3–5.0	0.46–2.39	25–76	0.35–6.8
	Bayterek	19.0	0.5	12–80	0.7–3.6
	Terekti	4.5–10	0.17–18.5	20.0–91.0	0.3–6.3
	Taskala	8.1	0.3	8.0–64.0	0.2–6.2
	Syrym	5.6–9.9	0.2–1.8	20.5–60	0.3–7.1
Semi-desert	Taskala	4–12	0.8–2.4	38–45	0.8
	Terekti	-	-	22	1.76
	Syrym	3.8–9.0	0.3–9.8	-	-
	Akzhaik	3.9–13.5	0.16–11.85	10–38	0.6–9.3
	Zhanybek	5.0–15.5	0.48–8.77	15–80	0.5–11.5
	Kaztal	4.0–21.58	0.1–10.51	20–93	0.4–27.4
	Karatobe	2.9–17.0	0.34–16.59	15–50	0.2–11.84
Desert	Bokey Orda	1.8–22.5	0.16–9.36	12–80	0.22–19.9
	Zhanakala	2.7–10	0.17–9.9	20	1.13

Farms also use boreholes for livestock water supply, where the flow rates (0.2–4.0 l/s) and mineralization (0.16–9.8 g/l) are sufficient and suitable for these purposes. Some farms are experiencing water shortages due to the salinity of borehole water (11.0–41.3 g/l) unsuitable for livestock. The depth of the boreholes is in the range of 15.0–93.0 m.

In the desert zone, in the water supply sources for pastures, from the mineralization point of view the water of shaft wells is mainly fresh (0.1–1.0 g/l) or brackish (1.1–10.0 g/l), suitable for livestock water supply. On some farms, there are wells with salt water (10.5 g/l). Wells with a low flow rate are available on some farms (0.02–0.09 l/s). On most farms, there are wells with a sufficient flow rate for livestock water supply. The depth of the shaft wells equals 1.8–22.5 m. Farms also use boreholes for livestock water supply, where the flow rates (0.4–2.6 l/s) and mineralization (0.16–8.7 g/l) are sufficient and suitable for these purposes. On some farms, there are boreholes with salt water (11.6–19.9 g/l). The depth of boreholes falls within 12.0–80.0 m.

The largest share of the desert zone is occupied by the territory of the Bokey Orda district. Here, the most promising aquifer is the permeable modern Aeolian horizon. The depth of the surveyed 297 wells varies between 1.8–26 m and the depth of 46 boreholes varies from 12 to 80 m. The flow rates of wells (0.02–1.8 dm^3/s) and boreholes (0.4–2.6 dm^3/s) in the permeable modern Aeolian horizon are mainly sufficient for the organization of watering points. The mineralization of water in the permeable modern Aeolian horizon is more often low with fresh (0.11–0.9 g/dm^3) and brackish (1.1–9.36 g/dm^3), water generally promising for the water supply of various livestock types. In the permeable modern Aeolian horizon, drilling of shaft wells can be recommended for water supply.

Similar zoning of groundwater, using geographical information systems (GIS) and RS methods to identify and map zones of groundwater potential using indirect data, was carried out for the Magech River basin (Ethiopia). Identified and systematized maps of groundwater potential provide information about the location of productive boreholes in the studied area [Berhanu and Hatiye, 2020]. All thematic maps or layers with groundwater potential were prepared in a reclassified raster format.

The final map indicates a zone of high groundwater potential, located mainly near Lake Tana (Dembia Plain). The zone of high groundwater potential covers an area of about 124 km^2 (18% of the total area of the Magech water collection area). The zone of moderate groundwater potential is mainly located in the northwestern part of the Magech watershed, which covers part of the Dembiya plateau, the districts of the city of Gondar and Lay Armachiho. Areas with low groundwater potential are located along the northeastern part of the studied territory, which covers the areas of Lay Armachiho, Woghera, and Gondar Zuria.

Confirmation of the results was carried out according to the inventory of groundwater sources, including boreholes, springs, and manually dug wells [Berhanu and Hatiye, 2020]. In general, the cross-validation analysis showed that 78.5 of the groundwater inventory data (boreholes, manually dug wells, and springs) were consistent with the corresponding classifications of potential groundwater zones obtained based on qualitative analysis.

The groundwater potential model of southwest Nigeria divided the studied territory into classes with high, medium, and low groundwater potential [Akintorinwa et al., 2020]. Most of the studied territory falls into zones with low groundwater potential (about 85%). Of the forty-eight (48) wells dug manually for validation, 77% are in areas with low groundwater potential, and these are wells with low water volume that dry up during the dry season. The remaining 23% that stay productive throughout the year belong to zones with medium/high groundwater potential.

The use of similar approaches in these studies made it possible to zone the territory of the West Kazakhstan region of the Republic of Kazakhstan according to the potential of groundwater within the natural and climatic zones of the region. The zoning map of the territory according to hydrogeological indicators shows the availability of the groundwater potential available for the water supply of pasture lands in various zones. The inventory of the water supply sources confirmed the zonality of the groundwater placement on the territory of the region.

The results of the conducted studies have shown that in many farms in the region, shaft wells drilled more than 40 years ago have low flow rates (flow rates equaling 0.01–0.09 l/s). In some farms, when there is a shortage of water for livestock water supply, boreholes drilled in recent years for these purposes have high water mineralization (which reaches 41,300 mg/dm^3) and are not used due to unsuitability. These farms experience an acute shortage of water suitable for livestock.

To solve the issue of water supply for seasonal distant pastures of family-operated farms in the region, it is sufficient to drill boreholes with a flow rate of about 0.3–0.5 l/s (25.92–43.2 m^3/day) with a depth of about 8.0–120.0 m.

The decisive factor in determining the suitability of water for consumption is the dry residue content of 20,000 mg/ l and a magnesium ion content of 100 mg/ l, which causes a bitter taste. According to the State Standard "Rules for the selection and assessment of the quality of sources of centralized household drinking water supply" for drinking water supply, such a source should be selected where the dry residue does not exceed 1,000 mg/l, the sulfate content in the water does not exceed 500 mg/l and the chloride content does not exceed 350 mg/l. If there is no such source, it is necessary to desalinate the water. In exceptional cases, it is allowed to use water with a dry residue of up to 1500 mg/l with the permission of the State Sanitary Supervision authorities.

The optimal solution to the issues of water supply for seasonal distant pastures depends on the volume of water consumption and the availability of underground and surface water suitable for livestock water supply.

CONCLUSION

The organization of water supply for pastures directly depends on the availability of water resources in the territory. The organization of water supply at pastures using groundwater is dictated by hydrogeological indicators of available aquifers, which differ significantly within the natural and climatic zones of the region, and hydrochemical indicators of groundwater. The monitoring and data analysis confirmed that underground springs in the territory of the West Kazakhstan region of the Republic of Kazakhstan were manifested at various depths and differed in a wide range of water mineralization. Underground springs were confined to various geological horizons and had a certain zonality in their location.

In the dry steppe zone, significant groundwater reserves are located in the middle-upper quaternary alluvial, upper Pliocene Akchagyl, and upper cretaceous Maastricht aquifers. In the semi-desert zone, the upper-quaternary marine Khvalynsky and lower-middle-quaternary marine Baku-Khazar horizons are the most water-rich ones. In the semi-desert zone, the permeable modern Aeolian horizon is the priority water source.

Acknowledgments

The study was carried out within the framework of the scientific and technical project (NTP) of the target financing program of the Ministry of Agriculture of the Republic of Kazakhstan (PTsF MSKh RK) for 2021–2023 as a part of NTP BR10764915 "Development of new technologies for the restoration and rational use of pastures (use of pasture resources)" for the program "Organization of water supply for the pastures of West Kazakhstan with replication in various natural and climatic zones".

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