

GIS-Based Geochemical Investigations of Water Samples from the Kapshi Lake Region in Akola, Maharashtra, India

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ABSTRACT

This study examines the physicochemical properties of surface and groundwater in the Kapshi Lake near Akola, India. Six water samples from bore wells, dug wells, and Kapshi Lake were examined for pH, TDS, EC, TH, Ca, Mg, Cl, color, and temperature. The primary objective is to determine the relationship between surface and groundwater quality and whether or not they are suitable for drinking and irrigation. The research indicates that the varied levels of contamination observed in the water sources of Kapshi Lake are primarily caused by anthropogenic activities such as agricultural runoff, industrial discharge, and improper waste disposal. Understanding the physicochemical properties of the surface and groundwater in Kapshi Lake is essential for both public health and sustainable resource management. Using the helpful information gathered from this study, policymakers and local communities may create effective strategies for controlling water quality. Future research should focus on identifying the specific sources of contamination and implementing mitigation measures to improve the water quality in this region.

Keywords: Kapshi, leaching, contamination, evaporation, runoff, and groundwater.

1. Introduction:

Numerous studies have demonstrated that in developing countries, the absence of clean, safe drinking water has a detrimental impact on public health and is linked to health issues. Adimalla N. in 2018. The kind and level of chemical contamination in groundwater are significantly influenced by the geochemistry of the soil that groundwater seeps through before entering aquifers. (1990) Zuane. Information on groundwater quality can be very helpful in understanding the lithology of the region's rocks and the movement, recharge, and storage of groundwater (Walton, 1970), as well as the duration of time that water is in contact with rocks, since it is impossible to stop undesirable substances from dissolving in the waters once they reach the ground (Johnson 1979; Sastri 1994). In the scientific discipline of hydrogeochemistry, groundwater is examined to ascertain its chemical composition and interactions with the surrounding geological environment. Six water samples were carefully gathered from a variety of sources, including bore wells, dug wells, and Kapshi Lake, in order to thoroughly evaluate the water quality and its link to the environmental elements in the Kapshi watershed. These sampling sites were carefully selected to reflect a variety of hydrological conditions and land use types (Phalke M.D. et al, 2026). Although hydrogeochemistry may seem like a simple process of collecting and testing water, it provides significant insights into the quality and suitability of groundwater for different uses. In hydrogeochemical investigations, field sampling methods and laboratory analysis are essential components. One of the primary objectives of morphometric analysis is to quantitatively test theories about the processes determining shape (Phalke M.D. and Khadri SFR, 2025). Hutton (1983) provides a comprehensive review of these methods. Groundwater samples are typically collected using sterile containers from sources such as lakes, hand pumps, drilled wells, and tube wells in order to prevent contamination. By analyzing groundwater samples, we can determine the water's chemical composition and identify any potential contaminants.

2. Study Area:

The Akola district of Maharashtra is home to the village of Kapshi. According to Survey of India Toposheet No. 55D/14, the study area is situated between 20°33'47.989"N and 76°57'39.285"E. The entire area is 11,2468 square kilometers. One tributary of the Kapshi Lake Basin is the Morna River Basin.

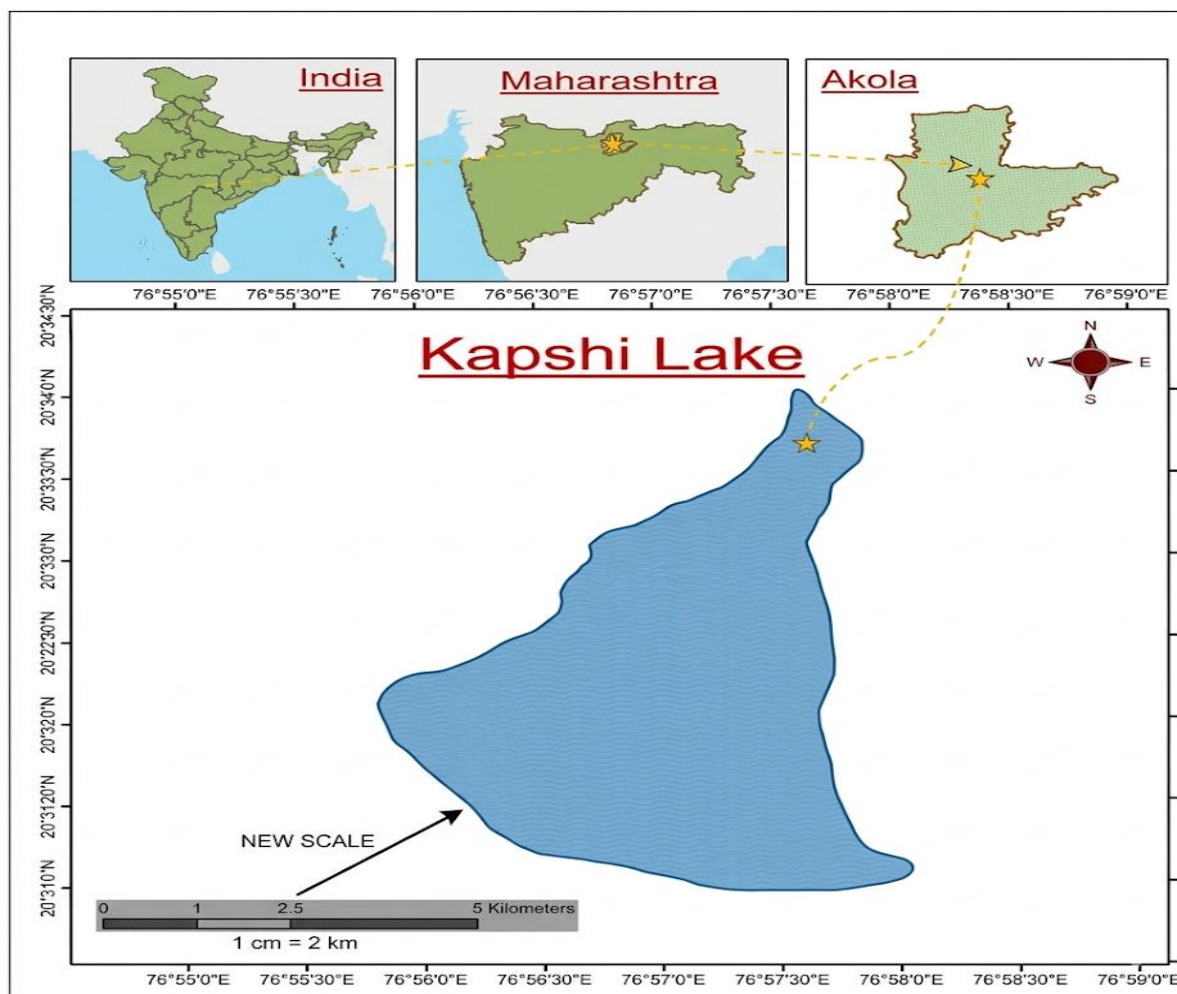


Figure 1: Study area map

Methodology:

This data provided valuable information about potential sources of contamination as well as the general condition of the watershed's water bodies. To better understand the spatial relationships between hydrogeochemical parameters and environmental circumstances, we integrated Geographic Information Systems (GIS) with remote sensing techniques. This enabled us to investigate how the distribution of water quality indicators in the study area is impacted by topography, hydrology, and land use.

3. Results & Discussions:

The current work used GIS tools for the morphometric analysis, which made it easier to compute and analyze morphometric and morpho-tectonic parameters (Phalke M.D. and Khadri SFR, 2025). Samples were collected from the wells and surface of the study region. The spot-by-spot data found after the study is shown in Tables 1 and 2.

Table 1: Water Samples collected from the study area

Sample no.	Location	Well type	Lat	Long
1	Chikhalgaon	Dug well	20.52881056	76.9487
2	Near Kapshi Lake	Surface water (Nala in village)	20.56674273	76.9602
3	Kapshi Lake	Surface water in lake	20.56642091	76.9603
4	Chikhalgaon		Bore well	20.53728427
5	Chikhalgaon	Dug well	20.55827442	76.9573

Temperature:

The water sample's temperature was determined to be between 220 and 250 degrees Celsius. At location VI, the temperature was found to be 250 C, whereas at location II, the lowest, it was 220 C. While the temperatures at sports III and IV were found to be 240 C and 230 C, respectively, the temperatures at locations I and IV were found to be the same, or 230 C.

Colour:

The water samples were found to be clear, or colorless, throughout the investigation.

pH:

Although it has no direct impact on human health, pH can influence the taste of water and exhibit relationships with other aspects of water quality (Islam ARMT, Ahmed N, Bodrud-Doza M, Chu R (2017)). It was found that the pH of the water sample ranged from 6.5 to 9. Whereas spot V had a pH of 6.5, spot VI had a pH of 9. Spots III and IV were found to have pH values of 7.9 and 8, respectively. Nevertheless, it was found that the pH at locations I and III was 6.9.

Table 2: Geochemical parameters of water samples collected from the study area

SR. NO.	PARAMETERS	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4
1)	Colour	Colourless	Colourless	Colourless	Colourless
2)	Temperature	24 ⁰ c	23 ⁰ c	26 ⁰ c	25 ⁰ c
3)	Turbidity	1 NTU	1 NTU	1 NTU	4 NTU
4)	Ph	6.8	7.8	6.9	7.9
5)	Conductivity	1080 µmho/cm	316 µmho/cm	685 µmho/cm	450 µmho/cm
6)	Total dissolved solids	990 mg/lit	500 mg/lit	700 mg/lit	700 mg/lit
7)	Dissolve oxygen	2.3 mg/l	7 mg/lit	8.5 mg/lit	3.4 mg/lit
8)	Total alkalinity	472 mg/lit	275 mg/lit	293 mg/lit	462 mg/lit
9)	Total hardness	462 mg/lit	213 mg/lit	702 mg/lit	825 mg/lit
10)	Calcium hardness	88.18 mg/lit	72.16 mg/lit	259.86 mg/lit	285.24 mg/lit

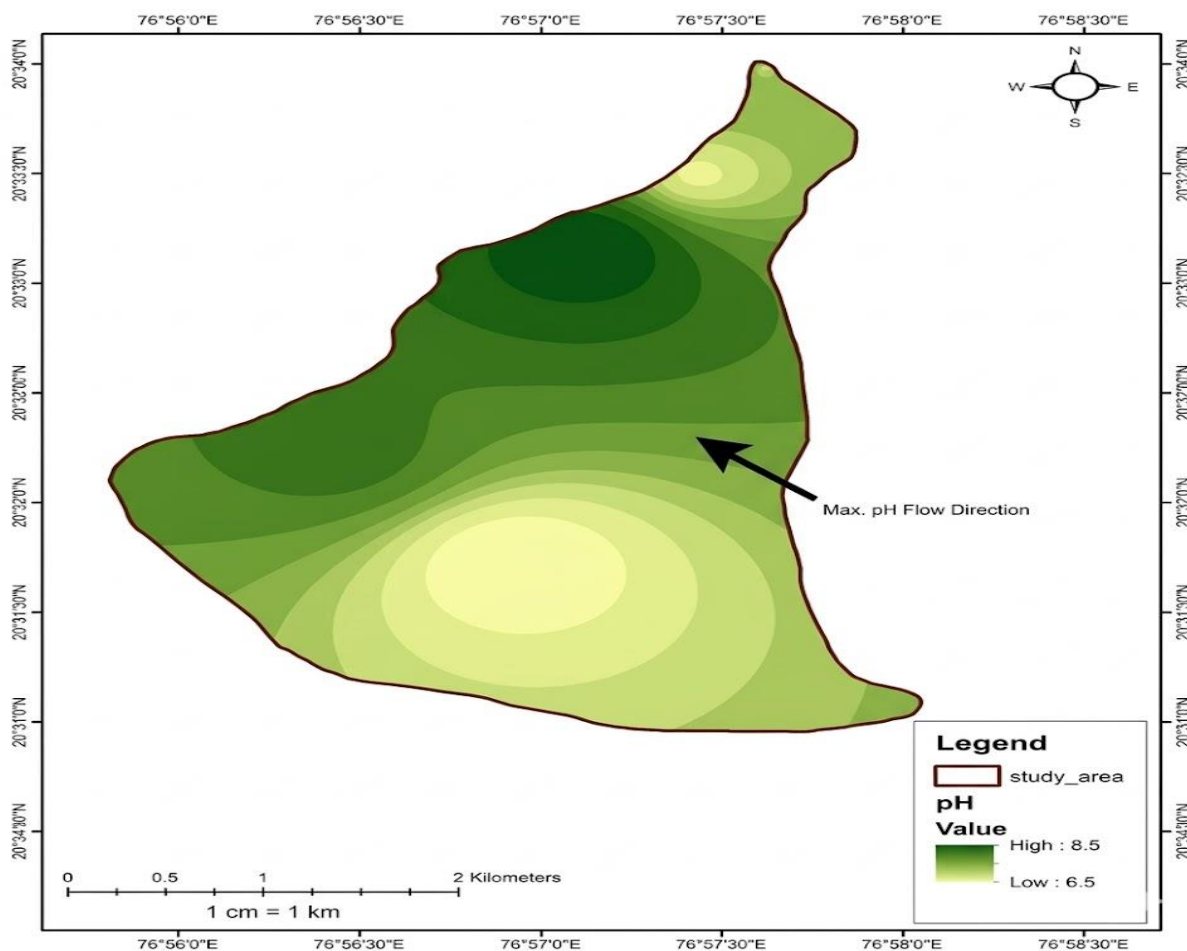


Figure 2: pH Map

Conductivity:

According to Panaskar DB, Wagh VM, and Pawar RS (2014), conductivity in water is especially significant because it rises with temperature and the quantity of dissolved salts. Spot III had the lowest conductivity at 314 $\mu\text{mho/cm}$, while spot VI had the highest conductivity at 1174 $\mu\text{mho/cm}$. The water sample's conductivity was found to range between 314 to 1174 $\mu\text{mho/cm}$. The conductivity was measured at 1096 $\mu\text{mho/cm}$, 680 $\mu\text{mho/cm}$, 456 $\mu\text{mho/cm}$, and 1114 $\mu\text{mho/cm}$ at positions I, II, IV, and V, respectively.

Total Dissolved Solids (TDS):

It was discovered that the water sample had between 400 and 1000 mg/lit of TDS. The total dissolved solid was found to be 1000 mg/l at location I, while it was 400 mg/l at site II. Total dissolved solids were found at 800 mg/l in locations III and V, and at 600 mg/l and 900 mg/l in spots IV and VI.

Dissolved oxygen:

In the well water sample, dissolved oxygen was found to be between 2.2 and 8.6 mg/l. Location I had the lowest oxygen level (2.2 mg/l), while place III had the highest oxygen content (8.6 mg/l).

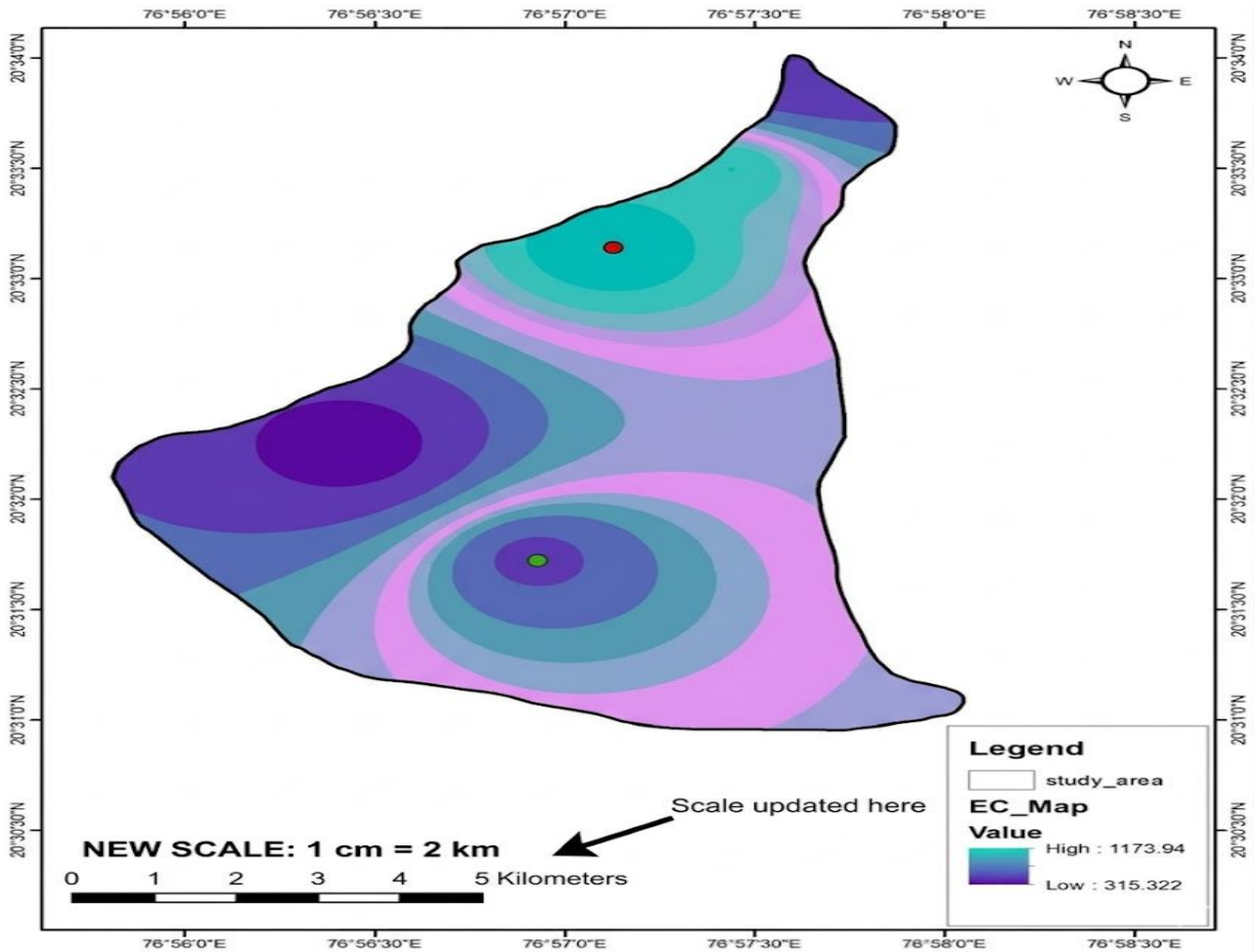


Figure 3: EC Map.

Chloride:

The water sample had between 76.68 to 159.04 mg/l of chloride. At 76.68 mg/l, spot III had the lowest concentration of chloride, while spot VI had the highest at 159.04 mg/l. Chloride levels at sites I, II, IV, and V were found to be 110.76 mg/l, 85.2 mg/l, and 122.12 mg/l, respectively.

Total hardness

The hardness of the whole water sample was found to range between 216 and 820 mg/l. Spots I, III, V, and VI had total hardness values of 464 mg/l, 700 mg/l, 688 mg/l, and 748 mg/l, respectively. Spot II had the lowest overall hardness (216 mg/l), while spot IV had the highest total hardness (820 mg/l).

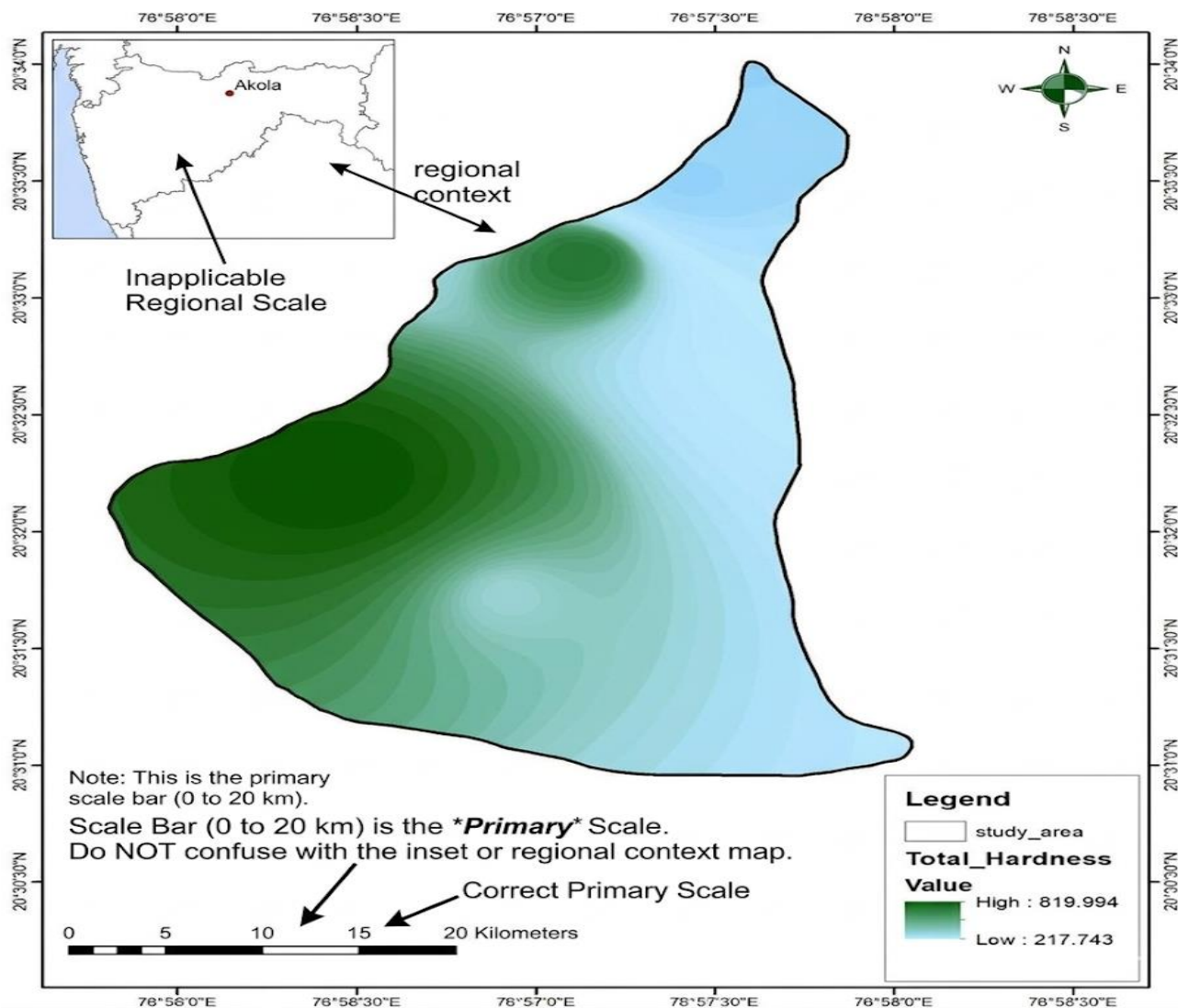


Figure 4: Total Hardness Map

CONCLUSIONS

GIS is a useful tool for analyzing the spatial distribution of water quality measurements and their relationship with environmental factors in the Kapshi Lake region. By integrating several data layers into a GIS context, we may find potential hotspots and unearth crucial information about the factors influencing water contamination. The analysis of the water quality data might yield numerous important conclusions. The groundwater in the Kapshi Lake region is prone to contamination, as evidenced by the rising amounts of TDS, EC, TH, and other pollutants. Anthropogenic activities such as industrial discharge, agricultural runoff, and improper rubbish disposal are major contributors of water contamination in the region. Because of its interactions with geological formations, groundwater is more mineralized than surface water, resulting in a chemical difference between the two. Maintaining public health and ensuring sustainable resource management depend on effective water quality management strategies. This entails identifying the exact causes of contamination, implementing pollution control tactics, closely monitoring the situation, and developing comprehensive water management plans. By addressing these issues, policymakers and local people may collaborate to improve the water quality and ensure the long-term sustainability of water resources in the Kapshi Lake region.

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