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Assessment the Groundwater on A Basis of Analysis of Correlation Matrices

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ABSTRACT

Groundwater which is distributed at a depth of 13-17 meters in Amudaryo district, was done evaluated on a basis of changeful parameters. The object was analyzed on account of Pearson correlation matrix and its monitoring was carried out by virtue of statistical analysis of several parameters (hydrogen indicators, pH, Cu, Cl^-, NO_3^2, SO_4^{2-}, total solids).

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Introduction

The strongly developed industries, urbanization, and increased agricultural production have led to freshwater shortages in a great deal of parts of the world.

Exterior water is unevenly distributed due to the different distribution of precipitation in different zones (Adams S, Titus R, Pietersen K, Tredoux G, Harris, 2001). Additionally, increasing the intensity of irrigation from surface water alone can lead to an alarming rise in water levels, which will cause salinity problems and negatively affect the productivity of agroecosystems. This has resulted in attention increased to groundwater exploitation. Simultaneous exploitation of groundwater, especially through dug wells and shallow pipelines, lowers the water table, provides vertical drainage, thereby preventing waterlogging and salinization, and can also rehabilitate flooded areas. On the other hand, the continuous increase in the use of groundwater in excess of the norm can lead to a regular decrease in the water level.

In such a situation, a serious problem arises, as a result of which shallow wells dry up and the need for deeper wells increases, which in turn has led to a focus on planned and optimal development of groundwater use (Agoubi, B., Kharroubi, A., & Abida, H, 2013).

The status of groundwater changes positively or negatively over the years on the strength of various environmental factors which are some cations and anions (pH, Cu, Cl^-, NO_3^{2-}, SO_4^{2-}, total solids) for example, pH values of groundwater might be a little higher during rainy seasons than dry periods (Adams S, Titus R, Pietersen K, Tredoux G, Harris, 2001). However, in the confined aquifers than unconfined aquifers the average pH values of groundwater are lower slightly (Agoubi, B., Kharroubi, A., & Abida, H., 2013), On a basis of the lack of alkaline substances in the groundwater system, the acidity of groundwater increases and becomes

unusable (Sadat-Noori, S. M., Ebrahimi, K., & Liaghat, A. M., 2014). The acidic water which contains a lot of hydrogen ions, accelerates corrosion. According to the criteria of the US Environmental Protection Agency (EPA), the pH value of water used for domestic purposes have to be between 5.5 and 9 (Baram, S., Kurtzman, D., Ronen, Z., Peeters, A., & Dahan, O., 2014).

Most local villagers use underground water for drinking purposes, lamentably the level of water hardness is very high (Adams S, Titus R, Pietersen K, Tredoux G, Harris, 2001).

The aim of the research

The scientific work consists in assessing the water quality on a basis of the comparison of the results obtained by determining six indicators of underground water and the tap water as a consequence their statistical correlation matrix coefficient.

Materials and methods of research

We used the Carl Pearson correlation method to analyze the statistical data on groundwater. The main advantages of this method are not only to show whether there is a correlation between any two variables, but also to determine the degree of their interdependence, whether the correlation between the two variables is positive or negative (Rajabova, 2020).

The disadvantage of this method is that it is relatively difficult to calculate, since its calculation involves complex algebraic calculation methods. This is greatly interacted by the values of the extreme elements (Parvin, F., & Tareq, S. M., 2021).

Groundwater distributed in the Amudarya district of the Republic of Karakalpakstan, which is underground water taken from a depth of 13-17 meters, the general parameters for quality assessment are described in the correlation matrix and on a basis of pH, Cu, Cl^-, NO_3^{2-}, SO_4^{2-}, total solids comparing of groundwater and tap water furthermore using the variance method to obtain a statistical average, the results of which we depicted in diagrams.

Results and discussion

As a result of calculating the quantities obtained from the variation series using the statistical formula (Pearson Correlation Coefficient Calculator) and through Correlation matrixes of groundwater quality parameters were analyzed, it showed that they are equal to the following values.

$$R_{xy} = \frac{\sum(X_i - X)(Y_i - Y)}{\sqrt{(X_i - X)^2 (Y_i - Y)^2}} = \frac{0,75}{\sqrt{2,34}} = 0,5$$

Changing values of groundwater and tap water hydrogen indicators (according to 2022 statistics). Where Xi is the pH value of underground water, and Yi is the pH value of tap water.

The following values were obtained according to the statistical error formula. Where, E (X^2) = 612,91, E (X^2) = 609,98, E (Y^2) = 672,74, E (Y^2) = 647,64

$$\partial 1 = \frac{\sqrt{\sum X^2 - X_i X}}{n-1} = \frac{\sqrt{2,93}}{11} = 0,15$$

$$\partial 2 = \frac{\sqrt{\sum Y^2 - Y_i Y}}{n-1} = \frac{\sqrt{25,1}}{11} = 0,45$$

$$S(\partial 1^2 - \partial 2^2) = \sum \frac{\sqrt{\partial 1^2 + \partial 2^2}}{n^2} = \frac{\sqrt{(0,15)^2 + (0,45)^2}}{144} = 0,003\ (3 \times 10^{-3})$$

Xi - the pH values of underground water, Yi - the pH

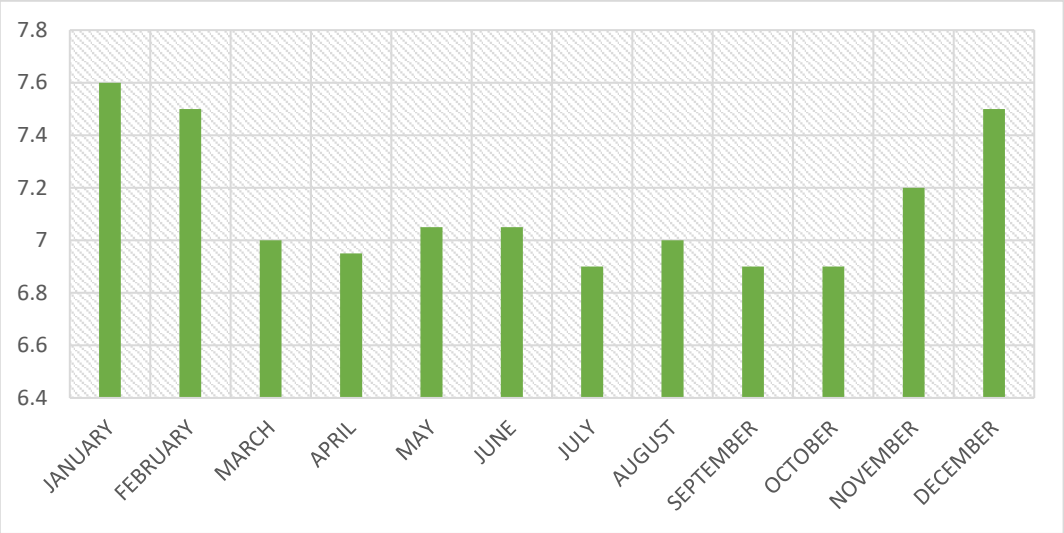

Diagram 1 The pH values of groundwater in Amudarya district in 2022

Table 1 (a), Correlation matrix of analysed groundwater quality parameters

	Cl^-	Total solids	SO_4^{2-}	pH	Cu	NO_3^{2-}
Cl^-	1					
Total solids	0,71146	1				
SO_4^{2-}	0,289441	0,383367	1			
Ph	-0,52942	-0,02476	-0,17418	1		
Cu	-0,14475	-0,00802	0,365437	0,339791	1	
NO_3^{2-}	0,469576	0,240333	0,586871	-0,07278	0,7158	1

Intercorrelations between 6 parameters during the 1st half year

Table 2 (b), Correlation matrix of analysed groundwater quality parameters

	Cl^-	Total solids	SO_4^{2-}	pH	Cu	NO_3^{2-}
Cl^-	1					
Total solids	0,95329	1				
SO_4^{2-}	0,914124	0,927264	1			
Ph	-0,33409	-0,12362	-0,00994	1		
Cu	0,941849	0,943838	0,963027	-0,03086	1	
NO_3^{2-}	0,011657	0,079909	-0,15742	-0,12985	0,030601	1

Intercorrelations between 6 parameters during the 2nd half year

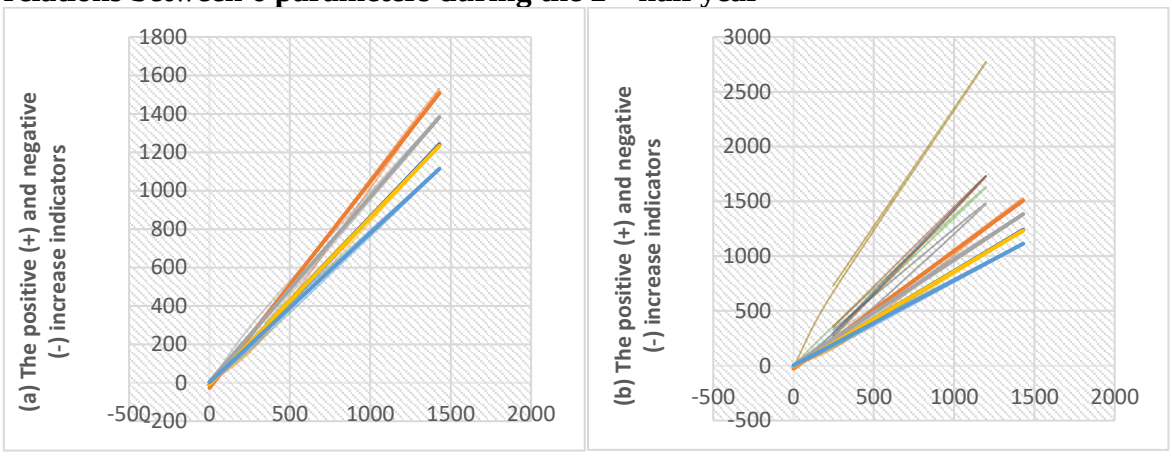

Diagram 2, Indexes of change of 6 parameters (pH, Cu, Cl^-, NO_3^{2-}, SO_4^{2-}, total solids) of the object during 2022
("a" is the first half term and "b" is the second half term)

Conclusion

The statistical correlation matrics coefficients of pH, Cu, Cl^-, NO_3^{2-}, SO_4^{2-}, total solids indicators of underground water (water impermeable layer, it is taken from the depth of 13-17 meters in the Amudarya district) were compared with six indicators of drinking water delivered through pipelines in the district and it was found that there are negative and positive correlations.

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