

ASSESSMENT OF GROUNDWATER ON A BASIS OF ANALYSIS OF THE  
CORRELATION MATRICES

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**Abstract:** Groundwater which is distributed at a depth of 13-17 meters, is evaluated on the basis of alterable parameters. The correlation and regression matrices, analysis, and their statistical status of water hydrogen indicators, pH, Cu, Cl<sup>-</sup>, NO<sub>3</sub><sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, and total solids could be done for making water quality monitoring.

**Keywords:** "groundwater", "tap water", total solids, hydrogen indicator, sulfate, nitrate, chloride anions, copper cation, correlation matrix, variation series

**Introduction:** 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<sup>-</sup>, NO<sub>3</sub><sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, total solids) for example, pH values of groundwater might be a little higher during rainy seasons than dry periods [1]. However, in confined aquifers than in unconfined aquifers the average pH values of groundwater are lower slightly [2;3]. Based on the lack of alkaline substances in the groundwater system, the acidity of groundwater increases and becomes unusable [4]. The acidic water which contains a lot of hydrogen ions, accelerates corrosion. According to the US Environmental Protection Agency (EPA) criteria, the pH value of water used for domestic purposes must be between 5.5 and 9 [1;4].

We know that most local villagers use underground water for drinking purposes, lamentably the level of water hardness is very high [1].

**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 tap water as a consequence of their statistical correlation matrix coefficient.

**Materials and methods of research:** 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<sup>-</sup>, NO<sub>3</sub><sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, 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.



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

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

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

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

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

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

$X_i$  - the pH values of underground water,  $Y_i$  - the pH values of tap water.

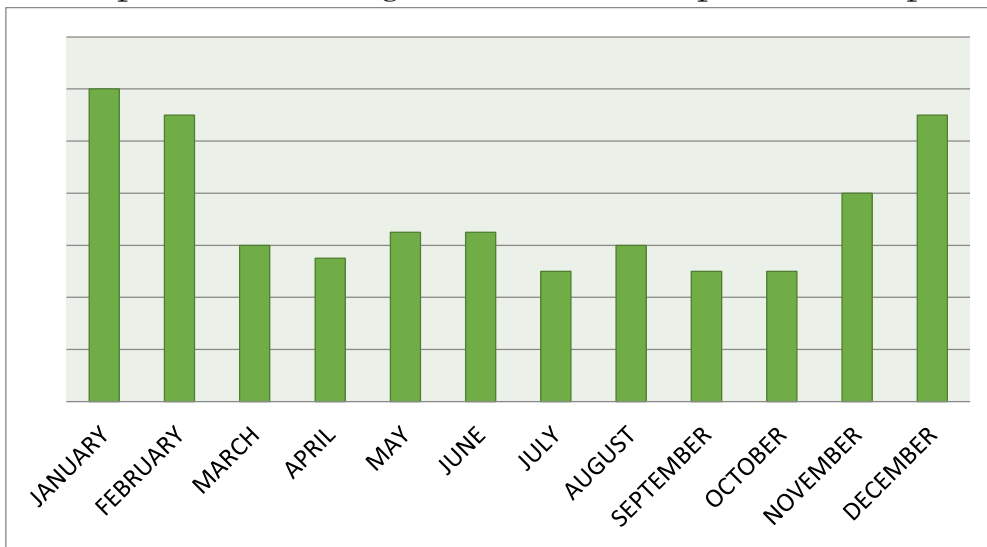


Diagram 1. The pH values of groundwater in Amudarya district in 2022

Table 1. Correlation matrix of analysed groundwater quality parameters

	Cl <sup>-</sup>	Total sulfides	SO <sub>4</sub> <sup>2-</sup>	pH	Cu	NO <sub>3</sub> <sup>2-</sup>
Cl <sup>-</sup>	1					
Total sulfides	0,71146	1				
SO <sub>4</sub> <sup>2-</sup>	0,289441	0,383367	1			
pH	-0,52942	-0,02476	-0,17418	1		
Cu	-0,14475	-0,00802	0,365437	0,339791	1	
NO <sub>3</sub> <sup>2-</sup>	0,469576	0,240333	0,586871	-0,07278	0,7158	1

Intercorrelations between 6 parameters during the 1<sup>st</sup> half year

Table 2. Correlation matrix of analysed groundwater quality parameters

Cl <sup>-</sup>	Total	SO <sub>4</sub> <sup>2-</sup>	pH	Cu	NO <sub>3</sub> <sup>2-</sup>
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	solids					
Cl <sup>-</sup>	1					
Total solids	0,95329	1				
SO <sub>4</sub> <sup>2-</sup>	0,914124	0,927264	1			
pH	-0,33409	-0,12362	-0,00994	1		
Cu	0,941849	0,943838	0,963027	-0,03086	1	
NO <sub>3</sub> <sup>2-</sup>	0,011657	0,079909	-0,15742	-0,12985	0,030601	1

Intercorrelations between 6 parameters during the 2<sup>nd</sup> half year

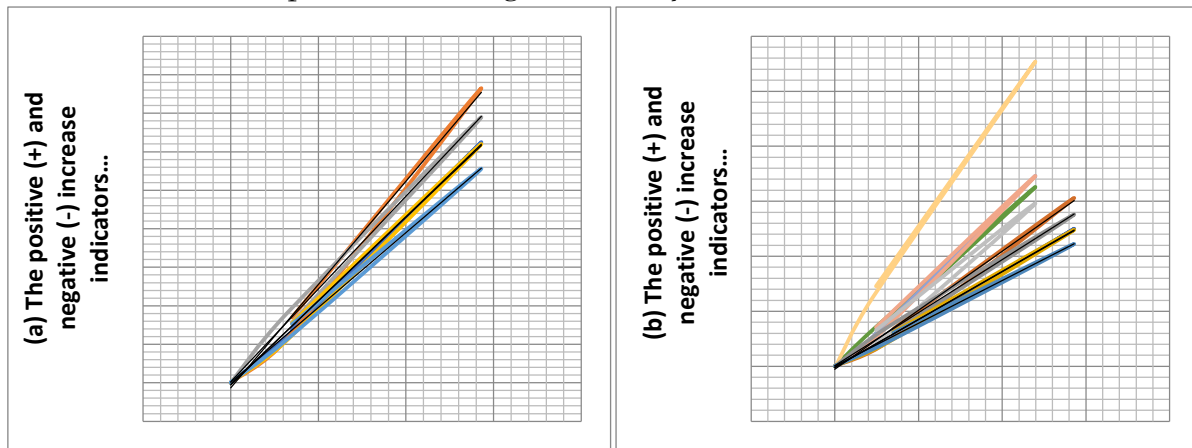


Diagram 2. Indexes of change of 6 parameters (pH, Cu, Cl<sup>-</sup>, NO<sub>3</sub><sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, total solids) of the object during 2022 ("a" is the first half term and "b" is the second half term)

**Conclusion:** The statistical correlation matrices coefficients of pH, Cu, Cl<sup>-</sup>, NO<sub>3</sub><sup>2-</sup>, SO<sub>4</sub><sup>2-</sup>, total solids indicators of underground water (water impermeable layer, it is taken from the depth of 13-17 meters in 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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