

**IMPLEMENTATION OF ECOLOGICAL MONITORING ON THE BASIS  
OF PHYSICAL AND CHEMICAL PROPERTIES OF DRINKING WATER  
RESOURCES OF THE REPUBLIC OF KARAKALPAKSTAN  
(ON THE EXAMPLE OF NUKUS CITY AND AMUDARYO DISTRICT)**

***Annotation***

*This article is based on some of its physical and chemical properties in the assessment of the current ecological status of drinking water resources of Nukus city and Amudarya district of the Republic of Karakalpakstan. The article used mathematical formulas to compare the amount of chemicals in drinking water and to determine how its composition changes over the years.*

*As well as, the concepts of ecosystems, ecological environment, factors were used to explain the ecological significance of the article.*

***Key words:*** *Environmental, factors, ecosystems, drinking water, turbidity, sulfate, nitrate anions, magnesium, calcium cations, mean arithmetic and geometric progression.*

It is known widely that the scientific study of all processes that take place in the environment leads to the smooth functioning of the laws of nature. In the other words, it is possible to prevent imbalances in nature.

In general, it is not possible to study all environmental factors in isolation under natural conditions. Because this is the mechanism of the laws of nature works in such way that the elements of the environment complement each other or can completely replace this element [1;2;3;4]. Of course, this process leads to

disruption of ecosystem sustainability. At this time, it is very difficult to see changes in ecosystems with the ordinary eyes, and the conclusions drawn from them lead us to misunderstand. However, through the process of empirical knowledge of natural or artificial ecosystems in nature, that is, by experimenting under natural and artificial conditions and studying the data obtained from it on the basis of deep rationality, the scientist will be able to determine whether the objects are undergoing negative or positive changes.

Based on the above basic concepts, we will study the changes in the drinking water resources of the population of the Republic of Karakalpakstan, in the current ecological condition of these resources. In this case, the objects of our study is the drinking water of the population of Nukus city (object #1) and Amudarya district (object #2). The subjects of research are water in the objects. To study the main similarities, differences and changes in physical and chemical parameters on the basis of empirical and rationality. During our study of the objects, we found that there is a certain difference between the water resources, despite the fact that the water resources in them are taken from one place. In both facilities, the turbidity of the water is high and the amount of some chemicals increases and changes are observed [5]. This can be seen in the following comparisons. Based on data from 2015, 2016, 2017, 2018 and 2019, we can determine the difference between them to some extent by comparing the arithmetic and geometric mean values of water. In which case we can use the following mathematical formulas [3;4;5;6;7].

$$A = \frac{a_1 + a_2 + a_3 + \dots + \dots a_n}{n} ;$$

$$G = \sqrt[n]{a_1 \cdot a_2 \cdot a_3 \cdot \dots \cdot a_n}$$

Using these formulas, we compared the amount of certain chemicals in drinking water only in April. In which we calculated the arithmetic and geometric mean values of the  $\text{SO}_4^{-2}$  and  $\text{NO}_3^-$  anions in the water, as well as the cations  $\text{Ca}^{+2}$  and  $\text{Mg}^{+2}$ , which provide the hardness of the water.

**Average arithmetic values of  $\text{NO}_3^-$  anions in drinking water:**

$$A = \frac{2,8 + 3,75 + 3,5 + 2,9 + 0,35}{5} = 2,66 \text{ mg/l}$$

**Average geometric values of  $\text{SO}_4^{-2}$  anions in drinking water:**

$$G = \sqrt[5]{411 \cdot 396,5 \cdot 382 \cdot 431,2 \cdot 306} = 2,53 \text{ mg/l}$$

If we compare the values of  $\text{Ca}^{+2}$  cations obtained from the two objects in 2019, then:

**Object #1 arithmetic mean of the cations of  $\text{Ca}^{+2}$  in drinking water:**

$$A = \frac{90,2 + 100,2 + 100,2 + 84,2 + 88,2 + 72,1 + 46,1 + 52,1 + 64,1 + 74,1 + 90,2 + 88,2}{12} = 79,16 \text{ mg/l}$$

**Average geometric values of  $\text{Ca}^{+2}$  cations in drinking water:**

$$G = \sqrt[12]{90,2 \cdot 100,2 \cdot 100,2 \cdot 84,2 \cdot 88,2 \cdot 72,1 \cdot 46,1 \cdot 52,1 \cdot 64,1 \cdot 74,1 \cdot 90,2 \cdot 88,2}$$

$$\sqrt{64,1 \cdot 74,1} = 1,013 \text{ mg/l}$$

**Object #2 arithmetic mean of the cations of  $\text{Ca}^{+2}$  in drinking water:**

$$A = \frac{92,2 + 110,2 + 124,2 + 80,2 + 94,2 + 70,1 + 46,04 + 56,1 + 66,1 + 74,1 + 100,2 + 86,2}{12}$$

$$\frac{74,1 + 100,2 + 86,2}{3} = 83,32 \text{ mg/l}$$

**Average geometric values of  $\text{Ca}^{+2}$  cations in drinking water:**

$$G = \sqrt[12]{92,2 \cdot 110,2 \cdot 124,2 \cdot 80,2 \cdot 94,2 \cdot 70,1 \cdot 46,04 \cdot 56,1 \cdot 66,1 \cdot 74,1 \cdot 100,2 \cdot 86,2} = 1,013 \text{ mg/l}$$

Now, if we calculate the arithmetic and geometric values of  $\text{Mg}^{+2}$  cations in drinking water in both objects, they are as follows:

**Object #1 arithmetic mean of the cations of  $\text{Mg}^{+2}$  in drinking water:**

$$A = \frac{42,6 + 100,2 + 54,7 + 40,1 + 35,3 + 36,5 + 24,3 + 24,3 + 26,7 + 36,5 + 41,3 + 41,3}{12} = 83,97 \text{ mg/l}$$

**Average geometric values of Mg<sup>+2</sup> cations in drinking water:**

$$G = \sqrt[12]{42,6 \cdot 100,2 \cdot 54,7 \cdot 40,1 \cdot 35,3 \cdot 36,5 \cdot 24,3 \cdot 24,3 \cdot 26,7 \cdot 36,5 \cdot \sqrt{41,3 \cdot 41,3}} = 1,011 \text{ mg/l}$$

**Object #2 arithmetic mean of the cations of Mg<sup>+2</sup> in drinking water:**

$$A = \frac{42,6 + 51,1 + 53,5 + 38,9 + 38,9 + 35,3 + 24,3 + 24,3 + 26,7 + 36,5 + 36,5 + 41,3}{12} = 37,49 \text{ mg/l}$$

**Average geometric values of Mg<sup>+2</sup> cations in drinking water:**

$$G = \sqrt[12]{42,6 \cdot 51,1 \cdot 53,5 \cdot 38,9 \cdot 38,9 \cdot 35,3 \cdot 24,3 \cdot 24,3 \cdot 26,7 \cdot 36,5 \cdot \sqrt{36,5 \cdot 41,3}} = 1,010 \text{ mg/l}$$

Comparing the values obtained from the calculations: the arithmetic and geometric values of the anions NO<sub>3</sub><sup>-</sup> and SO<sub>4</sub><sup>-2</sup> in drinking water are 2,66:2,53 (Object #1). Object #1 and Object #2 differ in arithmetic quantities and appearance in terms of the values of Ca<sup>+2</sup> cations in water. That is, the comparisons are in ratios of 79,16:83,32 relative position. There is almost no difference in the geometric values on the study of these Ca<sup>+2</sup> cations. This is a 1,013:1,013 ratio or, say, a 1:1 ratio.

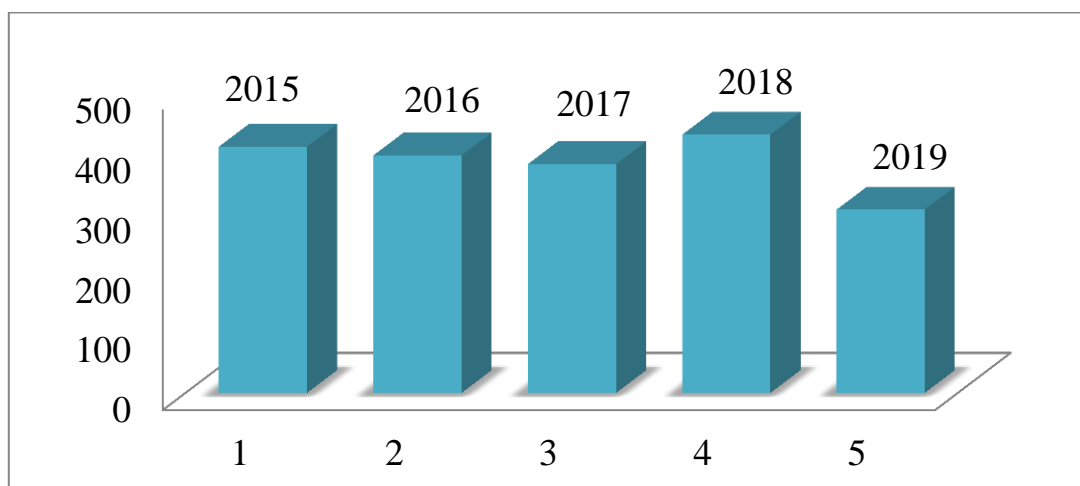
Also, the arithmetic values of the Mg<sup>+2</sup> cations in the drinking waters of object#1 and object#2 are 83,97:37,49 or 2,24:1, while the average geometric values are 1,011:1,010 or 1:1.

In other words, we can see that the level of chemical contamination of water sources changes with arithmetic and geometric progression as a result of adverse effects on the environment. Considering the above ratios, if we focus on the arithmetic value of NO<sub>3</sub><sup>-</sup> anions, the average value is 2,66 mg/l per month,

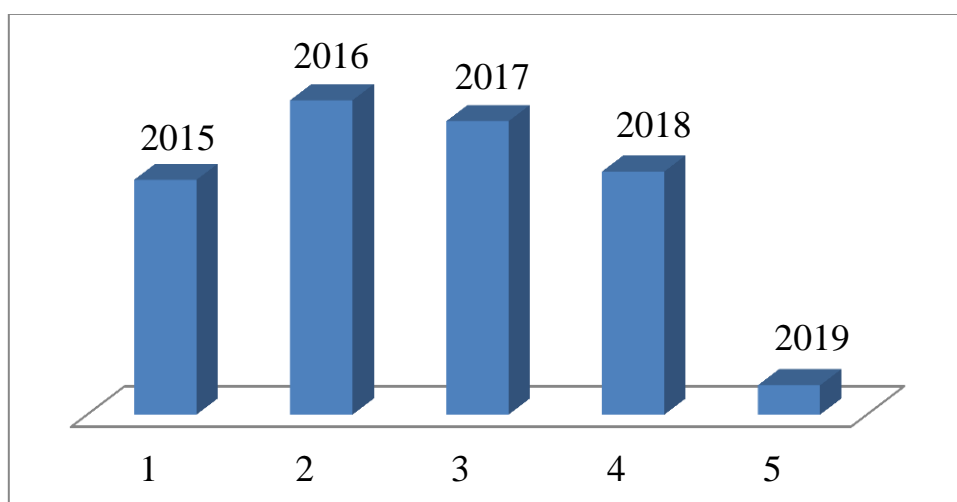
compared to twelve months in a year. The mean geometric growth rate of  $\text{SO}_4^{-2}$  anions is 2,53 mg/l or an average increase of 2,53 mg/l each month in addition to the total amount.

The difference between the arithmetic mean growth values of  $\text{Ca}^{+2}$  cations in objects # 1 and objects # 2 is 4,16 mg/l. That is the amount of  $\text{Ca}^{+2}$  in an object #2 is higher than in an objects # 2. Excluding the total, the geometric mean is 1,013 mg/l.

As you can see, from the diagrams below, the amount of chemicals in these drinking water resources is changing. In these diagrams we can see, that the sulphate and nitrate anions in the water of object #1 change quantitatively.



**Object #1. The amount of sulfate anions in drinking water resources changes over the years.**



**The amount of nitrate anions in drinking water resources changes over the years**

As can be seen, from the diagrams above, in 2019, the amount of nitrate and sulfate anions has the lowest values. But if we look at other years, we can see that this situation is temporary.

If the pollution of water resources with such substances continues in this way, through these growth indicators we will be able to forecast the ecological status of water resources for the next five years. If the sequence of numbers continues as we have predicted, the overall environmental condition of drinking water resources in the area may not meet the required level. That's why more needs to be done. In this case, it is important to do the following: to augmentation the environmental literacy of the local population, especially those working in agriculture, in the using of chemicals and other substances, then it is very important to grow green algae locally that have the property of purifying the water as much as possible in the ponds. In our opinion, it is not a very difficult problem to clean the water resources in the open basins with a certain amount of greenery in the local conditions. Because today, not only in foreign countries, but also in our country, many scientists have done research on the methods of biological treatment of water bodies and have achieved positive results.

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