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ASSESSMENT OF THE GEOECOLOGICAL CONDITION OF THE KHANBULANCHIN RESERVOIR IN THE AREAS OF THE AZERBAIJAN REPUBLIC

Babayeva U. A.

Lankaran State University, Lankaran, Azerbaijan
E-mail: babayevauka@gmail.com

Khanbulanchay reservoir was built with the intention of meeting irrigation requirements of tea plantation areas. Currently, the reservoir provides population of Lankaran with fresh drinkable water, besides irrigation. Taking into consideration all these advantages, main morphometric features of Khanbulanchay reservoir have been mentioned, its mineralization degree has been determined according to analysis results of examples, taken from the reservoir in June and December of 2018, and assessment of its modern ecological condition carried out in this article. *Purpose*. Assessment of the current state of water quality in Khanbulanchay reservoir, to determine ways of how to use them efficiently, as well as to investigate the region's water supply problems. *Methodology*. Analyzes were performed using spectrometric and catometric methods. *Conclusion*. The norms of microelements in water were analyzed in laboratory condition, the ways of using them were explained and the suitability of daily use of people has been determined.
Keywords: Lankaran, Khanbulanchay, Basharuchay, reservoir, watershed, degree of mineralization, eco-geographical assessment.

INTRODUCTION

One of the urgent global challenges of the 21st century is suppling the population and various sectors of the economy with water. In terms of population growth and economic development, the use of water resources is increased rapidly all over the world, water supply in some regions and countries is sharply deteriorated [1]. As a result of global warming, a tendency is observed in decreasing of available water resources. Aggravation of the water problem has a direct influence on the population's food supply and environmental safety of the regions [2].

Global climatic changes associated with the recurrence of abnormal temperature conditions pose a direct environmental threat to polluted water reservoirs [3]. In order to manage water resources, water reservoirs have been established in different regions of the world, which provide water for the population and economic areas. However, wasteful using them and harmful substances contained in water have caused a number of environmental problems on a regional scale.

Water pollution and water quality deterioration are the main environmental problems facing the water resources of Azerbaijan [4]. The damage caused by these problems to human health and ecosystems is very significant. A significant proportion of pollution occurs during the storage phase of water. Khanbulanchay reservoir (fig. 1) is one of the places where the water reserve of the Lankaran region is stored.

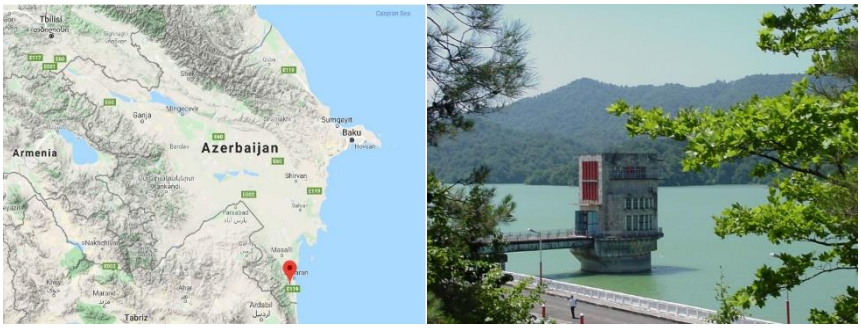


Fig. 1. Khanbulanchay reservoir

Lankaran region differs from other physical-geograhical districts of Azerbaijan for its wet subtropical climate, spread of yellow soil, existence of azonality, and having thick hydrographic network [5]. Although the rainfall is, on average, 1600 millimeters and there are many hydrological resources in the territory of the region, shortage of water can be observed in the vegetation period of plants. The reason for it is coincidence of rains in cold period of year, in general. In these times, the territorial rivers spend 75% of their annual runoff [6]. Rivers are the main sources for meeting water requirements in the whole Azerbaijan, as well as in Lankaran [7]. Rivers of the region are characterized by spring and winter floods relevant to the rainfall. After the floods, water scarcity happens, lasting for 2–4 months. Then underground water usually nourish rivers. As the flow of the period of water scarcity makes up 5–15% of annual runoff, river runoff severely decreases and problems in the irrigation and water provision occur due to lack of water.

RESEARCH METHODS

When calculating average annual water resources different methods are used such as water balance, flow maps, empirical formulas, regression, and so on. In order to calculate the average perennial quantity of water resources, water balance equation has also used based on world experience on the assessment of water resources. Given that the network of observations on atmospheric precipitation and evaporation is very sparse in our study area, where we can see that the accuracy of calculating meteorological quantities, in particular, evaporation values is very low. Therefore, the flow in the Khanbulanchay reservoir was calculated according to the equation water balance.

RESULTS AND THEIR DISCUSSION

The countries with limited water resources try to meet their water requirements by constructing water reservoirs. In the end of XX century, meeting water requirements in this way has been increased by 27% [8]. In the beginning of the XXI century, 21542.4 million cubic meters of water was kept in 135 water reservoirs, and 56,6 million cubic meters water was maintained in 73 water reservoirs, which has a capacity of less than 1 million cubic meter, in Azerbaijan [9]. Water reservoirs began to be built in order to provide water in Lankaran after 60s of the XX century. One of them is Khanbulanchay water reservoir,

which was put into use in 1976 and called "Pearl of Lankaran". As the reservoir was established and put into operation, irrigation of the area of 22 thousand hectare has been provided. A water receiver with discharge of 10 m^3/s was built over Basharuchay to provide the reservoir with necessary amount of water. Right and left coast channels, with the length of 7.8 and 8.2 kilometers and with the discharge of relevantly 2.2 and 8.8 m^3/s, were established.

The area of the Khanbulanchay reservoir is 3,74 km^2, its capacity is 52 million m^3. When we have look at the morphometric features of the reservoir, we can reveal that its height is 64 m, while average depth is 18 m.

Modern ecological condition of the reservoir has been assessed according to the results of analysis of the examples, taken from watershed dam, situated over Basharuchay, and exit of the Khanbulanchay reservoir by the Lankaran Regional Department of the Ministry of Ecology and Natural Resources (table 1).

Analysis results show that chemical demand for oxygen (COD) of the example, taken from the falling point of Basharuchay to the reservoir- watershed dam, has been stable — 1.6 mg/l during a year. On the contrary, COD of the example, taken from exit of the reservoir has decreased by six times and reached to 0.8 mg/l from 4.8 mg/l in winter as compared to summer. Its reason is drastic increase and oxygen absorbation of phytoplanktons in summer months in the reservoir.

The amount of dependent substances in water examples, taken from watershed dam has reached to 11.42 mg/liters from 3.2 mg/liter increasing by 3.6 times from summer to winter. The main reason of this increase is growth of the materials, washed from soil, due to rise of the agricultural activities in basin in summer months. On the contrary to the river, as the materials, brought by the river, were settled in the Khanbulanchay reservoir, amount of the dependent substances has reached to 2.88 mg/l from 5.48 mg/l by decreasing by 1.9 times in winter.

According to the M.A. Abduyev's research, river waters of Lankaran region (except Vilashchay and Istisuchay) belong to Calcium group of Hydrocarbonate category, while waters of Vilashchay and Istisuchay belong to Natrium group of the Chlorine category. The water bodies researched for their degree of mineralization, have average mineralization (200-500mg/l). Despite all of these, mineralization of Basharuchay is more than Khanbulanchay reservoir by 1.5 times in summer and 1.2 times in winter (fig. 2).

Table 1.

The results of analysis of the water examples, taken from Khanbulanchay reservoir in June and December of 2018

Row number	Name of ions within water	Unit of measure	Taking place and date of examples			
			Basharuchay watershed dam		Exit of Khanbulanchay reservoir	
			27.06. 2018	25.12. 2018	27.06. 2018	25.12. 2018
1	Chemical demand for Oxygen	mg/l	1,6	1,6	4,8	0,8

Continuation of table 1.

Row number	Name of ions within water	Unit of measure	Taking place and date of examples			
			Basharuchay watershed dam		Exit of Khanbulanchay reservoir	
			27.06. 2018	25.12. 2018	27.06. 2018	25.12. 2018
2	Dependent substances	"----"	3,2	11,42	5,48	2,88
3	Mineralization	"----"	415,62	320,14	280,42	270,19
4	HCO_3^-	"----"	213,50	152,5	183	152,5
5	SO_4^{2-}	"----"	41,15	65,84	8,23	32,92
6	Cl^-	"----"	53,25	17,75	17,75	17,75
7	Ca^{2+}	"----"	70	55	50	45
8	Mg^{2+}	"----"	18	9	6	12
9	Na^++K^+	"----"	19,72	20,05	15,44	10,02
10	NO_2^-	"----"	0,0025	0,0015	0,0015	0,001
11	NO_3^-	"----"	1,6	2,88	2,4	3,06
12	NH_4^+	"----"	0,04	0,04	1,7	0
13	Fe^{+3}	"----"	0,05	0,05	0,05	0,05
14	Al^{+3}	"----"	0,007	0,055	0,008	0,044
15	Zn^{+2}	"----"	0,003	0,003	0,004	0,003
Roughness	pH	mg.ekv/l	5,0	3,5	3,0	3,25

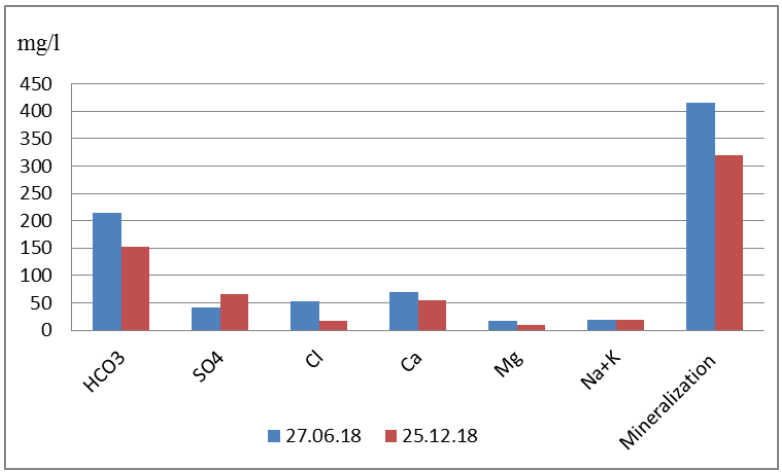
High degree of mineralization in summer can be explained by decrease of water discharge in river [10]. The mineralization remains almost stable in Khanbulanchay during a year.

The smallest unit of the mineralization coincide to the period, when water discharge increases [11]. In Basharuchay, Hydrocarbonate (HCO_3^-) exceeds among anions, and Calcium (Ca^{2+}) among cations in both summer and winter months. From the superiority point of view, Sulphate (SO_4^{2-}) among anions, and the sum of Sodium and Potassium (Na^++K^+) among cations occupy second place. The third place belong to Chlorine (Cl^-) from anions and Magnesium (Mg^{2+}) from cations.

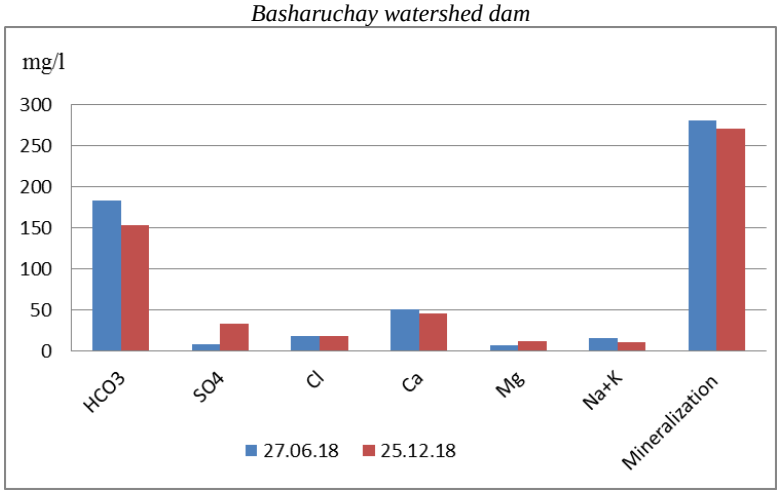
Amount and percentage proportion of main anions, registered in summer and winter months, are described in fig. 3.

The formation of the macro-component composition of waters under the influence of the man-made formations leads to an increase in the content of sulfate ion. Hydrocarbonate (HCO_3^-) from anions, and Calcium from (Ca^{2+}) cations exceed in the examples, taken from exit of Khanbulanchay reservoir, in both summer and winter months. However amount and percentage proportion of Sulphate ion has increased by four times in winter with comparison to summer. Thus, while the amount of the Sulphate was 8.23 mg/l and mineralization degree was 3% in summer, these figures increased and its amount reached

to 32.92 mg/l and mineralization degree became 12% in winter. There is not any drastic change in the amount of other ions (fig. 4).



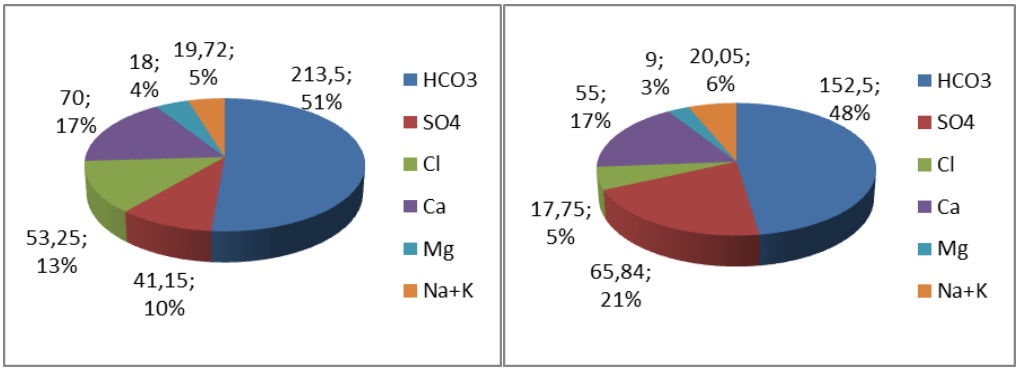
Basharuchay watershed dam



Khanbulanchay reservoir

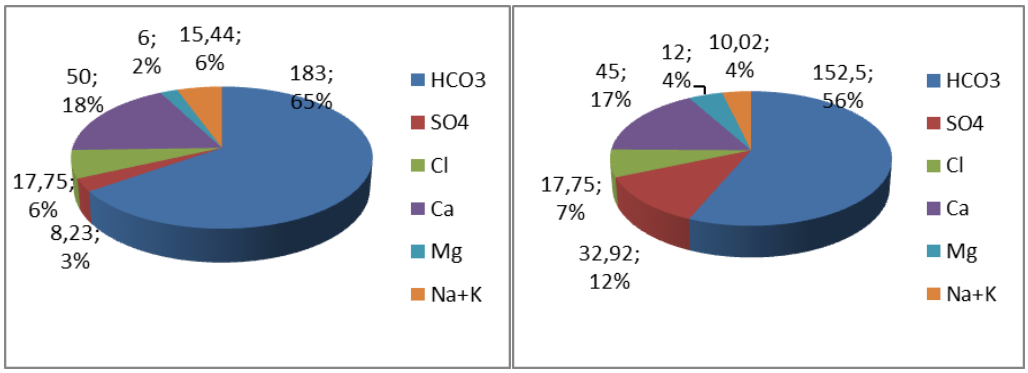
Fig. 2. Mineralization in the Basharuchay watershed dam and exit of the Khanbulanchay reservoir in summer and winter months

Main indicators of the pollution level of water objects include sum of nutrient and organic substances within water, permanganate and dichromate oxidation, chemical and biochemical need for oxygen, etc. Nutrient elements, containing nitrogen compounds, have a special place among them [12]. These nutrient elements, which seem harmless at first sight, radically change physical-biological quality of water. Being main element of water, they determine biological productivity of the water objects. The quality of water, generally, depends on concentration of these elements. However activity and flow of these elements are researched less than main ions due to the technical difficulties.



27.06.2018 *25.12.2018*

Fig. 3. Amount (mg/l) and percentage proportion of main ions in Basharuchay watershed dam, registered in summer and winter months



27.06.2018 *25.12.2018*

Fig. 4. Amount (mg/l) and percentage proportion of main ions in Khanbulanchay reservoir, registered in summer and winter months.

Information about concentration of the nutrient elements in rivers of the Republic can be found in works of reserachers such as S.H.Rustamov, R.M.Gashgay, M.A.Salmanov, M.A.Abduyev, etc. Nitrogen compounds are in the form of Ammonium (NH_4), Nitrate (NO_3), and Nitride (NO_2) within water. Majority of the nitrogen compounds, solved within river water, are in the form od Nitrate (NO_3). As the Nitrates are distinguished by their high degree of solution, most of them diffuse to water objects. The environmental pollution, caused by the nitrates, increase, as intentivity of agriculture and long-term use of fertilities are expanded. It is observed minimum in summer, but maximum in winter in activity of nitrate ion. Its reason is receivement of nitrate by water plants in summer. In some cases, receivement of nitrate is so strong that its amount becomes almost zero.

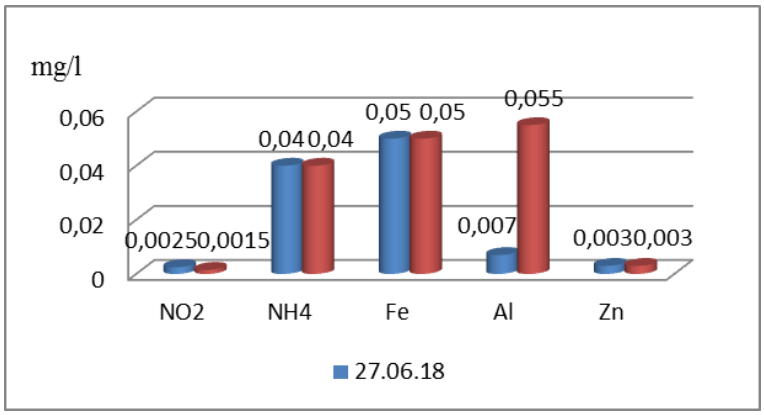
However as acceptance of nitrate by plants decrease, its amount rises in autumn, and reaches its highest point in winter. Its consumption is necessary for dissolvement of organic substances and transition of nitrate from organic to mineral form in winter. As the

temperature rises and lightening is strengtening in spring, receivement of nitrate by plants increases and as a result, its amount severely falls down.

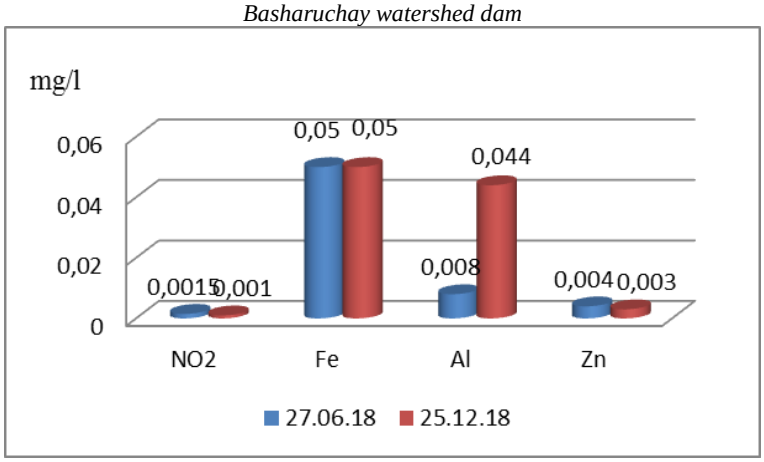
The research, conducted by M.A.Abduyev, revealed that perennial average amount of the nitrates in Azerbaijan rivers can be 0,25–1,20 mg/l [13]. The amount of nitrate is 1,6 mg/l in summer, 2,88 mg/l in winter in Basharuchay, while in Khanbulanchay these figures are 2,4 mg/l in summer, 3,06 mg/l in winter, according to the investigation.

International Health Organization determined standard amount of nitrates in drinkable water should be 11 mg/l. Hence, the amount of the nitrates in the rivers studied is relevant to standards.

Main soruce of Ammonium, Nitrate, and Nitride in natural waters is considered various complex organic substances, with origin of protein-containing animal and plants. The research, conducted by us, showed that amount of the Ammonium changes between 0,04 mg/l to 1,7 mg/l in investigated water bodies, and it is higher than standards. Both activity of Nitride (NO_2), and Ammonium (NO_2) is relevant to the activity of Nitrate ion (NO_3).



Basharuchay watershed dam



Khanbulanchay reservoir

Fig. 5. Amount of nutrient and microelements in Basharuchay watershed dam and exit of Khanbulanchay reservoir in summer and winter

The reason of frequent meeting iron compounds within the natural waters is its diffusion to water from different rocks, as iron widely spread in nature. Accoding to the "Protection Regulations of Ground Waters" [14], the amount of iron in drinkable water should not be more than 0,3 mg/l.

As the amount of iron in investigated water objects is less than above-mentioned figure, these waters are drinkable (fig. 5).

The value of the pH in investigated waters can be 3–5 mg.ekv/l. As a result, these waters have more acid reactions, strong erosion of soil and rocks, and less mineralization, as organic substances are bigger than main ions. The amount of zinc is less than standard concentration level (0,005 mg/l), by changing between 0,003–0,004 mg/l. The concentration of Aluminium can be 0,007-0,055 mg/l, and it is under the standard level.

RESULTS

Providing the population with drinkable water in Lankaran city, as well as the current environmental condition of the Khanbulanchay reservoir which was built for the irrigation of arable land can be considered satisfactory.

Based on water samples taken from the Basharuchay water catchment point and the Khanbulanchay reservoir, it can be said that here the amount of additive substance increase by 3.6 times during the winter months and decrease by 1.9 times during the summer months. This is due to the economic activity of people in river basins.

Water pollution rate in the Khanbulanschay reservoir is minimal and complies with stationary norms.

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ОЦЕНКА СОВРЕМЕННОГО ГЕОЭКОЛОГИЧЕСКОГО СОСТОЯНИЯ ХАНБУЛАНЧАЙСКОГО ВОДОХРАНИЛИЩА АЗЕРБАЙДЖАНСКОЙ РЕСПУБЛИКИ

Бабаева У.А.

Лянкяранский Государственный Университет, Лянкярань, Республика Азербайджан
E-mail: babayevauka@gmail.com

Одной из актуальных глобальных задач XXI века является обеспечение водой населения и различных секторов экономики. С точки зрения роста населения и экономического развития, использование водных ресурсов быстро увеличивается во всем мире, водоснабжение в некоторых регионах и странах резко ухудшается. Ханбуланчайское водохранилище было построено с целью орошения чайных плантаций в Азербайджане. В настоящее время водохранилище, помимо орошения, обеспечивает население г. Лянкяран пресной питьевой водой. Учитывая эти преимущества, в статье даны основные морфометрические показатели Ханбуланчайского водохранилища и по результатам анализа образцов, взятых в водохранилище в июне и декабре 2018 года, была определена степень ее минерализации и дана оценка современного экогеографического состояния.

Цель исследования – оценка современного состояния качества воды Ханбуланчайского водохранилища, определение путей эффективного их использования, а также решение проблемы снабжения региона водой.

Методология. Анализы проводились с использованием спектрометрических и катометрических методов.

Вывод. В лабораторных условиях были проведен анализ нормы содержания микроэлементов в воде, пути их использования и определения ее пригодность для ежедневного потребления людьми.

Обеспечение населения города Лянкяран питьевой водой, а также нынешнее экологическое состояние Ханбуланчайского водохранилища, построенного для орошения пахотных земель, можно считать удовлетворительным.
Основываясь на пробах воды, взятых из водосборного бассейна Башаручай и Ханбуланчайского водохранилища, можно сказать, что здесь количество добавочного вещества увеличивается в 3,6 раза в зимние месяцы и уменьшается в 1,9 раза в летние месяцы. Это связано с экономической активностью людей в бассейнах рек.
Уровень загрязнения воды в Ханбуланчайском водохранилище минимален и соответствует стационарным нормам.
Ключевые слова: Лянкяран, Ханбуланчай, Башаручай, водохранилище, водораздел, степень минерализации, экологическая и географическая оценка.

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