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QUALITY INDICATORS OF IRRIGATION WATER IN THE GANJA-GAZAKH SLOPING PLAIN

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Abstract. In the paper the irrigation water in the Ganja-Gazakh sloping plain of Azerbaijan is analyzed. It is shown that the amount of phosphorus in the water of the soil irrigation sources in the study area changes between 0.23-0.32%. The highest amount is 0.32% in Kura river and Shamkir channel, and the lowest indicator was 0.23% in the source called Artesian 1 in Agasibeyli village, the amount of K2O is quite high and is 2.47-3.37mg/l. The water samples taken from Goshgarchay and Ganjachay waters of which are used for irrigation of lands in the territory of Samukh district are analyzed. According to the results of the analysis, the amount of salt in the waters of Goshgarchay was 0.222 g/l, and in Ganjachay it was 0.367 g/l.

Keywords: *water, soil, relief, river waters, groundwater, artesian wells, salinization, humus, floods, floodwaters.*

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1. Introduction

The soils of the Ganja-Gazakh economic-geographical region of Azerbaijan allow to cultivate many valuable plants in the conditions of sufficient heat, light, and long-term vegetation, and to engage in animal husbandry fed by grazing and pastures all year round. Azerbaijan has a unique and complex land cover that has been created as a result of many ecological processes. The complexity of ecological conditions is reflected in the occurrence of a number of soil types, subtypes of soil and smaller soil units.

The land cover in the Ganja-Kazakh region is also characterized by its diversity. Here there are mainly grassland, mountain meadow, steppe mountain meadow, mountain meadow-forest, brown mountain forest, brown mountain forest, steppe mountain-brown, meadow-alluvial soils, gray brown (chestnut brown), gray soils, etc. is spread. The relief of the Ganja-Gazakh region has a complex structure, and its height varies from 300 meters to 3722 meters. The soil and climate conditions allow them to cultivate potatoes, horticulture, fruits and vegetables, and grain plants (Jafarov *et al*., 2013).

2. Research methodology

The climatic conditions and humidity of the Ganja-Kazakh plain do not allow agricultural plants to be grown in the dry-farming enterprise. Therefore, irrigation is applied to all cultivated lands.

Depending on irrigation methods, irrigation regulation, as well as defined water norms and regimes, soil transformation occurs in different directions in the indicator of

irrigation water application. Before the mentioned ones, the quality indicators of irrigation water have a greater influence on soil transformation (Pakhomov, 2016).

The quality indicator of irrigation water has always been the focus of researchers. There is enough research data in this direction both in our country and in the world.

In the scientific literature, the first information about the quality indicator of the irrigation source in the research area belongs to F.P. Savarinsky. He determined that 1.25% of the water used for irrigation in Aghasibeyli village in Samukh region is thick dry. He mentioned the negative effects of water with that composition on the soil.

A.I. Rozanov and N.I. Kondorskova ratios provided comprehensive information about the quality indicators of irrigation water sources available in the area we studied. In the following years, research works of great importance in this direction were carried out. V.H. Hasanov generally applied the composition of river, soil and spring (water, unsuitable for drinking) waters in this area and their mineralization and change depending on their topic. The researcher analyzed the flowing river waters of the Ganja-Gazakh Kura river, the sewage waters of all undrinkable , impure water sources created in subasars (watered meadows) and determined their main composition indicator. It also showed the quality changes of these waters according to the analysis. V.H. Hasanov characterized the role of these waters in soil cultivation, their seasonable suitability for use depending on their chemical composition, and the possibilities of irrigation. During the research phase, we took samples from the main irrigation sources, artisanal well waters, Kura river, Shamkir canal, Goshgarchay and Ganja rivers, and analyzed them in the laboratory. The quality indicators of the composition were studied by taking samples from two artesan wells located in the territory of Agasibeyli village, which are mostly used for irrigation, and from two more artesan wells, (a well whose water comes out spontaneously under natural pressure) which are considered to be an important source of irrigation located between the village of Ahmedbeyli and the Kura river valley, located northeast of it.

3. Results

We determined in the laboratory that the water from the artesan well operating in the village of Aghasibeyli has the highest salt content. The salinity of the water of the well, which we call Artizan-1, was 0.847 g/l, while the water of Artizan-2 was more salty, 1.136 g/l (Table 1) (Babayev *et al*., 2011).

The amount of Na+ in Artizan-1 was 0.109 g/l or 4.78 m-equivalent, and the amount of HCO3- was more like 0.307 g/l. The water content of this artisanal well is Ca+Mg- eq. according to the indicator, it was 7.82. From the content indicator, it turns out that this water is hard and unsoft, it is quite insignificant to use it for irrigation and domestic use. Because this water contains a lot of dissolved salt. Undoubtedly, the influence of these waters on the anthropogenic transformation of soil properties is great (Hasanov, 2013).

The water of the artizan-2 well located in the village of Agasibeyli, which we mentioned above, is more salty. The amount of salts in the water of this well was 1,136 g/l. The amount of Na+ in the water of this well is 0.143 g/l or 6.25 m-eq. It has been noted that The amount of SO4-2 is 0.390 g/l or 8.12 m-eq. The content of CO3-2 in these artesian waters is much higher. This indicator is typical for underground water.

Table 1. Ion content and average indicators of mineralization of irrigation water sources in the study areas

The water source from which the sample was taken	Time of sampling	Total g/l of salts	$\frac{q/l}{m-ekv}$							Ca+Mg m-equivalent cod indicator
			CO_3^{-2}	HCO_3	Cl	$SO_4^{-}{}_2$	Ca^{2+}	Mg^{2+}	Na^{+}	
Agasibeyli village Artizan –1 Artizan –2	18.03.2018	0,847	0,062 / 2,08	0,307 / 5,04	0,042 / 1,20	0,206 / 4,28	0,069 / 3,49	0,052 / 4,33	0,109 / 4,78	7,82
	19.03.2018	1,136	0,005 / 0,16	0,317 / 5,20	0,106 / 3,04	0,390 / 8,12	0,130 / 6,54	0,045 / 3,73	0,143 / 6,25	10,27
Ahmadbeyli village Artizan-1 Artizan –2	20.04.2018	0.680	0,012 / 0,40	0,151 / 2,48	0,119 / 3,36	0,200 / 4,16	0,053 / 2,67	0,035 / 2,94	0,110 / 4,79	5,61
	28.04.2018	0.577	0,012 / 0,40	0,219 / 3,60	0,039 / 1,20	0,145 / 3,02	0,064 / 3,22	0,015 / 1,29	0,083 / 3,63	4,41
Kur River	21.05.2018	0.293	–	0,132 / 1,92	0,020 / 0,56	0,067 / 1,39	0,042 / 2,12	0,014 / 1,19	0,018 / 0,80	3,31
Shamkir channel	31.03.2018	0.295	–	0,122 / 2,00	0,031 / 0,88	0,066 / 1,37	0,044 / 2,21	0,017 / 1,38	0,015 / 0,66	3,59
Goshgar river	20.03.2018	0.222	–	0,107 / 2,08	0,014 / 0,40	0,044 / 0,92	0,026 / 1,29	0,011 / 0,92	0,020 / 0,87	2,31
Ganja river	20.03.2018	0,367	–	0,190 / 3,12	0,011 / 0,32	0,072 / 1,50	0,069 / 3,42	0,014 / 1,14	0,011 / 0,38	4,56

There are different types of land reclamation. Types of amelioration are classified according to their purpose and methods of implementation of amelioration measures

There are such types of reclamation according to its purpose as: irrigation reclamation (creating artificial moisture to increase soil productivity); drainage melioration (removal of excess water from the soil); regulatory reclamation (removal of excess salts harmful to agricultural plants); melioration against erosion (measures taken to protect the soil from washing and disintegration) (Abduev *et al.*, 2012).

After the washing of the plots of land is completed, appropriate cultivation operations should be started immediately to prevent evaporation. Drains, farm and field channels should be cleaned regularly and water stagnation in the drains should not be allowed. The starting and ending time of washing, arat (plowed, watered and seeded land) and irrigation and its irrigation norm should be followed correctly, uncontrolled flow of water should not be allowed, and a shift work method should be created. It should be taken into account that as a result of the implementation of the mentioned measures, by preventing water loss and repeated salinization, favorable conditions will be created for the improvement of soil fertility and efficient use.

The supply of irrigation water to agricultural fields in excess of the required rate creates a very harmful soil for the development of agricultural plants, and the water permeability of the soil decreases. Also, excess irrigation water washes away the fertile layer of the soil. This process is most often observed in irrigation with excessive water consumption in areas with large slopes. The negative impact of irrigation water on the soil can be prevented by strictly controlling the water supplied to the fields, choosing the correct irrigation methods and implementing suitable agrotechnical cultivation measures. During the irrigation of plowed and softened fields, the water seeping into the deep layers washes the silt particles and carries them to the sub-plough layer. This creates a compressed soil layer at different depths. When irrigation is carried out frequently and with large rates, the plow layer is compacted ahead of time, and this has a negative effect on the development of plants. This cannot be allowed. During the use

of excess irrigation water, part of the water seeps into the lower layers of the soil and causes the groundwater to rise. This leads to swamping and salinization of the soil, and as a result, the arable land areas decrease (Imanov *et al*., 2017).

The waters of Artizian-2 are harder. The sum of Ca+2 + Mg+2 is 10.27 eq. We do not use such water for irrigation, it is a condition for plants and soil. But since there is no other source of water here, this water is used. Here HCO3 is added to 0.317 g/l, Cl increases to 0.106 g/l. Waters with such structure result in intensive salinization and anthropological transformation of the soil. Water from an artesian well in the territory of Ahmadbeyli village is more accessible for irrigation. But these waters also contain dangerous salts. The artesian waters around this village are used for irrigation and domestic purposes throughout the year. The addition of salt in Artizian 3 is 0.680 g/l where the addition of Na-1 is 0.110 g/l or 4.79 m-eq. contane. These waters also contain Ca^{+}, Mg^{+} m- eq. total is 5.61. İn Artisian 4, Ca^{+} M^{+} m- eq is underutilized with only 4.41 m- eq. The effect of such waters on the soil is not so great. As mentioned, the salinity of both selected artesian waters is not so high . (Selezneva *et al*., 2020).

Crops located in the subasar and terraces of the Kur River in Samukh region are irrigated with Kur waters. Pumps and transmission pipes are used to deliver water to crops. Alluvial-meadow and light-gray brown soils are common in these areas. According to the results of the analysis of the samples taken from the water of the Kur River in this part, the salinity was 0.293 g/l. CO_3 was not observed in these waters. The amount of HCO_3 is 0.132 g/l or 1.92 m-equiv. has been determined.

The role of effective use of available land and water resources in increasing the production of agricultural products is very large. It should be noted that the irrigated lands are mainly located in the plain-arid zone of the republic, which is characterized by its own warm climate, low atmospheric precipitation (200-300 mm) and the complexity of soil and climate conditions. Timely and correct irrigation of plants is of particular importance. Timely irrigation depends, first of all, on keeping the collector-drainage and irrigation systems and the hydrotechnical facilities on them in good condition.

The development of the agricultural sector in Azerbaijan is based on irrigation farming as a whole. Thus, 85-90 percent of crop production, all cotton plants are grown on irrigated lands. Ensuring the economic efficiency of irrigated agriculture can be achieved by obtaining a stable and high yield from agricultural plants, using all resources economically, maintaining the melioration status of the land at a normal level, agrotechnically and technologically correct and accurate irrigation and operational management 10 (Rustamov *et al.,* 2014).

The total of Ca^{+2} + Mg^{+2} is 3.31 m-eq, such waters are considered very hard, suitable for irrigation and domestic work. Experience shows that negative transformation is not observed in lands irrigated with such water.

The Shamkir reservoir has been built, extended to the northern part of Ganja city, and the Shamkir canal is used for irrigation of the lands we are conducting research on. It is important to prepare and use the water of this channel in any way. Because the mass of water entering this channel remains in the reservoir and flows into the channel, it is transformed at least a little. But in general, the indicators correspond to the composition of Kur river water (Table 1). It should be considered safe to irrigate the soil in these waters.

Goshgarchay and Ganjachay waters can be used for irrigation of lands in Samukh region. Therefore, we have analyzed the water taken from these rivers. According to the

results of the analysis, the addition of salt in the waters of Goshgarchay was 0.222 g/l, and the increase in Ganja was 0.36 g/l. There is no hardness in the waters of Goshgarchay, so the total of Ca^{+2} + Mg^{+2} is 2.91 m-eq. In Ganjachay, this indicator is 4.56 square meters. Na^{-1}-in is very low in both river waters.

From the above analysis, it is possible to conclude that these waters used for irrigation can play a role in soil transformation to a varying extent. Irrigation with these waters allows the accumulation of harmful salts in the soil. The relative slope of the irrigated land surface can create conditions for natural deepening. However, this cannot be said for all areas.

At present, the main task before us in the field of agriculture is to increase the productivity of all cultivated plants, the quality indicators of the product, and to expand the injured areas for planting as a result of reclamation measures. This requires learning ways to increase the fertility of lands that have been used for a long time and to improve the fertility of low-fertility lands at a substantial speed (Allahverdiyev *et al*., 2021).

Along with irrigation water, valuable elements and substances enter the soil. These elements and substances mainly have a positive effect on soil fertility. First of all, they settle in the composition of dissolved and silty materials in this water. One of the main indicators of irrigation water is its turbidity.

Artesian waters are not turbid in the areas of our study, but river and main canal waters are mostly turbid to varying degrees (table 2). Turbidity in Kur river is 2.28 g/l, in Shamkir channel this indicator is 2.88 g/l. This indicator was 0.56 g/l in Goshgarchay, and 0.48 g/l in Ganja river. It is known that turbid waters are rich in valuable nutrients. The soil irrigated with these waters has a high fertility rate. The analyzes show that the samples taken from the spring water contain humus, nitrogen, phosphorus and other biogenic elements. The amount of humus in the sediments obtained from the waters of the Kura River was 1.48%, and in the sediments from the Shamkir canal it was slightly less, 1.31%. This indicator is much less observed in Goshgarchay and Ganjachay waters (table 2).

Table 2. Turbidity and chemical composition of irrigation water sources in the study area indicator

The water source from which the sample was taken	Turbidity	Humus %	Nitrogen %	Phosphorus %	K_2O mq/l	common mineral	pH q/l	NH_4 mq/l	NO_2 mq/l	Fenol mq/l
	Agasibeyli village									
Artizan-1	--	--	0.12	0.23	2.93	2.93	8.2	0.02	0.03	0.21
Artizan-2	--	--	0.13	0.26	2.88	2.99	8.1	0.01	0.03	0.22
	Ahmadbeyli village									
Artizan-1	-	--	0.13	0.25	2.79	2.01	8.1	0.02	0.04	0.19
Artizan-2	-	--	0.14	0.31	2.82	2.05	7.9	0.02	0.03	0.18
Kur River	2.75	1.48	0.13	0.32	3.37	1.27	7.4	0.05	0.05	0.37
Shamkir river	2.28	1.31	0.21	0.32	3.36	1.12	7.5	0.02	0.05	0.38
Goshgar river	0.56	0.64	0.10	0.28	2.47	1.38	7.8	0.02	0.04	0.42
Ganja river	0.48	0.72	0.12	0.29	2.56	1.41	7.3	0.03	0.05	0.41

Research shows that all water is observed to contain nitrogen. In the water of the Kur River and Shamkir canal, its amount is 0.23-0.21%, while in other water samples, this figure is relatively small and mainly 0.10-0.14%.

The amount of phosphorus in the water of the soil irrigation sources in the study area is between 0.23-0.32%. The highest amount was 0.32% in Kur river and Shamkir canal, and the lowest indicator was 0.23% in the source we call Artizan 1 in Agasibeyli village, the amount of K_2O is quite high and is 2.47-3.37mg/l.

Artesian waters differ in the level of mineralization and mainly vary between 2.01-2.99 g/l, in river waters this number does not exceed 1.22-1.41 g/l. Irrigation waters in Samukh district are mostly alkaline. The amount of ph in artisanal waters is 7.9-8.2, while in river waters it is between 7.3-7.8.

Irrigation water also contains NH_4 and NO_2. The amount of Nh4 is mainly 0.01-0.03 mg/l, and the amount of NO2 is 0.03-0.06 mg/l. Laboratory analyzes have shown that phenol is found in the irrigation water here. Its amount in river water is relatively high and it is 0.37-0.42 mg/l. In artisan waters, this is not higher than 0.18-0.22 mg/l.

From the analysis, it is known that there are enough mixtures in the irrigated lands in the territory of Samukh district. These chemical mixtures can undoubtedly affect the transformation of soils. In each vegetation period, the soil receives an average of 600 m3 per hectare of water, which creates conditions for the accumulation of a large amount of mineral and biogenic elements in the soil and its transformation (Gurbanov *et al*., 2009).

4. Conclusion

We determined in the laboratory that the water from the artesan well operating in the village of Aghasibeyli has the highest salt content. The salinity of the water of the well, which we call Artizan-1, was 0.847 g/l, while the water of Artizan-2 was more salty, 1.136 g/l From the content indicator, it turns out that this water is hard and unsoft, it is quite insignificant to use it for irrigation and domestic use. From the content indicator, it turns out that this water is hard and unsoft, it is quite insignificant to use it for irrigation and domestic use. Water from an artesian well in the territory of Ahmadbeyli village is more accessible for irrigation. According to the results of the analysis, the addition of salt in the waters of Goshgarchay was 0.222 g/l, and the increase in Ganja was 0.36 g/l. There is no hardness in the waters of Goshgarchay, so the total of Ca^{+2} + Mg^{+2} is 2.91 m-eq. In Ganjachay, this indicator is 4.56 square meters Artesian waters differ in the level of mineralization and mainly vary between 2.01-2.99 g/l, in river waters this number does not exceed 1.22-1.41 g/l. Irrigation waters in Samukh district are mostly alkaline. The amount of ph in artisanal waters is 7.9-8.2, while in river waters it is between 7.3-7.8.

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