Possibility of using the Caspian Sea in agriculture with water shortage

Narmina Aliyeva, *Sattar* Ibraqimov, and *Maya* Abdullayeva*

Azerbaijan State Oil and Industry University, Baku, Azerbaijan

Abstract. The article provides information about the possibility of using Caspian Sea water as irrigation water for growing crops under current drought conditions in the republic. The studies carried out studied the chemical composition and degree of mineralization of the water of the Caspian Sea, and studied its effect on agricultural plants by mixing it with both clean and irrigation water in different proportions. In addition, the effect of seawater on washing saline soils was studied and it was found that loamy and clayey soils with a salinity level of less than two percent and a density of up to 5-6 g/l could be washed with seawater. Seawater with a concentration of 10-12 g/l can be used to wash highly saline and saline soils. It is also possible to wash soils with a light mechanical composition with natural seawater. In all three cases, at least 5000 m3 of fresh water per hectare is recommended to completely flush and remove residual salts from the soil.

1 Introduction

The rapid development of agriculture in our country, the annual expansion of irrigated fields and the growing need for domestic fresh water have made the use of salt water, especially sea water, one of the most important problems of our time [1-4].

The use of salt water in agriculture has accumulated a wealth of experience in recent years in our republic and in foreign countries. The studies carried out show that, on scientific grounds, widespread use of sea water in agriculture is possible. The main amount of dissolved salts in sea water (up to 65-70%) is NaCl salt. At the same time, this water contains many compounds useful for plants (microelements, organic substances, microflora, oxygen). The main feature of this water is that its content is regulated. The toxic effect of any ion is neutralized by the presence of another ion [5-7].

In recent years, employees of the Azerbaijan State University of Oil and Industry have conducted a number of scientific studies related to the suitability of sea water for irrigation and leaching, the optimal mineralization of water to be used, determining the amount of water required for irrigation and leaching, the influence of sea water on soil processes and etc.

The purpose of the study is to identify alternative sources of water in conditions of current water shortage in our republic and to study the possibility of using non-traditional irrigation waters both for flushing saline soils and using them as irrigation water.

* Corresponding author: mayaabdullayeva@hotmail.com

The object of study is the waters of the Caspian Sea, the largest body of water in our republic. [8].

2 Experimental part

The experiments were carried out mainly in laboratory and experimental growing conditions. For this purpose, soil samples were brought from various areas of the Kura-Araz Plain and the Absheron Valley. Soil samples varied in mechanical composition, level of flatness, and percentage of salts in the soil. Thus, a soil sample taken from the Ujar region is heavy clay-saline (4.6% dry matter), light clay-saline from the Zardab region (salt content 3.0%), and the soil brought from the Agdash region is heavily grained and highly salted. The lands of the Absheron valley were sandy soils.

To study the changes occurring in the soil because of the use of seawater, the soil was washed with both seawater and distilled water through physical modeling in laboratory conditions. The main essence of physical modeling is that it is possible to work with various samples in a short time. Before leaching, the basic properties of the soils were determined. After this, the prepared samples were mixed in a flask with sea water 1:3; 1:5; 1:10; 1:20. It was mixed in proportions of 1:50 (№1 – soil, №2 – water) and after shaking for 3 minutes, kept for 24 hours and filtered through filter paper.

The filtered solution was fully analyzed. After this, the soil left in the filter was dried in air, crushed and re-sifted, and the chemical composition of these soils was determined by the method of complete water analysis, as well as the amount of residual gypsum and absorbed bases in the soil after washing, carbonization and reaction of the soil solution currently on the territory of the republic. are determined based on existing and widely used methods [9].

3 Results and discussion

In order to determine the values (parameters) of sea water suitable for irrigation, water samples were taken from the coast of the Caspian Sea, in the area of the village of Pirshagi, both in its natural state and in a ratio of 1:3; 1:5; 1:10; 1:20. Full chemical analysis was carried out after mixing with distilled water in proportions of 1:50. At this time, the amount of fresh water needed to mix it with plain water of different mineralization and for irrigation was determined. Taking soil and water in different proportions during leaching made it possible to find the optimal leaching speed. In addition, it was possible to determine the changes that occurred in the washed away soil at different rates. To determine the optimal concentration for irrigation, seawater of different concentrations was taken.

As a result of calculations, it was established that with a soil-to-water ratio of 1:3, the water norm is 4.5 thousand m3 per hectare, 1:5; 1:10; 1:20; 7.51 in a ratio of 1:50; 15; thirty; and was equal to 75 thousand m3. Determining the irrigation rate and optimal density of seawater through modeling is more convenient than field experiments. This method is quick and easy. Repeating the experiment several times provides more accurate information. The composition of the water of the Caspian Sea in different seasons of the year is shown in Table 1.

Table 1. Chemical composition of Caspian Sea water in different seasons of the year, g/l.

№	Na_2CO_3	$Ca(HCO_3)_2$	$CaSO_4$	$MgSO_4$	$MgCI_2$	NaCI	Total salts
1	0,026	0,279	0,965	3,079	0,562	10,070	14,981
2	0,025	0,257	0,880	2,826	0,516	9,243	13,755
3	0,008	0,297	0,850	2,942	0,442	8,442	12,961
4	0,049	0,299	1,018	3139	0,341	8,697	13,542
5	0,020	0,281	0,908	3,058	0,326	8,198	12,791

According to the anion composition, the water of the Caspian Sea belongs to the chloride type, and according to the content of cations, to the calcium-sodium type. Due to the fact that the main part of the flat composition consists of motor and easily washable chlorides and harmful salts in sea water (except NaCl) are significantly lower than the accepted standards for irrigation water (MgSO4 - 5 g/l, MgCI2-4 g/l) , made the water of the Caspian Sea salty it is important to make the soil suitable for washing and watering crops.

In this case, a certain portion of the required flushing rate must be carried out with fresh water at the end of flushing.

Depending on the type of plant, when using seawater for irrigation, it is advisable to mix it with fresh water or alternate salt and fresh water when watering. At this time, the amount of irrigation with demineralized water should be determined depending on climatic conditions. To determine the amount of mixing of sea and fresh water, their ratios were taken to be 1:1; 1:3; 1:5; 1:10; 1:20; 1:50 and chemically analyzed.

From the analysis results given in Table 2, it is known that with close proportions of the mixture of seawater and distilled water, it is more similar to seawater in composition, and irrigation water (fresh water) is significantly preserved. For example, the salinity level is 14 g per liter when mixing sea water with fresh water in a 1:1 ratio, the degree of salinity is reduced to 7 g, and fresh water is saved up to 50%. Water is saved by 25%. When watering agricultural plants 3-3.5 g. salt water has no harmful effects. The results of many mixed water samples show that when seawater is mixed with fresh water, the overall degree of salinity is significantly reduced, but its qualitative composition does not change.

Table 2. Amount of salts in various mixtures of sea and distilled water, %.

Water type	Na_2CO_3	$Ca(HCO_3)_2$	$CaSO_4$	$MgSO_4$	$MgCI_2$	NaCI	Total salts
natural	0,20	1,90	6,40	20,50	3,70	61,30	100
1:1	-	2,30	8,10	24,30	2,90	62,40	100
1:3	-	2,40	9,80	22,70	3,70	61,40	100
1:5	-	2,50	10,20	22,50	4,20	60,60	100
1:10	-	2,70	8,30	23,70	3,30	62,00	100
1:20	-	3,20	8,30	23,30	4,10	61,10	100
1:50	-	2,90	9,70	23,30	1,90	62,20	100

With this in mind, when mixing seawater with fresh water, the total flatness level should be kept at 3.0-3.5 g, and the amount of NaCl-flat should be kept at 2 g per liter or lower. In this case, the amount of other harmful substances will also be below the toxicity threshold.

In experiments carried out in the direction of leaching of saline soils, soil types with different mechanical compositions were tested, and thus both the degree of salinization and the factors of the mechanical composition of soils common in the irrigated territory of the Republic of Azerbaijan were studied.

Analogues of certain lands under consideration are widespread in the Absheron region and areas located along the Caspian coast (Sumgait, Khazmaz, Salyan, Neftchala, etc.). Table 3 presents the results of washing the heaviest, lightest and salt-free soil (Absheron) and the heaviest saline soil (Ujar) by mechanical composition.

Table 3. Amount of residual salts in soils washed with sea water, as a percentage per 100 g of soil.

Water salinity, g/l,	**Soil to water ratio**				
	1:3	1:5	1:10	1:20	1:30
Soil of the Absheron region					
Before washing	0,74	0,74	0,74	0,74	0,74
Distilled water	0,060	0,059	0,057	0,061	0,063
Sea water:					
3	0,115	0,121	0,119	0,118	0,118
5	0,126	0,128	0,135	0,150	0,148
10	0,144	0,156	0,164	0,164	0,164
14	0,195	0,224	0,232	0,218	0,205
Soil of the Ujar region					
Before washing	4,728	4,728	4,728	4,728	4,728
Distilled water	1,862	1,558	1,554	0,793	0, 638
Sea water:					
3	1,966	1,758	1,458	1,143	0,872
5	2,006	1,837	1,607	1,247	0,912
10	2,144	1,994	1,702	1,392	1,317
14	2,156	2,063	1,902	1,728	1,463
Soil of Zardab region					
Before washing	3,058	3,058	3,058	3,058	3,058
Distilled water	1,120	0,744	0,295	0,158	0,119
Sea water:					
3	1,329	0,941	0,525	0,366	0,236
5	1,295	1,026	0,615	0,367	0,291
10	1,629	1,453	0,971	0,673	0,612
14	1,991	1,730	1,350	1,004	0,698

The experimental results showed that increasing the flushing rate when using seawater affects the reduction of both the absolute and relative amount of harmful salts in the residual salts in heavy clay lobes. Increasing water hardness leads to an increase in the absolute amount of harmful solids, while the relative amount remains virtually unchanged. From this we can conclude that after washing heavy clay brines with sea water of varying

concentrations, although the residual salinity in the soil is high, the amount of harmful salts in its composition decreases.

The main part is gypsum and carbonate salts. residual salts. Washing soils or highly saline soils with sea water in any volume and concentration changes the type of soil salinization. This is mainly due to an increase in sulfates. This also shows that although seawater is rich in chlorides, chlorides do not accumulate in the soil during the leaching process. Only when flushed with natural seawater does chloride accumulate in the soil. More ions accumulate in the soil during and before leaching.

Therefore, the type of soil and water salinity should be considered when selecting areas for seawater leaching. In this case, there should not be a sharp difference between them in terms of salinity.

4 Conclusion

Summarizing the data obtained as a result of the research, the following conclusions were made:

- weak and moderately saline soils with salinity up to 2% can be washed with seawater in a concentration of up to 5-6 g/l.
- in this case, the leaching rate should not exceed 10-12 thousand m3 per hectare..
- when washing highly saline soils and saline soils, you can use seawater with a concentration of 10-12 g/l (natural seawater can be included). At the same time, the leaching rate should not be taken from 12-15 thousand m3 per hectare.
- mechanically lighter soils and sandy beaches can also be washed with natural sea water.
- in all cases, at the end of reclamation activities, at least 5 m3 of fresh water per hectare must be supplied to complete leaching work and clean up residual plains in the soil.

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