SOME ECOLOGICAL CONSEQUENCES OF SOIL SALINIZATION (*ON THE EXAMPLE OF NAMANGAN REGION*)

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Annotation

The article examines some of the environmental consequences of soil salinization using the example of the Namangan region. The main focus was comparing the chemical composition of saline and non-saline soils with the average chemical composition of the Earth's crust and identifying the differences between them. An attempt was made to determine the extent to which the chemical composition of certain crops grown in saline and non-saline soils depends on the chemical composition of the soil. It was emphasized that there is a need to widely strengthen scientific research in this area.

Keywords: Earth's crust, saline soil, non-saline soil, chemical composition, chemical analysis, K, Ca, Cl.

As the world's population continues to grow, the demand for land and water resources is increasing. The development of non-farm and irrigated agriculture is no exception. It is not for nothing that the UN Sustainable Development Goals report states that "the degradation of agricultural and irrigated lands, the decline in soil fertility, continues, and this process not only hinders the development of all countries, but also threatens their security".

Asia leads the world in terms of water use. The continent has irrigated land of 211.8 million ha, accounting for 70% of global water use. America has 48.9 million ha (16%), Europe has 22.7 million ha (8%), Africa has 13.6 million ha (5%), and Oceania has 4 million ha (1%). It is known that artificial irrigation ultimately leads to soil salinization and exacerbates negative ecological processes.

According to world statistics, there are more than 833 million hectares of saline lands on Earth. These saline lands cover 8.7% of the planet's territory, mainly in arid and semi-arid regions of Africa, Asia and Latin America. 20-50% of them are highly saline. Therefore, more than 1.5 billion people in the world face serious problems in growing food due to land degradation.

The Central Asian region also faces serious problems related to land and water resources, and the proper use of water resources is the most urgent task today. The area of irrigated land in Central Asia is 10,018,151 ha, of which 3,971,782 ha are affected by salinity. 83.84% of the 1,995,000 ha of irrigated land in Turkmenistan, 44.43% of the 4,214,300 ha in Uzbekistan, 45% of the 719,200 ha in Tajikistan, and 33% of the 2,313,000 ha in Kazakhstan are saline lands.

The total irrigated area in Namangan region is 288 thousand hectares, of which 24,800 hectares are affected by salinity. The saline lands of the region are mainly in Mingbulok and Pop districts. 16 thousand 100 hectares in Mingbulok district, 7 thousand 600 hectares in the Pop district are saline. The need to study problems such as the abundance of salt particles in the air of saline lands in the region, their impact on the climate, and the increase in certain diseases among the population as a result of consuming crops grown in saline lands determines the relevance of the topic.

Among the first studies on the impact of soil salinity on the human body are the works of German scientists Wynder E.L. Hultberg S, Jacobsson F, Bross I.J. “Ecological factors in cancer of the upper digestive tract”[5], J.Kmet, E.Makhbubiy “Esophageal cancer”[6]. Huseynov “Soil salinity and esophageal cancer”[2]. In this regard, Uzbek scientists I.Asqarov, M.Ashuraliyeva. “Chemical elements in the human body”, O.K. Komilov “Reclamation of saline lands of Uzbekistan”, Kh.Kh. Tursunov, R.Kurvontoyev. Information on the topic is given in the works of G.Yuldoshev “Properties, ecological and reclamation status and fertility of irrigated soils of the Fergana Valley” and “Soil chemistry”. In their article "On the Need to Study the Effects of Soil Salinity on Diseases"[3], the authors discussed the consequences of digestive system diseases, diseases of the blood-forming organs, certain disorders related to the immune mechanism, and infant mortality in saline areas.

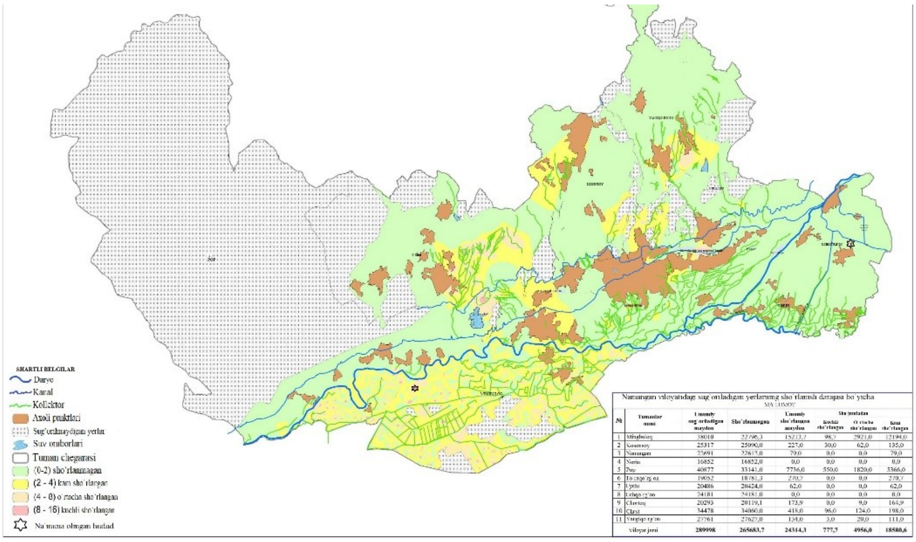
When assessing the level of study of the problem, it should be noted that there are significant uncertainties in the saline soils in the Namangan region [4]. Saline lands of varying degrees are most common in the Mingbulok (15213.8 ha) and Pop (7736.6 ha) districts of the Namangan region. Saline lands are not so extensive in the Chust (419.0 ha), Turakurgan (270.7 ha), Chortoq (173.9 ha), and Namangan (79.3 ha) districts of the region. To determine the difference in the chemical composition of saline and non-saline lands, samples were taken from the village of Gulistan of the Mingbulok district and the village of Kogay of the Uchkurgan district.

Main part. The study of saline areas and processes in them in Namangan region was carried out in Mingbulok district, where there are many saline areas, and in Uchkurgan district, where there are few saline areas.

The saline soil experimental site is the village of Gulistan, Mingbulok district, which is completely exposed to salinization. The selected area is located 12 km south of the Syrdarya basin and 10 km southwest of the village of Yangi Gulbog. The relief is flat. The area is open, with sparse vegetation.

Location of experience points

Figure 1.



The experimental site with non-saline soils is located in the village of Kogai Olmas, Uchkurgan district, 8 km southwest of the Naryn River basin and 3 km southeast of the village of Kogai. The relief is flat, the surrounding area is open, and rich in vegetation.

Soil samples were taken from these points and analyzed in the chemical laboratory of the Institute of Nuclear Physics of the Academy of Sciences of Uzbekistan. The results are presented in Table 1. This table presents the average chemical composition of the earth's crust for comparison with the data of A.P. Vinogradov [1].

Table 1

Comparison of the chemical composition of saline and non-saline soils with the chemical composition of the earth's crust.

Elements	In the Earth's crust (A.P. Vinogradov, 1962)	Saline soil	Non-saline soil
Fe	4,65	2,59	2,36
K	2,5	2,04	1,98
Ca	2,96	6,86	4,93
Na	2,5	0,99	0,65
Mg	1,87	2,15	2,21
Mn	0,1	0,049	0,056
Ba	0,065	0,09	0,077
Sr	0,034	0,028	0,022
Rb	0,015	0.0098	0,0089
Cl	0,017	4,76	3,61
Zn	0,0083	0,0096	0,0088
La	0,0029	0,0034	0,0035
Cr	0,0083	0,0055	0,0048
Ni	0,0058	0,0024	0,0022

Cu	0,0047	0,0048	0,0037
Sc	0,0011	0,00085	0,00079
Co	0,0018	0,00093	0,0009
Cs	0,00037	0,00077	0,00068
Hf	0,0001	0,00037	0,00036
Br	0,00021	0,00054	0,00039
As	0,00017	0,00094	0,00091
Mo	0,00011	0,00036	0,00035
Sb	0,00005	0,002	0,00019
Se	0,000005	0,000039	0,000046
Ag	0,000007	0,000014	0,000012
Au	0,0000009	0,000001	0,000001

Based on this table, their correlation graphs were constructed (Figure 2-3).

Figure 2

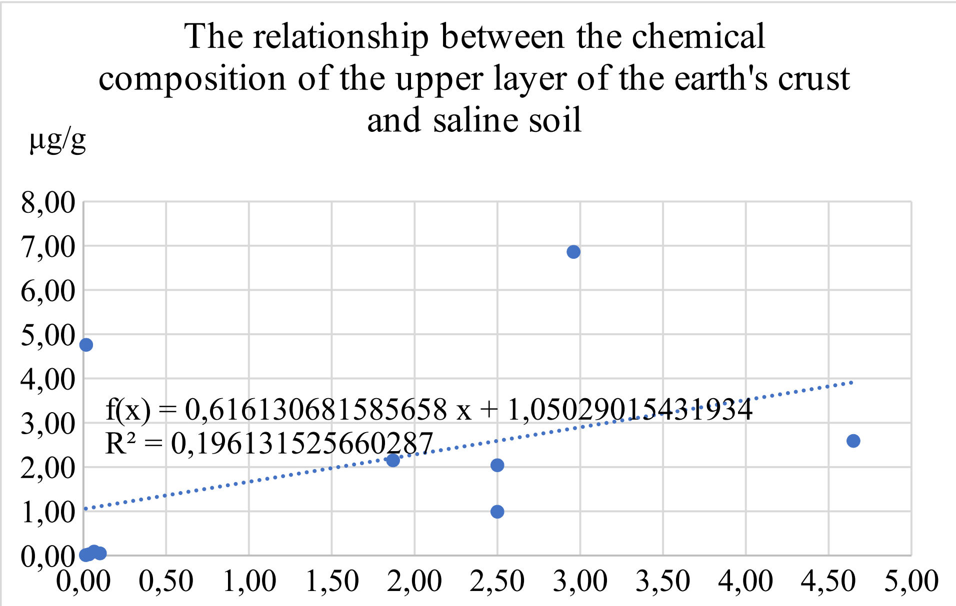
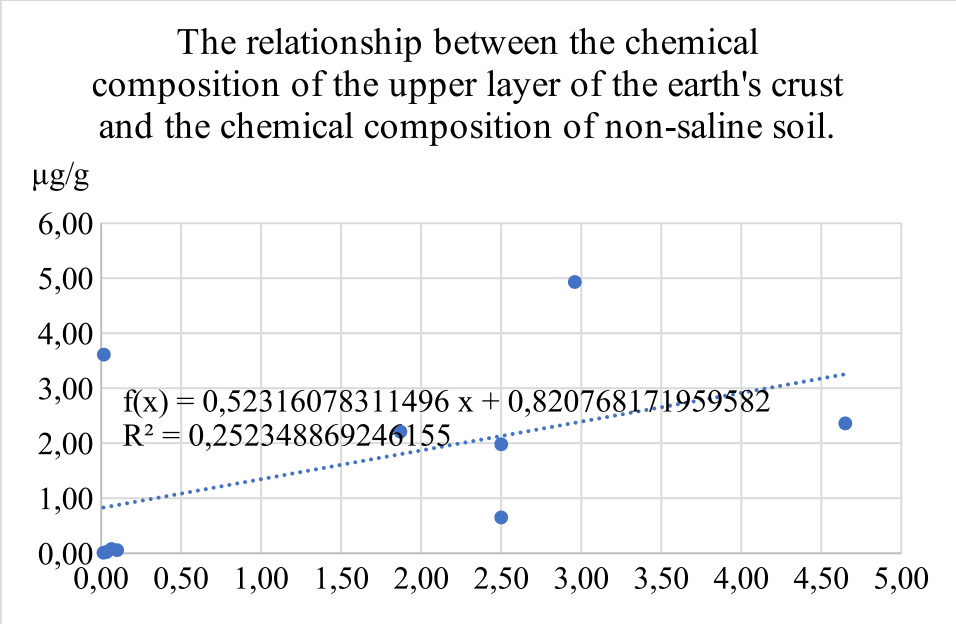


Figure 3



The graphs show that the correlation is positive in both cases. However, the degree of correlation is weak. The correlation between the chemical composition of non-saline soil and the topsoil is 0.5, and the correlation between saline soil and the chemical composition of the topsoil is 0.4, indicating that the correlation is somewhat weaker in saline soil.

Based on the graphs and tables, the total proportion of chemical elements that have a significant share in the composition of the upper layers of the soil and the soils is 15.79 µg/g in non-saline soils. It was 19.44 µg/g in saline soils. The proportion of the same elements in the topsoil is 14.59 g/t, and the chemical composition of non-saline soil and topsoil is very close to each other. Based on these data, elements that have a significant share in the chemical composition were identified. Based on them, the differences in the chemical composition of saline and non-saline soils were determined, and the results are presented in Table 2.

Table 2

Differences in chemical composition of crustal (1), saline (2) and non-saline (3) soils (%)

№	Elements	A.P. Vinogradov (gr/t)	Salty soil (µg/g)	non-saline soil (µg/g)	1-2	1-3	2-3
1	Fe	4,65	2,59	2,36	2,06	2,29	0,23
2	K	2,5	2,04	1,98	0,46	0,52	0,06
3	Ca	2,96	6,86	4,93	-3,9	-1,97	1,93
4	Na	2,5	0,99	0,65	1,51	1,85	0,34
5	Mg	1,87	2,15	2,21	-0,28	-0,34	-0,06
6	Mn	0,100	0,049	0,056	0,051	0,044	-0,007
7	Cl	0,017	4,76	3,61	-4,743	-3,593	1,15

The differences in the chemical composition of saline and non-saline soils are presented in Table 3. In saline soils, the elements Fe, K, Na were significantly higher than in non-saline soils. According to Table 2, the content of Ca in saline soils was 1.4 times higher than in non-saline soils, and the content of Cl in saline soils was 1.3 times higher than in non-saline soils. In non-saline soils, Mg was 1.02 times higher than in saline soils, and Mn was 1.14 times higher than in saline soils. These data indicate the main differences in the chemical composition of saline and non-saline soils.

Thus, the chemical composition of agricultural products grown on saline and non-saline soils, potatoes, tomatoes, carrots, onions, radishes, peppers, garlic, was analyzed in the above-mentioned chemical laboratory (Table 3).

Table 3

Chemical composition of soil and crops grown in it (μg/g)								
Elements	Saline soil		Non-saline soil		Saline soil		Non-saline soil	
	Soil	Plant	Soil	Plant	Soil	Plant	Soil	Plant
	Potato				Onion			
Fe	2,59	23	2,36	26	2,59	22	2,36	26
K	2,04	21000	1,98	21000	2,04	18000	1,98	13400
Ca	6,86	380	4,93	325	6,86	1800	4,93	1450
Na	0,99	57	0,65	61	0,99	500	0,65	420
Mg	2,15	1300	2,21	1260	2,15	1300	2,21	1240
Cl	0,049	970	0,056	550	0,049	900	0,056	380

Many elements are present in very small quantities both in the soil and in crops. Based on the table, a graph of the relationship between the chemical composition of the soil and the yield was constructed, and elements found in quantities exceeding 0.1 μg/g were identified (Table 3). The percentage of chemical elements found in significant quantities in the soil and in the yield is given in Table 3 for potatoes. According to the table, the content of the element K in potatoes does not differ at all in saline and non-saline soils, but has a large amount (21,000 μg/g), which approximately corresponds to its value in the soil. Despite the high content of the element Mg in the soil, its percentage in saline and non-saline soils is the same, but in both cases it is 15 times less in the crop. The element Na is 1.5 times less in non-saline soils than in saline soils. You will hardly notice any difference between the fruit from saline soil and the fruit from non-saline soil.

The Ca element in saline soil is 1.4 times more than in non-saline soil. The amount of Ca element in its crop is less. The Cl element in saline soil is 1.3 times more than in non-saline soil. The absorption of Cl element by plants is also significantly lower. Thus, the absorption of Cl element was the same in both cases.

The amount of Mg element was the same in both cases. Based on the above, it can be concluded that there are significant differences in the chemical composition of the soil in the saline area compared to the non-saline area. The largest difference is observed in the elements K and Ca. It is known that soil salinity also has a strong impact on productivity. In our example, cotton and grain yields in Mingbulak district are 1.5 times lower than in Uchkurgan district.

Table 3

Cotton and grain yields in Mingbulak-Uchkurgan districts (2010-2022)					
Name of the districts	Years	Grain area (ha)	Yield (s/ha)	Cotton area (ha)	Yield (s/ha)
Mingbulak	2010	8955	43,5	15856	21,7
Uchkurgan	2010	6622	66,7	10336	33
Mingbulak	2011	9065	44,9	15856	23,1
Uchkurgan	2011	6790	62,4	10336	35,6
Mingbulak	2012	8665	52,9	15856	23,1
Uchkurgan	2012	6990	71,1	11320	34,1
Mingbulak	2013	9365	51,7	15056	22,9
Uchkurgan	2013	7490	72,3	10336	34
Mingbulak	2014	8965	52,9	16056	23
Uchkurgan	2014	6790	75,1	10336	34,1
Mingbulak	2015	9201	57,2	16056	22,3
Uchkurgan	2015	7683	78,1	10336	33,6
Mingbulak	2016	8965	27	15906	17
Uchkurgan	2016	6790	36,4	10336	28
Mingbulak	2017	8965	55,7	15906	22,9
Uchkurgan	2017	6790	78,2	9836	26,6
Mingbulak	2018	8965	59,6	12916	25,2
Uchkurgan	2018	6790	77,5	9836	24,1
Mingbulak	2019	8965	61,4	12916	28,9
Uchkurgan	2019	6790	73,3	9436	32,3
Mingbulak	2020	9085	61,3	12916	30,5
Uchkurgan	2020	6890	69,1	9436	36
Mingbulak	2021	9085	70,3	12916	34
Uchkurgan	2021	6890	70,8	9436	33,7
Mingbulak	2022	9085	71,4	12916	38,5
Uchkurgan	2022	6890	73,5	9436	31,5
1 s=100 kilogramms. 1 ha=10000 m^2					

The table was compiled by the author based on data from the Namangan Regional Department of Agriculture.

Soil salinization can significantly change its chemical composition, which can also affect the chemical composition of crops grown in it. The high level of damage caused by soil salinization indicates the need for extensive scientific research and practical work to combat it.

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