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Soil Salinity In Irrigated Agrikulture And Methods Of Its Prevention

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Abstract
This article presents the results of observations that help to determine the causes of natural and anthropogenic salinity and to assess the melioration of irrigated soils in irrigated agriculture.
Also, one of the main indicators of the fight against salinity is the reduction of groundwater and its mineralization and evaporation.
Keywords: Saline soils, irrigated agriculture, groundwater, salinity, salt leaching, collector-sink systems.

Enter. Today, more than half of the irrigated agricultural lands in Uzbekistan suffer from salinity in varying degrees. It is known that soils with varying degrees of salinity yield much less than non-saline soils. As a result, salinization requires excessive labor and financial costs from peasants and farmers.
Historically, irrigated agriculture has had significant reductions in productivity due to high soil salinity, and there were no opportunities to cover the resulting costs. Therefore, such lands were considered unsuitable for future crop cultivation and were abandoned. In irrigated agriculture, there have been many cases of strong salinity when low salinity or non-saline land was irrigated for crops. As a result, irrigated cropland has often been left uncultivated as the land has become unusable.
Relevance of the topic. Salinity is one of the main soil processes that determine the productivity of arid soils, as well as the ecological status of arid and semi-arid ecosystems. Salinity of cultivated areas can be caused by natural and anthropogenic factors. The main factor determining natural (primary) salinity is the superiority of evaporation of moisture from the soil over precipitation, the proximity of the groundwater level to the surface of the earth, and the poor functioning of drains. Accumulation of various salts increases mainly in areas with arid climates, such as water-soluble salt reserves in bedrock or groundwater.
The second factor of salt accumulation is natural - it is aeolian input of salts. Two more sources of salts - biogenic and soil - are related to changes in the soil during soil formation. Their role in salt accumulation is significantly weaker than that of hydrogen and aeolian factors.
Anthropogenic (secondary) salinization is associated with the disruption of the natural development of soils and the landscape as a whole. It occurs as a result of anthropogenic and agrogenic pollution or the addition (compared to natural) of quickly soluble salts due to a change in the direction of natural processes. Secondary salinization can occur in a variety of natural areas, but most often occurs in arid and semi-arid conditions as a result of changes in natural hydrogeological and geochemical processes caused by irrigation.
The study of natural and secondary salinization processes is currently very relevant due to their active manifestation in different regions of the world [5].
Results and discussion. In irrigated agriculture, irrigation was used to improve

natural conditions, and this led to negative environmental consequences . As a result of irregular irrigation, the radical destruction of the natural environment changed the hydrogeological, hydrological, geochemical and soil processes, creating conditions for secondary salinization and increased desertification. A large amount of water used for irrigation leads to the rise of groundwater and soil salinity.

According to various estimates, about a million tons of agricultural products are lost in Uzbekistan every year due to low and moderate salinity. Low yields of cereals, vegetables and other crops in irrigated lands are in some cases due to salinity. For example, productivity decreases by 25-28% in low salinity lands, by 40-60% in medium salinity lands, by 80% and more in highly saline lands, and in permanent salinity fields (salt marshes) cotton plants die completely. Spot salinity causes significant damage to irrigated lands. Salinity areas in irrigated lands sometimes make up 20-40% of the cultivated area. In spotted salinity fields, the more salinity spots, the lower the yield. The yield of raw cotton in these fields is 10-12 centners per hectare, in non-saline lands it is 25-30 centners per hectare [4].

Among newly irrigated lands, there are many lands that are naturally prone to salinization during irrigation.

Therefore, measures to combat soil salinity are especially important when irrigating new lands. Currently, the science of land reclamation is more developed, practical experience in land reclamation has been accumulated, there are powerful techniques for carrying out land reclamation works in agriculture, land reclamation and irrigation are carried out according to the state plan, and the state has assumed the responsibility of carrying out heavy work.

Saline soils are an important component of steppe and desert landscapes. As drought increases, the proportion of saline soils in the soil cover increases.

Despite the accuracy of these obtained data, which is confirmed by geographical observations on the distribution of saline soils, mainly in hot, arid regions, their formation depends on many other factors: the geological structure and composition of rocks, the depth and mineralization of underground water, relief, hydrological regime, distance from the sea, wind regime and vegetation composition of the area, the economic method, purposes of rain, the properties and structure of the soil itself.

The direct cause of soil salinization is usually the evaporation of groundwater from the soil, since groundwater, with rare exceptions, contains some salts that remain in the soil after moisture has evaporated. It follows that the more the groundwater evaporates and becomes saline, the faster the soil becomes saline. Consequently, the main reason for the natural shallowness of groundwater in saline lands is the continuous upward flow of deep groundwater.

It was found that in dry, hot climates where irrigated agriculture is widespread, a layer of water 1.5-2.0 meters deep can evaporate from the surface of open water for a year, which is equal to 15-20 thousand cubic meters per hectare. At a depth of 4-6 meters of groundwater, evaporation is so low that it has almost no practical effect on soil salinity. For example, at a depth of 1 meter, the evaporation of groundwater is so great that, given its high mineralization, it leads to rapid and strong salinization of the soil.

The specific combination of groundwater depth, mineralization and evaporation rate determines the intensity of soil salinization and the difficulty of combating it. If we analyze the causes of soil salinity, we see that the primary methods of combating salinity are lowering the level of groundwater, reducing its mineralization, and reducing evaporation.

The unique combination of groundwater flow and evaporation from the soil explains not only the constant proximity of groundwater and seasonal fluctuations in its level.

It reveals the deeper and underlying cause of both soil and groundwater salinization. Centuries and centuries of groundwater seepage and evaporation have led to the accumulation of very large amounts of salts, for example, hundreds, often more than a thousand tons per hectare for the upper 10-meter layer. A significant part of the salt reserves is collected on the surface, near the evaporation surface, and the amount of salts decreases as the depth increases.

In conclusion of the brief description of the salinity of irrigated lands in the Central Asian region, it can be said that most of the irrigated lands in Central Asia and especially in Uzbekistan are salinized or at risk of salinization. More than half of the irrigated lands are characterized by unsatisfactory and unsatisfactory land reclamation. As noted, [3] the most active processes of anthropogenic (secondary) salinity are irrigation. 80-90% of the land of Turkmenistan is occupied by soils with varying degrees of salinity.

About 60% of irrigated land in Uzbekistan, 12% in Kyrgyzstan, and 18% in Tajikistan are affected by salinity.

Salinity of irrigated soils in Central Asia is characterized by different genesis: residual salinity associated with initial natural salinity of soil and rocks; secondary hydrogen salinization resulting from rising groundwater or changes in the soil water regime, and finally, salinization due to the intrusion of salts from the atmosphere (eolian salinization) and irrigation water. The salinity and salinity of irrigated soils in Central Asia are very diverse.

In the description of the salinity of the island's soils, the data of the analysis of the water extract (1:5) is mainly used.

Salt content is evaluated based on the ratio of ions, while salinity is evaluated based on total salt content, total toxic salt content, or content of individual ions. The criteria for evaluating soil salinity and salt content based on water extract analysis (1:5) are presented in Tables 1 and 2.

Abroad, data on the electrical conductivity of extracts from pastes is widely used in the classification of saline soils according to the degree of salinity (Table 3).

Its foundations were first laid in the fundamental works of land reclamationists and soil scientists [1, 2, 3, 4, 6, 5].

Assessment of salt processes requires not only a detailed study of the individual components and environmental factors that determine soil salinity, but also an examination of the relationships between them. It is important to determine the direction of the salt process and how all the elements of the salt balance are connected.

The entire system of combating salinity, including waterlogging of irrigated lands, should be based on measures that eliminate the main causes of these phenomena. Combating the effects of salinization and waterlogging of irrigated lands will yield the most sustainable positive results only when the possibility of re-salinization and waterlogging is completely eliminated.

Summary. Irrigated agriculture currently faces major challenges in increasing crop yield and productivity. For at least half of the conventionally irrigated lands, the most important, if not the most important, obstacle to this goal is their dehydration. Excessive salinity of the soil is the main obstacle to increase the yield of raw cotton in large areas from 10-12 quintals per hectare to the average 25-30 quintals, and to achieve high profitability from low productivity of farmer's labor.

Table 1. Indicators of soil salinity based on the sum of salts and chlorine content *(instructions, 1960)*

No.	Dense residue, %	Chlorine content, %	Degree of soil salinity	Effects of salinity on plant development

1	<0.3	<0.01	Unsalted	-
2	0,3-1,0	<0.3 <0.01 0.01-0.04	Lightly saline	Partial oppression
3	1.0-2.0 0.3-1.0	0.01-0.04 0.04-0.1	Moderately saline	Oppression
4	2.0-3.0 1.0-2.0	0.04-0.1 0.1-0.3	Highly saline	Strong oppression, places and death
5	>3.0	>0.3	Salt marshes	Complete destruction

Table 2. Classification of soils by determining the degree of salinity depending on the type (chemistry) of salinity *(Pankova, Bazilevich, 1970)*

No.	Salinity degree	Sulfate	Chloride-sulfate		Sulfate-chloride		Chloride
		Dense residue, %	Dense residue, %	Cl, %	Dense residue, %	Cl, %	Cl, %
1	Unsalted	<0.3	<0.1	<0.01	<0.1	<0.01	<0.01
2	Lightly saline	**0,3-1,0**	**0,1-0,3**	**0,01-0,05**	**0,1-0,3**	**0,01-0,04**	**0,01-0,03**
3	Moderately saline	**1,0-2,0**	**0,3-1,0**	**0,05-0,20**	**0,3-0,6**	**0,04-0,2**	**0,03-0,1**
4	Highly saline	**2,0-3,0**	**1,0-2,0**	**0,20-0,30**	**0,6-1,0**	**0,2-0,3**	**0,1-0,2**
5	Salt marshes	>3.0	>2.0	>0.30	>1.0	>0.3	>0.2

Note: *The sulfate type of salinity is determined only by the dense residue, the chloride-sulfate and sulfate-chloride - by the dense residue and chlorine, the chloride type of salinity only by the chlorine content.*

Table 3. Criteria for assessing the degree of soil salinity based on extracts from pastes [20]

Effects of soil salinity on crop yields	mS/cm at 25 0C	According to the saturated extract from the paste of 100 g of soil, %	Gradations according to the degree of salinity
Influence is negligible	Up to 2	**0-0,15**	Unsalted
Reduced yield of crops sensitive to salinity	**2-4**	**0-0,15**	Lightly saline
Same for most cultures. Decrease in yield of crops with average salt tolerance	**4-8**	**0,15-0,35**	Moderately saline
Reduced yields of medium- and highly salt-tolerant crops	**8-16**	**0,35-0,65**	Highly saline
Almost complete loss of harvest	**>16**	**>0.65**	Heavily and very highly salted

The most important means of combating soil salinity is drainage and well-planned land washing.

Drainage performs two main functions. First, it lowers the groundwater table, thereby reducing its evaporation and associated soil salinization. Secondly, a certain amount of salts is removed with drainage water instead, and with the decrease of the active salt layer, the salinization processes of the soil gradually weaken.

Consequently, none of the functions performed by drainage (lowering the groundwater table and removing salts) can achieve the intended goal of salinity removal. Therefore, although drainage is necessary in itself, it does not yet solve the problem of improving the reclamation of saline soils.

As for the washing process, when it is carried out using the traditional method (continuous flooding), it causes only a local, shallow, temporary movement of salts from the soil to the underground layers and groundwater, without significantly reducing the total salt reserves of the active layers. This happens because the washing method is not compatible with the drainage system. Thus, neither drainage without a saline flush, nor when used in coordination with drainage, can have an anti-salination effect. Therefore, drainage and salt washing should be considered as a single, indispensable tool in the fight against soil salinization.

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