

# The threat of saline lands, for example, in the Republic of Uzbekistan

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**Abstract.** Salinization of land poses a serious threat and harms all industries, including the environment, agriculture, economy, and so on. In this regard, this topic is very relevant today. The object of the research is the agriculture of the Republic of Uzbekistan. The aim of the study is the impact of saline soils on agriculture in the Republic of Uzbekistan. The current state of reclamation systems, the processes of soil salinization and the quality of irrigation water, as well as the features of the manifestation of secondary salinization on irrigated lands are analyzed. Analysis, observation, grouping and many other methods were chosen as research methods. In the conclusions, proposals were made to reduce the amount of saline soils. Greater efficiency of reclamation measures can be ensured by the complex consideration of natural factors in the design and the complex impact on them during the operation of reclaimed lands.

## 1 Introduction

The main problem of agriculture in all countries of the world is land salinization, this is one of the factors of desertification, which poses a serious threat to the national economy. There are about 950 million hectares of saline lands in the world, and every year about 10 million are lost due to salinization and alkalization.

Deserts and semi-deserts of Central Asia have a high air temperature, an arid climate, and little rainfall. A feature of such desert soils is the widespread salinity. Salt removal occurs in mountainous areas and most of the foothills. Getting to the plain, the salt-rich underground and surface waters are dispersed. In an arid climate, the evaporation process prevails over precipitation, and with poor soil drainage, the salt supply in the soil increases [1, 2].

Saline soils mean soils that contain, in their profile or in part, readily soluble mineral salts in quantities harmful to plants (more than 0.1-0.3%). The problem of soil salinization is global in nature and can harm the economy due to land desertification. And it also affects the agricultural yield, the negative impact of anthropogenic factors due to salinity reduces the irrigated land by more than 1 million hectares per year.

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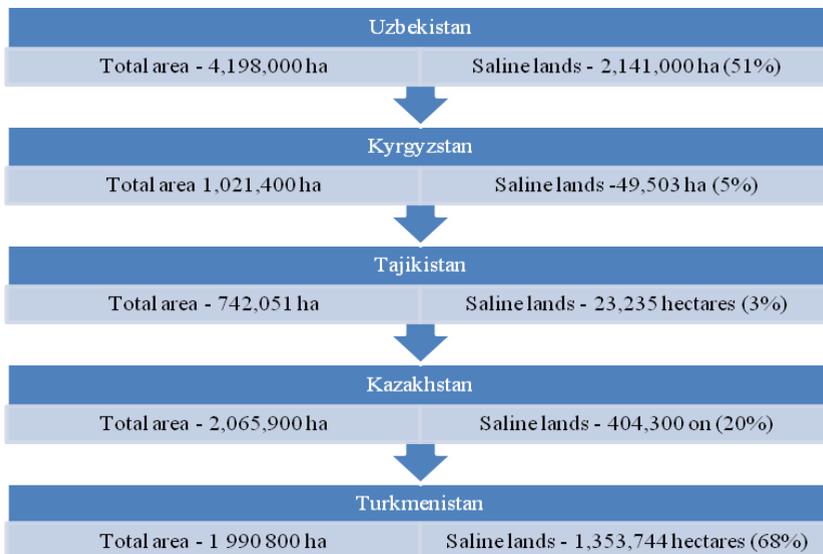
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In the world, the territory of saline soils occupies almost 25% of the entire surface of the Earth. Distinguish between primary and secondary soil salinization. Primary soil salinization is when the soil already contains impurities of various salts that have appeared due to the geographical location or the distribution of substances over the surface and overlying soil horizons is uneven. Secondary soil salinization is the result of an incorrectly chosen irrigation regime in crop production; it is caused by irrigation in excess of the norm, due to which the level of salty groundwater rises or irrigation with highly saline water.

**Table 1.** Soil classification by salinity levels.

| № | Soil types      | Amount of salts, % |
|---|-----------------|--------------------|
| 1 | non-salted      | <0.1 %             |
| 2 | slightly salted | 0.1-0.3 %          |
| 3 | medium salted   | 0.3-0.5 %          |
| 4 | highly salted   | 0.5-1.2 %          |
| 5 | salt marshes    | >1.2 %             |

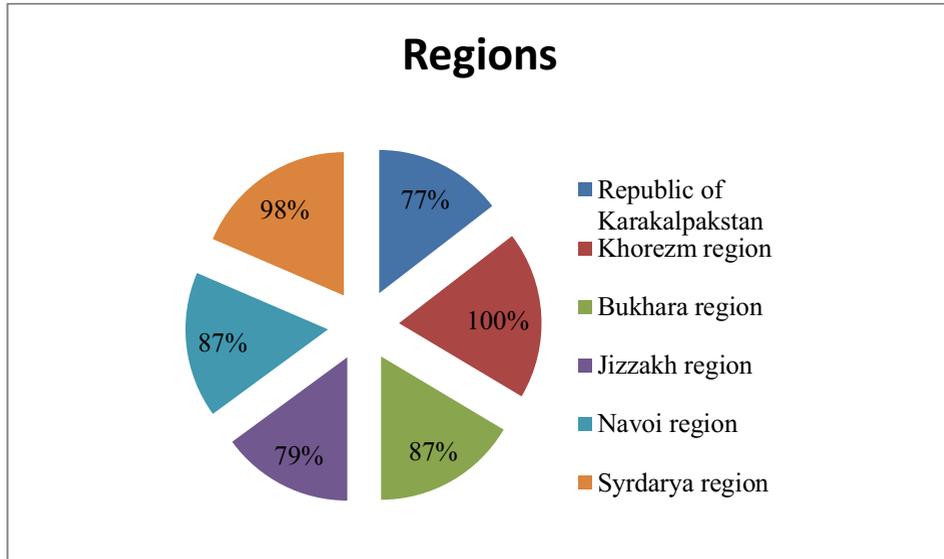
In Central Asia, irrigation began to actively develop throughout the territory in the 20th century, 60-70s. Irrigation places were steppes or desert areas, with the aim of growing cotton in the basins of the Amu Darya and Syr Darya rivers. This system used old technologies, which led to a rise in groundwater levels, which affected the secondary salinization of land, due to excess water in irrigation. As a result of the constant increase in saline lands, the yield of agricultural crops began to decline. As a result, saline lands in Central Asia accounted for 50% of the territory [3, 4].



**Fig. 1.** Salinity in Central Asia in 2013.

In the Republic of Uzbekistan, lands are subject to degradation processes, the most common are secondary soil salinization, a decrease in soil quality, the influence of water

and wind erosion, and others. In different regions of the Republic of Uzbekistan, the degree of soil salinity is different:



**Fig. 2.** The degree of salinity by regions of the Republic of Uzbekistan.

## 2 Methods

For a deep study of the material, directed studies of specific territories, covering a specific natural and economic state of the Republic of Uzbekistan, are of particular importance. All processes are considered from a specific anthropogenic point of view, from soil-ecological to socio-economic. Theoretical methods, analysis, synthesis, deduction, grouping are taken as a basis. Practical methods are hard to use; different regions have different levels of soil salinity [5, 6].

## 3 Result

Signs of the presence of soil salinity are the frequent manifestation of the disease in trees, their drying out, and the appearance of salt-tolerant weeds. In addition to the negative impact on the productivity of agricultural products, salinity also negatively affects the ecological state of water resources, the water becomes very salty for animals and people for drinking and industrial consumption. Salinity spreads rapidly from the headwaters downstream. So in the upper reaches of the Syr Darya and Amu Darya rivers, water salinity increased by 0.1-0.2 grams per liter, in the middle reaches by 0.3-0.4 grams per liter, in the lower reaches by 0.6-0.8 grams per liter, all this was a number of reasons for the increase by irrigated land, growth in demand for water for washing irrigation [7, 8].

The main factor in preventing salinity is to determine and control the level of salinity and the area of salinity. Determination of the salinity level is diverse, one of such methods is the measurement of electrical conductivity, and the measurement of the amount of salt in the solution. This method is called Total Solids and is used by many farms [9].

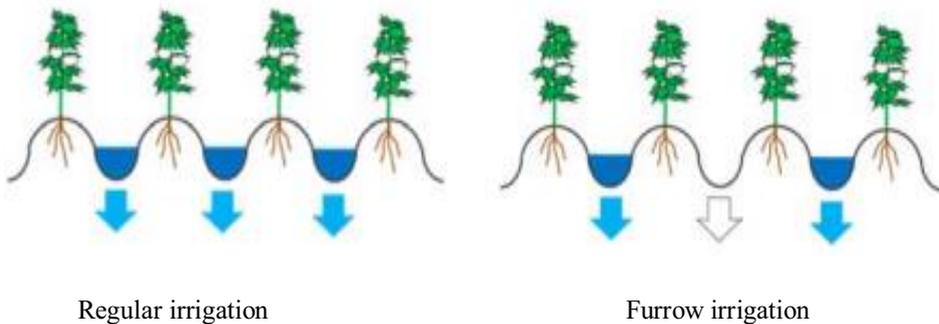
The main method for preventing salinization is soil reclamation. In irrigated fields, a decrease in the level of soil salinity is determined by the use of hydrotechnical reclamation,

but this path reduces the chance of obtaining more crops, due to the leaching of soil nutrients and residual salinity [10]. Salts in the soil increase the pressure, which makes it difficult to supply the plant with water.

Soil leaching is another way to combat saline soils. Soil leaching improves the condition of saline and saline soils. The efficiency of soil leaching depends on the physical properties of the soil and the degree of its salinity, the ratio of soluble salts of Ca and Na ions in the soil. Preventive measures to combat salinity include measures against salinization:

1-Watering. But it is not 100% effective, due to the fact that part of the water is spent on filtration losses in canals or in the soil. Due to filtration losses, the groundwater level rises, low-lying groundwater can return salts to the roots. In this case, constant monitoring of irrigation water loss and groundwater level is needed [11,12].

a) Furrow irrigation. The advantage of this irrigation is the irrigation of two beds with one furrow. The volume of water used is reduced, filtration losses from the non-irrigated furrow and side flow are reduced.



**Fig. 3.** Scheme of irrigation through the furrow.

B) Irrigation with discrete streams. This method means irrigation with periodic flows, and not, as in others, continuously. This method reduces the loss of infiltration by reducing the permeability of the soil through cyclic irrigation.

C) Furrow irrigation with variable rates. In places where there is a slope in the furrows, water is lost due to excess, such losses reach up to 30% of the flow. To remove this excess water, use a shallow drain at the end of the field. With this drainage method, waterlogging can be avoided [13].

2-Drainage. Water penetrates into the soil and remains in the pores of the soil, regardless of whether the water is supplied by irrigation or precipitation. With excess moisture, water is not absorbed into the soil, thereby forming puddles on the soil surface. Long-term saturation of the topsoil is harmful not only for plants, but also for plant roots. It is difficult for agricultural machines to drive in wet fields. Excess water replenishes the groundwater layer, thereby increasing the groundwater level. In this case, excess water must be removed from the soil surface and root zone. In arid and semi-arid climates, salinization occurs at the groundwater level at unsafe depths (at a depth of 1.5 to 2 meters). Effective monitoring should include drainage to control and stabilize the groundwater level.

A) Open drainage (surface drainage). It consists of shallow drains, with the help of which excess water is removed from the soil, dumping water into a larger and deeper collector. In order for excess water to flow into the drains, the surface of the field is given an artificial slope by the layout.

B) Closed drain. The goal of this method is to remove excess water from the roots and keep the groundwater level low. Deep open drainage or buried drainage pipes are used here.

-Deep open drainage means that excess water from the roots drains into deep open trenches. The main disadvantage of this method is that the trenches occupy a large area of agricultural land, and large construction equipment is used for its construction.

- Buried drainage pipes. The pipes have many small holes, they are located below the surface of the field and excess water enters the pipes and is discharged from the drainage collectors. The disadvantage here is the cost of building materials, machinery and skilled labor.

B) Vertical drainage. This method is used to lower the groundwater level. Here, a well is built to a layer of soil with high permeability and deep groundwater is pumped out. The condition of the vertical drainage structures is in poor condition. They have not been updated since the 1990s.

C) Bio-drainage. Along the canals in the fields, trees are planted with transpiration ability, they absorb a large amount of soil moisture, and as a result, the groundwater level decreases [14].

3- Layout (leveling the ground). Over time, the topography of the fields changes and becomes uneven, which negatively affects the cultivation of the land. Planning is becoming a permanent agricultural operation. With conventional grading, tractor operators change and adjust the grader's position according to the topography of the field, which takes a lot of time. There is also laser planning, the grader is corrected by an automated laser device that levels the field surface within 5 cm of the specified slope accuracy.

4- Suppression of capillary rise. High groundwater table in arid and semi-arid regions, salinity appears largely due to the capillary rise of dissolved salts by strong evaporation.

A) Mulching. The essence of the method is covering the soil surface with straw, dry leaves, gravel, sand or cellophane. This method keeps soil moisture in check and can prevent soil erosion, fertilizer leakage, weed problems and excessive soil temperature rise.

B) Deep plow. Capillary rise can be blocked by dry soil at the surface, which is formed by deep plowing.

C) Capillary barrier. Capillary rise is also blocked by creating a layer of gravel between the cultivated layer and the groundwater surface [15].

## 4 Discussion

In the modern world, not a single process is complete without the use of modern technologies, and here, when observing the spread of saline soils, it is advisable to use space sensing methods. Sounding methods include patterns of radiation and reflection of electromagnetic waves of different ranges, which can find the territory of soil salinization. The microwave radiation of the soil cover is influenced by temperature, particle size distribution of moisture and soil salinity. Integrated control of remote and ground observation gives an advantage in determining the space-time distribution of soil moisture with a depth of 15 centimeters. As a rule, data obtained from Landstat and TM Spot satellites are used [3].

There are many different methods for reclaiming saline lands. The most popular method is considered to be a method based on actions throughout the year with desalinization of saline soils to a certain rate, with the supply of a leaching rate, not forgetting to take into account the environmental restrictions of environmental management and the classification of saline soils and salt tolerance of agricultural crops. According to this scheme for the development of saline lands, the scheme should be carried out step by step on a time scale in annual intervals using the classification of saline soils and salt tolerance of agricultural crops.

Each stage should be characterized by the degree of soil salinity ( $S_i$ ), as well as the level of the forthcoming productivity of agricultural crops, taking into account salt tolerance ( $\bar{Y}_i = Y_i / Y_{max}$  here  $Y_i$  is the yield of agricultural crops at the existing salinity, kg / ha and  $Y_{max}$  is the maximum yield at the expected salinity, c/ha)

At each step of land development, the rate of leaching of saline lands is compulsorily determined:

$$Y_i = Y_{max} \cdot \exp[-k(S_i/S_{doni}-1)b]$$

$$N = (\alpha/\beta \cdot \lg(S_i/S_{doni}))$$

Here  $\alpha$  is the salinity coefficient

$\beta$  - coefficient of mixing speed

$S_{doni}$ - at the stage of land development, permissible salt content t/ha

$k$ -coefficient of salt tolerance of agricultural crops

$b$ -parameter of the equation

## 5 Conclusion

Usually, soil leaching is used to rid the soil of salts. This procedure destroys humus and is very costly. The main way to combat saline soils is to use water-saving technologies.

The use of drip irrigation is advisable to use when reducing soil salinity. With drip irrigation, pipes with holes are laid across each row of crops. Drip irrigation only moisturizes the plant itself, the soil between the plants remains dry. Usually this method is used for watering fruit trees, grapes, lettuce, but such watering cannot be applied to wheat or other crops of this kind. The introduction of microelements into the soil improves the ion exchange of plants under conditions of salinity. On salt licks (soils containing a lot of sodium), reclamation is carried out using gypsum, which leads to the displacement of sodium from the soil absorbing complex and its replacement with calcium.

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