# Chapter 8
# Environmentally Safe Technologies for Leaching Saline Soils in Rice Systems to Enhance Their Productivity

**Svitlana Kozishkurt**
https://orcid.org/0000-0002-3961-3731
*National University of Water and Environmental Engineering, Ukraine*

**Vasyl Turcheniuk**
https://orcid.org/0000-0002-1938-0344
*National University of Water and Environmental Engineering, Ukraine*

## ABSTRACT

*Rice systems in Ukraine are built on territories with saline soils, and with a complex hydrogeological situation. A method of calculating ecologically safe periods for growing dryland crops on saline soils is proposed, which will help to optimize the structure of rice rotations and prevent soil degradation. The considered technologies for leaching of saline soils, which make it possible to ensure qualitative soil desalination, to shorten the duration of leaching, to lower the level of groundwater, to improve the oxygen regime of the soil. The methods for calculating the technological parameters of capital and preventive soil leaching of saline soils have been developed. These methods allow improving the water permeability of the soil, attracting a natural thermal effect, reducing the volume of freshwater, and preventing the restoration of salts. It can be an important step in restoring fertility and increasing the productivity of rice systems in the face of water scarcity and climate change.*

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## BACKGROUND

The problem of salinization of soils, including rice systems, is one of the most pressing issues in modern agriculture, especially in view of the expected increase in global warming, prolonged droughts and shortages of water resources. This problem is expected to worsen in the coming years. The main agroecological feature of saline soils is the presence of harmful salts in the root zone in an amount that exceeds the permissible amount for the development of agricultural plants or leads to a significant decrease in their productivity. According to the Food and Agricultural Organization (FAO), the world area of saline soils is 424 million hectares (Montanarella L., et al., 2015; Global Map of Salt-affected Soils, 2024; Kuzmych, 2023; Yakymchuk et al., 2022). Factors influencing the salinization process include climatic conditions, soil type, irrigation, depth of groundwater, mineralization of irrigation water, as well as land use methods and technologies (Kuzmych et al., 2022; Pessarakli M., et al., 2019; Rahman M.M., et al., 2015; Stashuk V.A., et al., 2014; 2016). Various measures are used to counteract soil salinity, including various leaching methods, chemical amelioration, soil loosening, salt collection, and amelioration using halophytes. Often, a comprehensive approach involving several methods is necessary for the restoration of saline soils (Shaygan M., et al., 2022).

A distinctive feature of the rice systems of Ukraine and a limiting factor in planning their agricultural use is that they are located mainly in territories with complex hydrogeological conditions, saline soils of the aeration zone, and a shallow level of mineralized groundwater. The repurposing of rice systems to conventional crop rotations or the reduction of rice crops threatens the salinization of the soils of rice systems and the deterioration of the agrochemical composition of soils and groundwater, since in the absence of a leaching regime, salinization is restored. In addition, weather and climate changes, characterized by an increase in air temperature in the summer and a decrease in the amount of precipitation, increase the processes of evaporation from the fields, especially in conditions of shallow occurrence of mineralized groundwater. This contributes to the activation of secondary salinization processes, which deepens the problematic state of agricultural lands.

Preservation of rice systems has become critically important in Ukraine, as two of the three rice-growing regions (the Autonomous Republic of Crimea and the Kherson region) are currently under temporary occupation. These systems are located in areas that were previously exposed to salinization and have nearby weakly mineralized groundwater. The destruction of the Kakhovka reservoir, the main source of freshwater, led to the shutdown of 94% of irrigation systems in the Kherson region (Economic Consequences, 2023). This, together with the destruction of canals and hydraulic structures, makes it difficult to carry out the necessary remedial measures in a short time after the restoration of control over the territory. The analysis of Earth