

Assessment of the Environmental Condition of Irrigated Lands in Bukhara District

Khasanov Fayzullo Fazliddin ugli

Independent Researcher (PhD), Bukhara State Technical University

Abstract:

The article examines the environmental condition of irrigated lands in Bukhara District, Bukhara Region, Republic of Uzbekistan. Particular attention is paid to the current state of the soil cover, salinization processes, secondary sodification, changes in the water-physical and agrochemical properties of soils, as well as the impact of anthropogenic pressure on the sustainability of agro-landscapes. An analysis of the main environmental factors determining the productivity and ecological sustainability of irrigated lands was conducted. For a comprehensive assessment, the use of a combination of soil, hydrological, agrochemical, and ameliorative indicators is proposed. It is demonstrated that rational water resource management, improvement of drainage systems, optimization of irrigation regimes, and regular agrochemical monitoring are essential conditions for preserving soil fertility. The findings may be used in the development of measures for environmentally sustainable land use under the conditions of the Bukhara Oasis.

Keywords: irrigated lands, environmental condition, soil, salinization, land reclamation, groundwater, soil fertility, irrigation, Bukhara District, environmental monitoring.

Introduction

Irrigated lands constitute one of the most important natural-resource components of agricultural production in the Republic of Uzbekistan. They are particularly important for the arid territories of Bukhara Region, where sustainable agriculture largely depends on artificial irrigation. The intensive use of land resources under conditions of limited atmospheric precipitation and high evaporation rates is accompanied by a number of environmental problems. The most significant of these include secondary soil salinization, increased groundwater mineralization, deterioration of soil water-physical properties, depletion of organic matter, and disruption of the natural water-salt balance of agro-landscapes.

Bukhara District is characterized by a long history of agricultural development. As a result of long-term irrigation and economic activities, a specific system of interaction among soil, water, and anthropogenic factors has been established in the area. Insufficient drainage efficiency and improper regulation of irrigation can create conditions for groundwater rise and the accumulation of soluble salts within the soil profile.

Environmental assessment of irrigated lands is essential for determining their degree of sustainability, identifying the principal degradation processes, and developing scientifically sound measures for the restoration and preservation of soil fertility.

Materials and Methods. The object of the study comprises irrigated agricultural lands of Bukhara District, Bukhara Region. The research focuses on assessing the condition of the soil cover under conditions of long-term irrigation and intensive agricultural use.

The environmental condition of the lands was considered as a result of the interaction among natural conditions, irrigation regimes, the condition of the collector-drainage network, groundwater depth and mineralization, and applied agricultural practices.

For a comprehensive assessment of the environmental condition of irrigated lands, the following groups of indicators are recommended:

1. Soil indicators:

- ❖ humus content;
- ❖ soil texture;
- ❖ bulk density;
- ❖ soil structure;
- ❖ water permeability;
- ❖ content of readily soluble salts;
- ❖ soil solution reaction (pH).

2. Land-reclamation indicators:

- ❖ groundwater depth;
- ❖ groundwater mineralization;
- ❖ degree and type of salinity;
- ❖ drainage efficiency;
- ❖ dynamics of the water-salt regime.

3. Agrochemical indicators:

- ❖ content of available forms of nitrogen, phosphorus, and potassium;
- ❖ organic matter content;
- ❖ cation exchange capacity;
- ❖ soil reaction.

4. Anthropogenic factors:

- ❖ irrigation intensity;
- ❖ quality of irrigation water;
- ❖ soil management practices;
- ❖ application of mineral and organic fertilizers;
- ❖ condition of irrigation and collector-drainage networks.

Soil sampling should preferably be carried out from the genetic horizons of the soil profile, followed by laboratory determination of the main agrochemical and reclamation indicators.

The degree of soil salinity can be assessed using the total mineralization of the soil extract, while the water-salt regime can be evaluated based on data on groundwater depth and mineralization.

Results

An analysis of the natural and economic conditions of Bukhara District indicates that the environmental condition of irrigated lands is largely determined by the combination of an arid climate, high evaporation rates, long-term irrigation, and specific characteristics of the water-salt regime.

One of the most important environmental problems is soil salinization. Under conditions of intensive evaporation, dissolved salts may migrate from the lower soil horizons toward the soil surface. This process becomes particularly pronounced when mineralized groundwater occurs at shallow depths and when natural or artificial drainage is insufficiently effective.

Another important factor is changes in groundwater levels. A rise in groundwater within the aeration zone promotes increased upward movement of salts into the soil profile. As a result, conditions for the growth of agricultural crops deteriorate, and the efficiency of irrigation water use decreases.

Table 1.

Main Environmental Indicators of Irrigated Lands

Indicator	Environmental Significance	Main Risk
Soil salinity	Characterizes the accumulation of soluble salts	Reduction in crop yields
Groundwater level	Determines the water-salt regime	Secondary salinization
Groundwater mineralization	Indicates the potential risk of salt accumulation	Sodification and salinization
Humus content	Characterizes potential soil fertility	Soil degradation
pH	Determines the reaction of the soil environment	Disruption of plant nutrient availability
Water permeability	Characterizes the soil's ability to transmit water	Waterlogging and secondary salinization

The environmental condition of the land also depends on the quality of irrigation water. The use of water with elevated mineralization increases the risk of salt accumulation in the soil. Therefore, monitoring the quality of irrigation water should be considered an essential component of environmental monitoring.

The irrigation regime is of particular importance. Excessive irrigation may contribute to a rise in groundwater levels, whereas insufficient leaching of the soil profile under certain conditions may lead to the gradual accumulation of salts. Consequently, environmentally sustainable irrigation should be based on consideration of crop water requirements, the water-physical properties of the soil, and groundwater conditions.

A comprehensive approach makes it possible to move from the assessment of individual indicators to the determination of the overall environmental sustainability of the land.

Discussion. The results obtained indicate that the environmental condition of irrigated lands in Bukhara District should be assessed not only in terms of the current level of soil fertility but also with consideration of the dynamics of degradation processes.

Disruption of this cycle requires integrated management of water and land resources.

To improve the environmental condition of irrigated lands, the following measures are recommended:

- improvement of the existing collector-drainage system;
- regular monitoring of groundwater levels and mineralization;
- optimization of irrigation timing and application rates;
- implementation of water-saving technologies;
- regular assessment of the degree of soil salinity;
- increasing the organic matter content of soils;
- application of scientifically justified rates of mineral fertilizers;
- cultivation of crops and varieties that are relatively tolerant to salinity;

implementation of necessary land-reclamation measures in areas with a high degree of degradation.

A particularly promising approach is the application of differentiated irrigation management, in which irrigation rates and timing are established according to the specific soil and reclamation conditions of individual fields.

Environmental monitoring should be conducted systematically. A one-time survey does not allow for an objective assessment of the dynamics of degradation processes. Therefore, it is advisable to establish a long-term database containing information on soil salinity, groundwater conditions, irrigation water quality, soil fertility, and crop yields.

Conclusion. The environmental condition of irrigated lands in Bukhara District is shaped by a combination of natural and anthropogenic factors. The major environmental risks include soil salinization, changes in groundwater levels and mineralization, disruption of the water-salt regime, declining soil fertility, and insufficient efficiency of certain components of the land-reclamation infrastructure.

A comprehensive assessment of environmental conditions should be based on the integrated analysis of soil, agrochemical, hydrological, and reclamation indicators. The use of an integrated indicator makes it possible to compare the condition of different land parcels more objectively and determine the priorities for environmental protection and land-reclamation measures.

To ensure sustainable land use in Bukhara District, it is necessary to improve the environmental monitoring system, rationalize the use of irrigation water, maintain the effective functioning of drainage networks, and implement modern water-saving technologies.

Thus, maintaining and enhancing the environmental sustainability of irrigated lands should be regarded as a key prerequisite for ensuring the long-term productivity of agricultural lands and the rational use of land resources in Bukhara District.

References

1. *FAO. The State of the World's Land and Water Resources for Food and Agriculture: Systems at Breaking Point. Rome: Food and Agriculture Organization of the United Nations, 2021.*
2. *FAO. Global Soil Partnership: Soil Salinity Assessment and Management. Rome: Food and Agriculture Organization of the United Nations.*
3. *Розанов Б.Г. Генетическая морфология почв. Москва: Издательство Московского университета.*
4. *Добровольский Г.В., Никитин Е.Д. Экология почв. Москва: Издательство Московского университета.*
5. *Ковда В.А. Основы учения о почвах. Москва: Наука.*
6. *State Committee of the Republic of Uzbekistan for Geology and Mineral Resources. Materials on the Monitoring of the Condition of Land Resources of the Republic of Uzbekistan.*
7. *Ministry of Water Resources of the Republic of Uzbekistan. Materials on the Condition of Irrigated Lands and Water Resources of Bukhara Region.*
8. *Scientific materials on the problems of soil salinization, land reclamation, and sustainable management of irrigated lands in Central Asia.*