

**Review Article**

**CONDITION OF IRRIGATION AND DRAINAGE SYSTEMS IN THE KHOREZM REGION AND RECOMMENDATIONS FOR THEIR IMPROVEMENT**

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**Abstract**

This article provides information on the state of irrigation and drainage systems, the main types of groundwater regime, changes in the dynamics of the groundwater level, as well as changes in their salinity in the Khorezm region. The data on the distribution of land by salinity, the change in the total length of drainage systems on irrigated lands of the Khorezm region of the Republic of Uzbekistan are given. Recommendations are given for improving the passage of drainage water from irrigated areas. A set of organizational, land reclamation, land reclamation, and operational measures aimed at improving the technical and land reclamation condition of irrigated lands by improving the performance of irrigation and land reclamation systems has been substantiated. Rational methods of irrigation of crops in the Khorezm region are given.

**Keywords:** irrigation, drainage, regime, groundwater, salinization.

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**INTRODUCTION**

In practice, one of the main operational problems is the cases of prolonged operation of the pumps with greatly increased compared to the design hydraulic losses in the suction line and mechanical damage to individual elements due to cavitation-abrasive wear[1].

Currently, there is a shortage of water in the world, including the Republic of Uzbekistan. If we analyze the last 60 years, the consumption of drinking water in our planet has increased by 8 times. Therefore, it is necessary to use irrigation water according to the needs of plants for water using water-saving irrigation technologies. In this case, the reclamation state of the land will be improved by reducing the groundwater level of the irrigated area.

According to the International Commission on Irrigation and Drainage, the area of irrigated land in the world is about 299.488 million hectares. About 40 percent of world food and 60 percent of grain crops are produced on these irrigated lands [1].

In the Strategy of Action for Five Priority Directions of the Development of the Republic of Uzbekistan in 2017-2021, approved by Decree of the President of the Republic of Uzbekistan dated February 7, 2017 № UP-4947 and "On the State Program for the Development of Irrigation and Improvement of the Reclamation Condition of Irrigated Lands" for the period 2018-2019 approved by the Decree of the President of the Republic of Uzbekistan dated February 27, 2017 № UP-3405, special attention is paid to further improving the reclamation status of irrigated lands, the development of reclamation and irrigation systems, on Widespread implementation of intensive

irrigation techniques, especially reclamation of irrigated land [2-4].

**METHODS AND MATERIALS**

In the study, state of irrigation and drainage systems, indicators of performance indicators were used [5]. The indicators cover water supply, water use efficiency, maintenance, irrigation sustainability, environmental aspects, socio-economic situation and management.

Important points of emerge that there was no steady or linear progression in techniques across time - instances of the transfer of ideas are balanced by cases of independent development - and that the correlations between irrigation systems structures demand more complex explanations than often proposed.

Moreover, using the MASSCOTE technique (this is the search for a solution to improve irrigation management and operation and better user service) [6]. The necessary materials were taken from annual reports of the Regional Department of Water Management of the Khorezm Region also irrigation and drainage expedition [7, 8].

Khorezm region is located in the northwestern part of the Republic of Uzbekistan and occupies part of the territory of the left-bank delta of the Amu Darya.

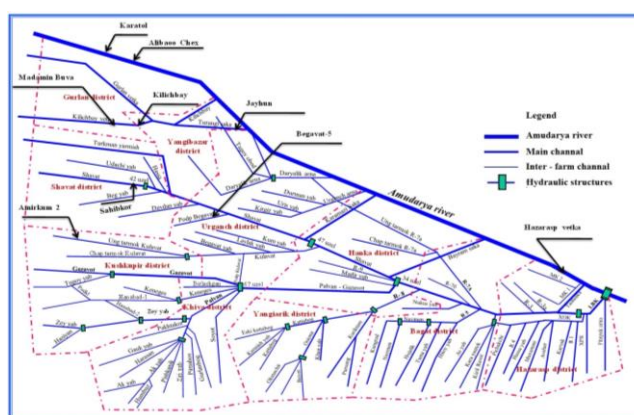
The Khorezm region borders: from the north and north-eastern part with the Amu Darya River and the Republic of Karakalpakstan, the southern and south-western part of the Republic of Turkmenistan.

The main source of irrigation in the Khorezm region is the Amudarya River. All irrigated lands of the Khorezm region are

served by irrigation systems, Pitnyak arna, Tashsaka, Shavat, Urganch arna, Daryalik arna, Kilichbay, Palvan, Gazavot and others (Table 1, Figure 1).

**Table 1. The main irrigation systems of the region**

№	Channel Name	The length, km.	Total service area, ha
1	Pitnakarna	6.0	6155
2	Tashsaka	684.6	173774
3	Shavat	150	109100
4	Urgench arna	10	6316
5	Daryolik arna	22	14803
6	Kilichbay	65	26680
7	Palvan	18	27700
8	Gazavat	88	47400



**Figure 1. Schematic map of the irrigation system of the Khorezm region**

Irrigation systems, represented by a system of canals in earthen channels with an excessively specific length of elements of the economic and on-farm network, non-working hydraulic structures, have an efficiency in the range of 0.60-0.84. Losses of water in half of the plots with the adopted irrigation technology, which ensure desalination of the active layer in the inter-irrigation periods, comprise (surface discharge, excessive depth filtration) from 20 to 40 % of the irrigation rate, i.e. The efficiency of irrigation equipment is in the range of 0.65-0.84.

#### MATERIALS AND METHODS

The irrigated area of the Khorezm region is approximately 276.4 thousand ha, or about 7% of the total irrigated area of Uzbekistan. Currently, open collector-drainage networks in the region occupy more than 30 thousand ha of irrigated area.

Based on numerous studies, the hydrogeological and reclamation features of the oasis were determined. Three main types of groundwater regime are distinguished [10, 11, 12, 13]:

1. Hydrogeological (observed on the area of the floodplain and the first floodplain terrace of the Amu Darya);
2. Irrigation and land reclamation (in the irrigated areas of the ancient delta regions);
3. Hydrological-climatic or hydrological-irrigation-reclamation (over the entire area of non-irrigated lands).

In the irrigated areas at a depth of 1-3 m or more, a fresh pillow forms; fresh lenses with a thickness of 25-30 m are observed along the routes of large channels; in the lake-peripheral region,

mineralization increases sequentially - from 2-3 in the upper layers to 50-60 g / l at a depth of about 20 m [14].

#### RESEARCH RESULTS

The groundwater regime in the lower reaches of the Amu Darya river is formed under the influence of climatic conditions, as well as human irrigation and land reclamation. The hydrogeological conditions of Khorezm are extremely complex, which is explained, first of all, by the lithological and geomorphological structure of the territory and the features of the economic use of land for irrigation.

Under the influence of artificial or natural drainage, groundwater carries accumulated salts into drains. The moisture consumption for transpiration in continuous crops is not only useful from the point of view of crop formation, but also plays an extremely large preventive role in preventing soil salinization. Therefore, on irrigated lands it is necessary to have fields with a full green cover of cultivated plants.

Due to the negligible flow, groundwater is shallow (within 0.5-1.5 m, sometimes 2.5-3 m or more). Their level reflects the total result of all waters filtered in the region and, due to the irrigation seasonality, has a pronounced seasonal character. The main feature of the groundwater regime is the clearly expressed amplitude of their level fluctuation between the spring-summer (March-July) maximum and the autumn (September-November) minimum, reaching 50-80 cm, and sometimes 100 cm or more. The annual amplitude of the groundwater level for individual years of the Khorezm region reaches 130-220 cm (Fig. 2).

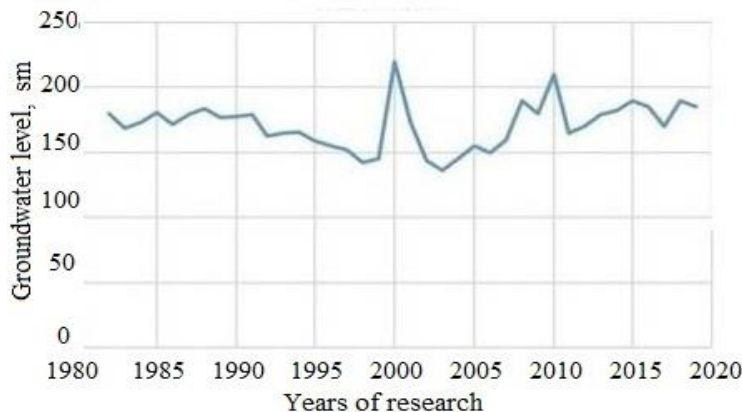


Figure 2. Dynamics of the groundwater level in the Khorezm region over the years of research

Higher groundwater levels are maintained throughout the growing season, and only from the second half of September does the decline begin, lasting until the beginning of autumn (November) or spring (March) irrigation. This is due to higher KZI, large specific water supplies, as well as geomorphological conditions of the region.

According to the conditions of natural inflow and outflow of groundwater in the Khorezm region, the following are distinguished:

1. The modern floodplain and floodplain strip of the Amu Darya river with favorable conditions for local influx and outflow, and poor salinity of groundwater.
2. The irrigated territory of the ancient delta zones of the ancient rivers Daryalyk and Daudan with improved conditions for local outflow with average salinity of groundwater.
3. The lake-peripheral zone of the Amudarya river with difficult outflow and strong salinity of groundwater.

In the zones of the modern Amu Darya river strip and the irrigated territory of the ancient delta zones, due to the developed collector-drainage network, a relatively better water exchange is ensured than under natural conditions with difficult groundwater outflow. Mineralization of collector-drainage flow is on average 2-3 g / l.

The soil cover of the region is formed by an ancient alluvium covered with agroirrigation sediment. The soil-forming process is characterized by the presence of agro-irrigation sediment received together with irrigation water, and is distinguished by hydromorphism. The highest standing of GWL is up to 0.5-1.5 m. Natural underground outflow is difficult and absent in some places, which leads to intensive annual salinization, the need for flushing and cleaning the drainage.

The natural features of the region, namely the drainage of groundwater, require the maintenance of the soil layer in a desalinated state. Agricultural production is based on land leaching, frequent watering of crops and loosening of the upper soil layer. The experience of recent decades shows that the expansion of sown areas on the basis of increasing water availability and switching to gravity irrigation has necessitated the development of artificial drainage.

The collector-drainage network affects the reclamation state of the soil in the aeration zone. This is evidenced by the dynamics of changes in the degree of salinization of irrigated lands.

The area of highly saline lands does not change or changes slightly, depending on the water content of the year. In Fig. 2, long-term soil observations were carried out according to the degree of salinization.

Lightly saline lands account for 56.1% (2010-2018), the rest are medium (31.5%) and highly saline (12.4%) (Fig. 3).

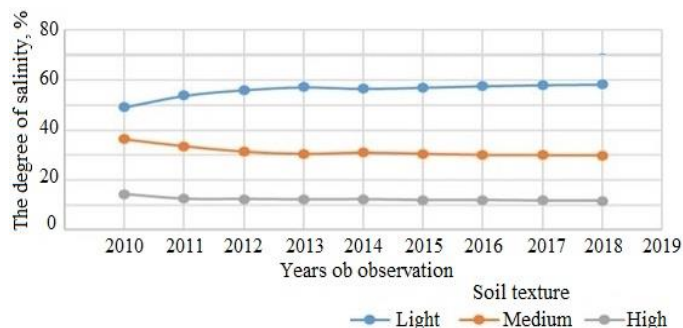


Figure 3. Distribution of land in the Khorezm region by the degree of salinization

Conducted by numerous field and laboratory studies, it was found that on lightly saline lands, the yield of raw cotton decreases by 10-15%, medium-saline - up to 35% and highly saline 80-85% compared with non-saline soils, which is confirmed by the data of the Research Institute of Selection, seed

production and agricultural technology of cotton growing (Uzbek Scientific Research Institute of Cotton Production).

The mechanical composition of the irrigated meadow-alluvial soils of the region is dominated by medium loamy soils - 51.0%, heavy loamy - 17.9%, light loamy - 31.1%.

From 1980 to 2000, the length of the GDS increased from 6,750 to 10,618 km, including inter-farm GDS from 3,150 to 3,718 km, i.e. 568 km, on-farm CDS - from 3,600 to 6,900 km - at 3,300 km.

From 2000 to the present, the length of inter-farm CDS has not changed much. This is due to the sufficient length of the water supply system for the removal of groundwater outside the region (38.5 lm / ha). Theoretically, for the region, the specific length is 35-40 m / ha (Fig. 4).

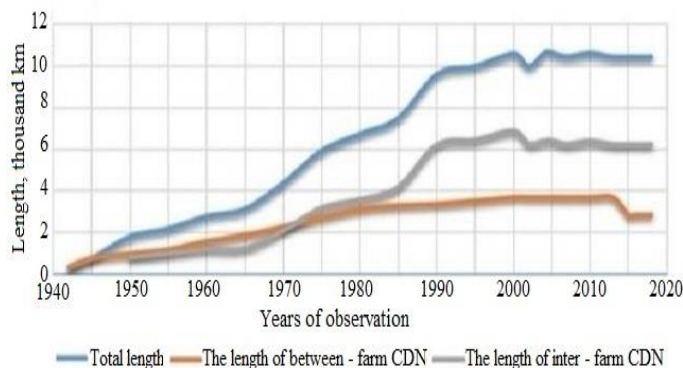


Figure 4. The length of the CDN in the Khorezm region

The increase in water horizons in the main canals made it possible to transfer almost 80% of the land to gravity irrigation, the remaining 20%, mainly in the upper and middle parts of the system, remained on machine-chigir irrigation. However, a sharp increase in water availability without simultaneous measures to improve the operation and ensure the normal reclamation state of the land caused negative consequences. Inadequate operation, uneven water distribution and low technical level of the systems contributed to the discharge of excess water from inter-farm canals, as a result of which the area of wetlands increased in the center of the oasis [15].

Gravity irrigation led to a sharp increase in groundwater, a change in water balance and the secondary salinization of the region's lands.

With the growth of technical and economic opportunities, 3 main systems of main collectors have been created: Lake-Equalization, Shavat-Andreevsky, Divankulsky and Daryalyksky. In 1961, the Big Lake Collector Druzhba was put into operation with the drainage of collector-drainage water to the Sarykamysh depression, with a maximum flow rate of up to 180 m<sup>3</sup> / s. Due to these measures, the opportunity arose for the further development of the collector-drainage network, ensuring a sustainable reclamation state of the land.

The main component of drainage flow throughout the year is filtration losses from the canals and filtration in the fields during the growing and leaching periods. Therefore, to reduce the flow of collectors, without deteriorating the reclamation state of the land, it is necessary to increase the efficiency of all parts of irrigation systems through the introduction of modern irrigation techniques and technologies, as well as the design of concrete and chute irrigation systems [16].

#### CONCLUSIONS

1. In the conditions of the Khorezm region, to improve the work of irrigation and drainage systems, the following measures should be taken:
2. Annually, it is necessary to clean inter-farm collectors with a total length of 1200-1300 km, and on-farm collectors - completely. This is due to the fact that the relief of the region is flat, the water flow rate is small, soils are mainly

sandy loam and drainage is overgrown with vegetation annually.

3. For the further development of irrigated agriculture, increasing water availability and improving the reclamation state of old irrigated lands, it is necessary to improve irrigation and drainage systems based on progressive irrigation and drainage techniques, which will increase the productivity of reclaimed lands.
4. It is necessary to put into practice the design of science-based solutions for the reclamation complex of irrigated lands.
5. Conduct a survey of the state of irrigation and drainage systems and determine the priority of the engineering work.
6. Make a plan and budget for the implementation of rehabilitation work in irrigation and drainage systems.

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