

# Technologies to reduce water waste during land leaching and cultivation of industrial crops

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**Abstract.** More than half of Uzbekistan's irrigated land is saline to some degree. The drying up of the Aral Sea has intensified this process. For many years, chronic salt storms in the northern part of the country have sprayed large quantities of salt onto agricultural land, leading to increased salinization. These processes cause the water required to flush saline soils year after year.

The problem is exacerbated by water shortages worldwide, including in Central Asia. This requires the leaching of saline soils and a multiplication of the water used in crop cultivation. Therefore, alternative use of water resources in our country is one of the most important issues for agriculture. The introduction of salt leaching and cultivation in farms based on outdated technologies and the low efficiency of new technologies (bio-solvent washing, etc.) in the production of new salt leaching and cultivation remain a negative obstacle for the economic development of farms and the country as a whole.

The analysis shows that in our country, billions of cubic meters of water are used to flush saline soils and cultivate agricultural crops. Still, only 60% of this water reaches the fields where crops are grown, while the rest of it disappears into the irrigation systems and irrigation processes (canals, ditches, and branch lines).

When providing water resources for soil salinization and cultivation using trapezoidal canals, part of the water flowing through them dissolves and filters the mineral and organic fertilizers in the soil due to air pressure and gravity; as a result, up to 30% of water is lost (wasted).

In this paper, the water resources for soil washing and crop cultivation are replaced by a parabolic excavator with a trapezoidal boom, designed to save up to 30% of water resources.

## 1 Introduction

Over half of Uzbekistan's irrigated land is saline to one degree or another [1]. With the drying up of the Aral Sea, this process is intensifying, as evidenced by a large number of salt storms in the spring of 2019 in the country's northern territories and the salt and sand

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storms that took place in the summer of 2021. These events in the country are increasing year on year the consumption of water needed to flush saline soils.

The current water shortages in the region exacerbate this problem and require a significant reduction in water loss. Therefore, alternative use of the republic's water resources is one of the most important problems in agriculture today. Because water is the main creative factor in agriculture and, simultaneously, the most expensive (invaluable) and scarce resource (resource). More than one-third of irrigation production value is spent on water supply. Therefore, maximum water saving and more efficient water use is the basis for efficient irrigated farming.

The introduction of salt leaching and cultivation based on obsolete technologies and low efficiency of new salt leaching (use of biosolvents) and cultivation technologies in farms remain a negative obstacle to the economic development of farms and the country as a whole [1-5].

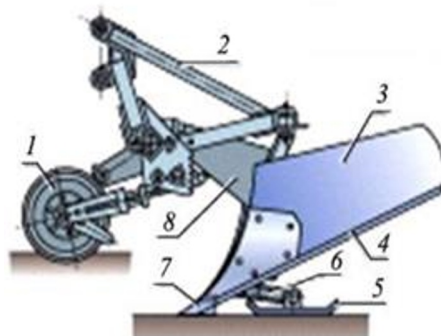
## 2 Materials and methods

The Decree of the President of the Republic of Uzbekistan of 17 April 2019, "On measures for rational use of land and water resources in agriculture", has led to the deterioration of the ameliorative condition of arable land and its decommissioning over the years.

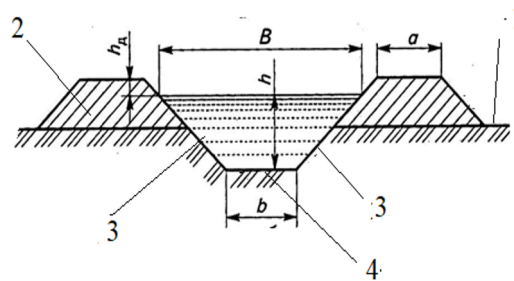
On 6 September 2019, President Shavkat Mirziyoyev held a meeting on agricultural development priorities for 2020-2030. It was noted that the rational use of water resources in the country is a very important task. As a result of the analysis, it was noted that billions of cubic meters of water are used to irrigate crops in the country. Still, only 60% of this water reaches the fields, and the rest in irrigation systems and irrigation processes (ditches and fields.) disappears.

This Decree and Council include reduction of water losses through the introduction of water-saving technologies and reconstruction of on-farm irrigation networks, systematic improvement of land reclamation, and reduction of water use for crop irrigation.

KZU-0.3D, KZU-0.3E, KBN It is recommended to use – 0.35 type ditches (Fig. 1). These arrowheads form a trapezoidal cross-sectional surface shape (the lower base is small, and the upper is large) (Fig. 2). To change the working depth of the prepared arrowhead, a sliding ski (base) - 5 is mounted on its trunnion (Fig. 1). This results in uneven preparation of the base of the boom tip, which reduces water consumption [2].



**Fig. 1.** Schematic diagram of KZU-0.3D ditch digger widely used in farms: 1 is support wheel; 2 is main frame; 3 is mouldboard; 4 is blade; 5 is skis (base, heel); 6 is holder; 7 is knife (Imemex); 8 is column (bracket).

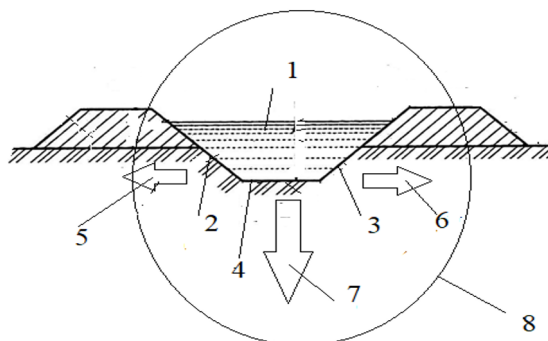


**Fig. 2.** Trapezoidal arch shape: 1 is field surface, 2 is cavalry, 3 is side ribs, 4 is lobes; a is length of top of cavalry, B is length of water level in channel, b is width of channel bottom, h is height of water level,  $h_a$  is distance to water level above cavalry.

Canals used for many years in agriculture of the republic for soil leaching and crop cultivation and irrigation are made in the form of trapeze, mainly from KZU-0.3D, KZU-0.3E, KBN-0.35. Amenity canals prepared for this purpose have the following disadvantages: they require a high level of labor and skills, water consumption increases due to excessive water supply to the canal, the canal area becomes waterlogged, and soil erosion occurs. To eliminate these disadvantages, leveling works will be required. It will be difficult to flush the soil evenly with the saline solution and control the water distribution on uneven fields.

### 3 Results and discussion

Analysis shows that when saline soils are flushed with water using ditches prepared in this form, part of the water passing through the ditch is absorbed directly into the soil by dissolving mineral and organic fertilizers in the soil through air pressure and water gravity (gravity.) (Fig 3). Some water flowing out of the ditches in stony and sandy soils joins the groundwater (drainage). This raises the water table, and in some cases, secondary salinisation occurs.



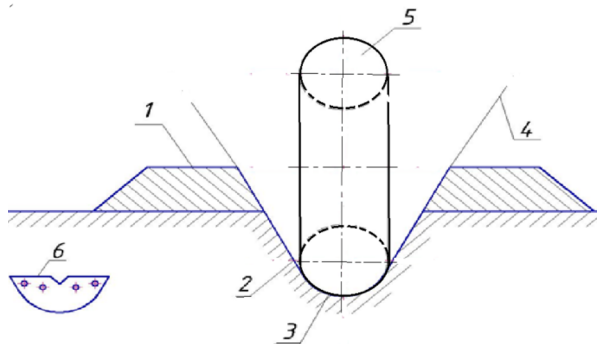
**Fig. 3.** Schematic diagram (contour) of soil moistening, occurring in trapezoidal arch-aryk during flushing of soil salts and crop irrigation: 1 is water level, 2, 3 are lateral edges of ditch, 4 is crest part; 5, 6 are water infiltration in horizontal plane, 7 is water infiltration in vertical plane, 8 is release (contour) of soil moisture

As a result of studies of soil moisture contours during water outflow from the trapezoidal boom in the cross-section, it was found that the wetting diagram of this type of ditch is 8-circular (Fig. 3).

As a result of analysis of this method, it has been established that part of the water flowing out of existing trapezoidal ditch 1 flows through capillaries in 7 vertical directions under gravity and atmospheric pressure, dissolving mineral and organic fertilizers in the soil.

As a result, soil fertility significantly decreases, and by the results of research and practice, it has been established that water losses are up to 30 %.

The long-term research, development, and patent studies and practical works carried out by the staff of Tashkent Institute of Irrigation and Agricultural Mechanization Engineers and Tashkent State Technical University and Tashkent State Technical University [6] on the study of salt leaching and irrigation methods used in crop cultivation have been analyzed. As a result, to eliminate drawbacks of the existing application of trapezoidal channels in agricultural and water leaching soils and crops, the section of channels was prepared as parabola 4 and its marking 3 and side 2. It was proposed to mechanically add compaction (trampling) to it using mounted support wheels 5 (Fig. 4).



**Fig. 4.** The proposed cross-sectional profile is parabola-shaped arrowhead: 1 is cavalry; 2 is lateral and 3 is birefringent; 4 is parabola; 5 is base wheel; 6 is parabola-shaped working part (lemex).

To give the proposed transverse profile a parabolic geometric shape of the shaft, the blade tooling 6 must have the shape of the lower part of the parabola, and the rear part of the prepared shaft requires the installation of a rubber support wheel 5 with a parabolic cut surface (Fig. 4).

The equipment design proposed by the authors fully meets the requirements of agricultural engineering, agro-amelioration, and ecology,

the boom tip and the lateral part are mechanically compacted, the water flowing down from it is minimally infiltrated (filtered) into the soil, the cross-section is prepared by parabolic boom tip (Fig. 4).

The proposed profile is assumed to have an elongated oval shape 8 of wetting epithelium when 1 water passes through 4 parabolic arrows (Fig. 3). In this method, the flow of water 1 through the stem is accelerated, and efficiency is increased, water infiltration through the capillaries in the horizontal 5 and 6 directions and the vertical 7 directions is minimized. Melting and infiltration of mineral and organic fertilizers into the soil are minimized, the area around the ditch is not swamped, and soil erosion is avoided.

As a result of research and practice, using parabolic booms in soil leaching and cultivation has shown that soil salinity and water loss during crop cultivation can be reduced by up to 30%.

## 4 Conclusion

1. Proposed use of a parabolic boom for washing soil salts and cultivating industrial crops; mechanical compaction of its shank and side using a rubber support wheel will reduce water losses up to 30 %.

2. Improvement, preparation, and assimilation of KZU-0,3E, KBN-0,3, and other similar equipment, used in the farms of the republic for the production of parabolic profile booms, installation of rubber-armed support wheels for sealing the mark and side parts. Industrial enterprises of the republic do not need special technological equipment and mean to perform this work.

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