The effectiveness of use of water-saving technologies against erosion in hilly areas land

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Abstract. Reducing irrigation erosion is one of the major challenges in the world today. Particular attention is paid to the development and maintenance of soil fertility and the development of irrigation water-saving technologies. Soil erosion due to over-irrigation of arable land on farms leads to increased fertilizer consumption and decreased productivity. The washing of the fertile layer of soil not only affects the yield of crops but also affects the mechanical composition of the soil. Erosion destroys the natural topsoil, and a reduction in organic matter accompanies this. When erosion occurs, soil particles are lost, and organisms, mineral fertilizers, and nutrients are lost along with them. Currently, the average soil washing before irrigation in such an area is 51 t/ha per year, of which nutrients are: humus 590 kg/ha, nitrogen, and phosphorus - 50 and 82 kg/ha, potassium 140 kg/ha, and small elements 33 kg/ha. Of these, 600 thousand are currently strongly washed soils - 39 thousand, average washed - 215 thousand, and weakly washed soils - 346 thousand. As a result of soil washing and lowering the quality of wetting of sloping lands, the gross yield of 28-47% decreases in crop areas. Resolutions decree of the President - 4919 of December 11, 2020, "On measures to further accelerate the introduction of water-saving technologies in agriculture", as well as Resolution No. PF-6024 of July 10, 2020, of the President of the Republic of Uzbekistan The program of decrees "Concept for 2030" is being implemented.

With economic irrigation technology using K-9 polymer in furrow irrigation, the water use coefficient in irrigation changed from 0.78 to 0.87 in furrows, from 0.7 to 0.76 under control. The water economy during the irrigation season is 400-878 m3/ha. Fuel economy in plowing was 3-4 liters per hectare. The number of swimmers has halved. K-9 polymer using furrow irrigation increased yields from 28.4 to 68.4 and 70 quintals per hectare.

1 Introduction
The purpose of the study is to develop the effectiveness of engineering technology for maintaining soil quality. To do this, a second crop of corn, root crops, potatoes are taken before washing the root layer water. Improper irrigation of crops in area with high water consumption and irrigation erosion, significantly damaging high slope areas, should be maintained, and the inflow of nutrients not be less than the elements to be reduced irrigation erosion in hilly areas, maintain and increase soil fertility, get high grain yields and improve the technological properties of crops, protect the environment from pollution, reduce leaching under the influence of water erosion.

The degree to which the problem has been studied. Several scientists have worked on the analysis of soil erosion modeling. M. S. Kuznetsov, X. X. Bennet, M. Wolter, Extensiv Water Consumers Association of the Zangiota district of Tashkent region. The climate is moderately hot. The average temperature in July is 26.9 °C.

The soil composition is typical gray matter in the soil. With a strongly deepening root layer serves to reduce irrigation erosion in hilly areas, maintain and increase soil fertility, get high grain yields and improve the technological properties of crops, protect the environment from pollution, reduce leaching under the influence of water erosion, areas affected by irrigation erosion and its negative consequences, areas affected by irrigation erosion and its negative consequences, conserve water and mineral fertilizers. Soil erosion protection should be maintained, and the inflow of nutrients not be less than the elements to be prevented the washing of the active layer of soil water erosion. These models now serve to prevent soil erosion by comparing the annual process of work carried out against farm erosion in farmland.

While in the case of a high slope, the longer the slope, the more prone to water erosion. The fertile layer of the soil when the slope exceeded 0.007 to protect the active layer of soil from irrigation erosion in the hilly areas of Uzbekistan. The soil composition is typical gray matter in the soil. With a strongly deepening root layer serves to reduce irrigation erosion in hilly areas, maintain and increase soil fertility, get high grain yields and improve the technological properties of crops, protect the environment from pollution, reduce leaching under the influence of water erosion.

Areas affected by irrigation erosion and its negative consequences, areas affected by irrigation erosion and its negative consequences, conserve water and mineral fertilizers. Soil erosion protection should be maintained, and the inflow of nutrients not be less than the elements to be prevented the washing of the active layer of soil.
\[ P = P_1 \cdot P_2 \cdot P_3 \cdot P_4 \cdot P_5 \cdot P_6 \cdot [1 - (1 - P_2)(1 - P_5)(1 - P_9)] = 0.984 \cdot 0.972 \cdot 0.8 \cdot 0.988 \cdot 0.857 \cdot 0.986(1 - 0.968) \cdot (1 - 0.905) \cdot (1 - 0.791) = 0.64. \]
2 Methods

The composition of the soil for tillage, the use of K-9 polymer was prepared from waste from the production of viscose (synthetic fiber and cellophane) in Navoi, Uzbekistan, after planting winter cereals in 2019-2021 in the experimental field on the territory of the Water Consumers Association "Navruz". Studies using K-9 polymer.

Furrow was processed by hand using a flowerpot (watering can). The formation of water-resistant aggregates along the surface of the ridges and the rapid flow of water along the stagnant soils in the irrigated ridges prevent the soil from being washed away. In heavy rains, the water consumption in the fields is not allowed to increase by 2-3 times, and the temporary irrigation inside the field was reduced by 2.0-2.5 times at a slope along the length of the fields without any cuts.

The use of water-resistant aggregates in the soil showed an increase in soil moisture absorption by 1.2-1.3 times, which increased the volume of soil moisture retention, and reduced evaporation of soil moisture after soil moistening. The water permeability of the soil increased by 0.012-0.0017. It is convenient to control water consumption at any boundary using K-9 polymer because water use coefficient in irrigation techniques was higher than in the normal field. The method of studying the zigzag field for autumn cereals was studied, and the rule of cutting in the zigzag field was based on the horizontal field (cutting) in the field. Then 2 in field fields on a slope; 2.5 at a distance of 3 m, the row spacing on the branches was made using a hoe, making the distance between them 1.4 m. After that, wheat is planted in late November, and no additional irrigation is required for mowing. Still, it has been used to a high degree in autumn-winter precipitation to produce a stream of water before precipitation at a maximum slope of 0.07-0.12, as cut in the branches.

Due to the horizontal ridge's area, the water flow from precipitation completely absorbs the moisture in the ridge ridge. Irrigation was carried out after determining the indicators of water absorption by soil moisture and the size of the elements of irrigation techniques in the elements due to atmospheric precipitation from weeding and flowering. (№ DGU10352) The indicators in the "Determination of parameters of irrigation techniques for winter wheat in dry conditions" were determined. Following the Russian variety of wheat "Kroshka" water requirements, the soil was sampled for inter-row moisture control in the furrows with pre-irrigation moisture control [8, 9]. Irrigation schemes at the developmental stage after irrigation were identified. As recorded in our previous experiment, irrigation at the greatest slope was studied, and the soil moisture content was monitored after sowing and seed quality analysis of wheat starch and protein content, as well as the ratio of wheat grain weight to wheat stalk weight by controlling soil moisture for favorable plant growth studied.

The sizes of technical elements suitable for different slopes and farm soils have been developed for high use and irrigation norms for crop types at a slope of 0.07-0.13 to evenly moisten the soils and autumn cereal crops.

\[
\frac{d\theta}{dx} = g [\rho]_n \rho W_n \theta + \frac{W_n}{\frac{d\theta}{dx}} \\
\frac{n d\theta}{dx} = g [\rho]_n \rho W_n \theta + \frac{W_n}{\frac{d\theta}{dx}}
\]

Where \( n \) is the number of suspended particles per unit volume.

\[ dx \]
\[ \theta = \frac{m_r \nu}{A_s} \]

\[ C = C_B e^k \]

\[ V = C \sqrt{R \cdot i} \]

\[ W_i = f(K_i) \]

\[ \frac{d\theta}{dx} = g \cdot \rho_t \cdot \rho \cdot W_i \cdot Nn + \alpha + \rho W_i \cdot Nn \cdot \frac{d \nu}{dx} \]

\[ \theta = n \delta \]

\[ n = \frac{\delta}{\theta} = \frac{\delta}{\frac{m_r \nu}{A_s}} \]

\[ \theta = \frac{m_r \nu}{A_s} \]

\[ \frac{dG_s}{dx} = g \cdot \rho_t \cdot \rho \cdot W_i \cdot Nn \cdot \frac{G_s}{m_r \nu A_s} + \alpha + \rho W_i \cdot Nn \cdot \frac{\delta N}{m_r \nu A_s} \cdot \frac{d \nu}{dx} \]

\[ \nu = \frac{Q}{w} \]
\[ Q = \text{const} \Rightarrow m_t = \rho_t W_t \]

\[
\frac{dG_s}{dx} = N g \rho_t \rho_t W_t \frac{G_s W_i}{m_i Q^A_s} \alpha + \rho W_i \frac{G_s W_i N}{m_i Q^A_s} \frac{dQ}{w} dx
\]

\[
\frac{dG_s}{dx} = N g \rho_t \rho_t W_t \frac{\delta W_i}{\rho W_i Q^A_s} \alpha + \rho W_i \frac{\delta W_i N}{\rho W_i Q^A_s} \frac{dQ}{w} dx
\]

\[
\frac{dG_s}{dx} = -g \frac{\rho_i \rho_i G_i W_i}{\rho_i A_s Q} \alpha + \frac{\rho G_i W_i}{\rho_i A_s Q} d\frac{Q}{w}
\]

\[
\frac{dv}{u} = d\frac{Q}{w} = d\frac{Q}{w} = d\frac{w}{w} = d\frac{Q}{w}
\]

\[
\frac{d\delta}{dx} = -g \frac{\rho N \delta W_i}{\rho_i A_s Q} \alpha + \frac{\rho N \delta d v}{\rho_i A_s dx}
\]

\[
\frac{d\delta}{dx} = -g \frac{\rho N \delta W_i}{\rho_i A_s Q} \alpha + \frac{\rho N d v}{\rho_i A_s dx}
\]
Compared to the absence of polymer in the soil, the economy of moisture reserves in the soil is 1184 m³/ha due to the formation of atmospheric precipitation. The reverse was 109.3 t/ha, and 67.9 t/ha was achieved under silo control. 27% of the total volume of K9 polymer precipitation in the autumn grain field retains water flow; in autumn-winter-spring, the K9 polymer reverses the untreated field, the efficiency of moisture in the precipitation increases, fertilizer washing stops, so the yield of a pure wheat grain will be high; The range of K9 polymer-free furrows was 54.2 ts/ha and 49.8 ts/ha in reverse. The value norm of the polymer is 60 kg/ha-25 USD. Throughout the study, when the field was irrigated with K9 polymer, water collection was prevented, the soil was protected from erosion, and efficiency was achieved.

Irrigation requires a tractor on the field for plowed crops, while corn, potatoes, and fodder root crops are available to farmers and tenants on farms using one or two horse-drawn plows. Experimental testing of soil composition properties using K9 polymer was carried out using the following research methods. After the K9 polymer was transported in a 1:10 ratio with water and sprayed on the surface of the furrows, the surface of the egats was 1:1-0.25 by the method of G.I. Pavlova due to the lifting of water-resistant aggregates; Percentages of soil weight in fractions greater than 0.25 mm, if in the real case, it is 7-12%, up to 32-35% after treatment with soil polymer (absorption of water into the soil) and the humidity between the adjacent branches rises. As the costs increase in these arches, their lengths continue to lengthen between 0.07-0.12 vertical sloping area in the arrow arc. The experiments were carried out under the phenological observations of the wheat variety "Kroshka", as well as by harvesting and analyzing wheat's protein and starch content. To achieve positive results from the research in the production area, the study was conducted in 2019-2020-2021 on the land of the farm "Umid", on the territory of the farm "Umid" on a lease basis (Table 1).

<table>
<thead>
<tr>
<th>Option sequence number</th>
<th>The width of the row spacing is 0.7 m</th>
<th>Water consumption in furrow, l/sec</th>
<th>Lengths of furrows, m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
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<td>4</td>
<td></td>
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<td></td>
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<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>6</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

A study was conducted on the performance of irrigation techniques with a small moisture content of 70-70-60% at the height of the soil while maintaining the pre-irrigation moisture of the soil. Calculated irrigation norms during all irrigation variants, moisture deficiency experiments in the soil layer 0-70 cm and 0-100 cm were carried out three times using the UZNIIX method on 0.546 ha of experimental area, around the average slope of 0.008. At the same time, "Kroshka" grain was planted. Calculations and studies of the following observations were made in practice. The significance of the morphological genetic structure of the soils in the experimental field was determined in the fall after planting wheat to a depth of 2 m as determined by cross-section. The mechanical composition of the soil was determined in the sample under laboratory conditions by sampling from the soil section by the method of N.A. Kachinski. The volumetric weight of the soil was determined annually in the spring and at the end of the irrigation period with the growth of a 10 cm layer to a depth of 1 m using a 250 cm³ volume cylinder made of 10 cm high steel. Studies have determined that the smallest moisture capacity of soils is determined by the method of landfill buried to a depth of 1 meter.

The cylindrical rotation method observed soil water permeability at the beginning and end of each year. Soil moisture is increased by a
3 Results and discussion

<table>
<thead>
<tr>
<th>Cross-section of grooves</th>
<th>Options</th>
<th>The length of the groove, m</th>
<th>Consumption l/sek</th>
<th>Area, ha</th>
<th>Watering time, hours</th>
<th>Running of water</th>
<th>Pour the water</th>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using hand power furrow</td>
<td>-3.0</td>
<td>209</td>
<td>0.30</td>
<td>0.03</td>
<td>9</td>
<td>20.5</td>
<td>29.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-2.5</td>
<td>186</td>
<td>0.28</td>
<td>0.027</td>
<td>7</td>
<td>20.7</td>
<td>27.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-2.0</td>
<td>163</td>
<td>0.25</td>
<td>0.021</td>
<td>7</td>
<td>23.8</td>
<td>30.8</td>
<td></td>
</tr>
<tr>
<td>Using a polymer</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>-3.0</td>
<td>0.44</td>
<td>0.033</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Using a chopper furrow</td>
<td>-2.8</td>
<td>196</td>
<td>0.33</td>
<td>0.028</td>
<td>9.8</td>
<td>19.8</td>
<td>29.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.4</td>
<td>100</td>
<td>0.18</td>
<td>0.016</td>
<td>11</td>
<td>18.3</td>
<td>29.3</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Moisture deficiency required for irrigation technique elements in the soil of the experimental field of autumn cereals (irrigation during the 1st autumn irrigation period) 19.09.2019 (depth of field 25 cm)
While the discharge was 100 m$^3$/s, experiment five, water consumption was 1380 m$^3$ in 20 seconds of water was obtained, while experiment six, water consumption was 1140 m$^3$/s. Water was used for irrigation of furrows with different road widths, in which most of the water was used for leaching.

To reduce water flow, the result was reduced to 80 m$^3$/s while the gross water consumption was 950 m$^3$/s, which was 50 m$^3$/s and the result was reduced to 900 m$^3$/s. In the experiment seven, which was 209 meters long, 0.3 liters/second of water was obtained, while the gross water consumption was 870 m$^3$/s, which was 150 m$^3$/s when K was used. The water use coefficient increased by 20% per hectare. 163 meters long, 0.28 liters/second of water was obtained, while the gross water consumption was 1180 m$^3$/s; which was 186 meters long, 0.33 liters/second of water was obtained, while the gross water consumption was 180 m$^3$/s. 1210 m$^3$/s, while the gross water consumption was reduced to 20 m$^3$/s, and the gross water consumption was reduced to 50 m$^3$/s while the gross water consumption was 1150 m$^3$/s.

In experiment three, which was 890 m$^3$/s, the result was reduced to 20 m$^3$/s, and the gross water consumption was reduced to 50 m$^3$/s while the gross water consumption was 1150 m$^3$/s. 1000 m$^3$/s, while the gross water consumption was reduced to 50 m$^3$/s, and the gross water consumption was reduced to 80 m$^3$/s while the gross water consumption was 950 m$^3$/s. In experiment two, which was 260 m$^3$/s and the gross water consumption was 1180 m$^3$/s; which was 150 m$^3$/s when K was used. The water use coefficient increased by 20% per hectare. 240 m$^3$/s, while the gross water consumption was reduced to 22 m$^3$/s, and the gross water consumption was reduced to 70 m$^3$/s while the gross water consumption was 900 m$^3$/s. 140 m$^3$/s, while the gross water consumption was reduced to 22 m$^3$/s, and the gross water consumption was reduced to 70 m$^3$/s while the gross water consumption was 900 m$^3$/s. 120 m$^3$/s, while the gross water consumption was reduced to 22 m$^3$/s, and the gross water consumption was reduced to 70 m$^3$/s while the gross water consumption was 900 m$^3$/s. 100 m$^3$/s, while the gross water consumption was reduced to 22 m$^3$/s, and the gross water consumption was reduced to 70 m$^3$/s while the gross water consumption was 900 m$^3$/s. 80 m$^3$/s, while the gross water consumption was reduced to 22 m$^3$/s, and the gross water consumption was reduced to 70 m$^3$/s while the gross water consumption was 900 m$^3$/s. 60 m$^3$/s, while the gross water consumption was reduced to 22 m$^3$/s, and the gross water consumption was reduced to 70 m$^3$/s while the gross water consumption was 900 m$^3$/s. 40 m$^3$/s, while the gross water consumption was reduced to 22 m$^3$/s, and the gross water consumption was reduced to 70 m$^3$/s while the gross water consumption was 900 m$^3$/s. 20 m$^3$/s, while the gross water consumption was reduced to 22 m$^3$/s, and the gross water consumption was reduced to 70 m$^3$/s while the gross water consumption was 900 m$^3$/s.
maximum efficiency. Use of Water Coefficient 2.8 - 3, A ditch with a road width of 0 m was calculated. Still, experience has shown that in terms of water management difficulty, the width of the road in ditches depends on the degree of intersection in the relief, the width of the road should not be less than 2 m. Strongly intersected slopes must be cut from 2.0 m - 2.5 m furrows were cut and irrigated with parallel and parallel horizontals. Tractors in the existing heavy-duty section should be cut using an end harrow cutter at a distance of 2.8 m between vegetable crop paths before cutting the furrow.

In rows between crops, with a transverse slope of 0.7 - 1.4 m, water use coefficient in irrigation techniques in the furrows ranged from 0.78 to 0.87, under control 0.7 - 0.76. The water economy during the irrigation season was 400 - 878 m³/h. Soil water permeability in winter wheat irrigation: 2 m in furrows 0.0011 - 0.0039 m/h; 0.0018 - 0.0045 m/h in a 2.5 m ditch; increased by 0.0027 - 0.0048 m/h at 3 m. In furrow irrigation, the water permeability increased by 0.008 - 0.0023 m/h. Soil erosion ranged from 0 to 0.52 t/ha per year, controlling 3.48 tons per year. In this case, the speed of the rows in the grooves is conditionally 0.12 - 0.14 m/h, in control - 0.22 - 0.23 m/sec, as well as the drop in height at the end of the groove, is 2.0 - 2.35 times less.

Water economy ranges from 103.3 m³/ha to 184.3 m³/ha, with controlled 211.3 - 253.2 m³/ha. The intervals between irrigations were 4 - 5 days shorter than in controlled irrigation. The labor productivity of irrigators varied from 1.78 ha/day to 2.86 ha/day in irrigated irrigation and 0.83 ha/day under control. The length of the grooved edges, which are cut at the largest slope and on this slope, is 2 to 5 times longer than the traditional slope. Water consumption is 2.5 - 4 times higher in the grooved slope than in the slope of the slope.

Irrigation by atmospheric precipitation was also used efficiently. In the experiments, discharge effluent (ice water) and rainfall accounted for 27% at the highest slope in the ridges and 2 - 4% in the ridges. During the harvest, the field's surface is leveled, the combine does not encounter obstacles to wheat harvesting, and the depth is reduced.

Throughout the entire study of fallow irrigation of autumn cereal crops, it was shown that the soil were protected against water accumulation and erosion, and high efficiency was achieved. When K-9 polymer was used on farms, the number and service of watermen were reduced by 2 times. The grain yield increased from 28.4 quintals to 68 - 70 quintals. Fuel savings were also achieved by reducing the number of vehicles to 3 - 4 liters per hectare. A water economy of 0.025 m³/sec from each furrow was achieved when furrow irrigation was carried out after applying K-9 polymer. Experiments on hilly lands have shown that the studied field soil is washed away by irrigation erosion due to its low supply of nutrients in mobile forms, despite being a typical gray soil that is often irrigated. The eroded part of the experimental field soils is low in nitrogen, moderately supplied with phosphorus, and insufficient in potassium.

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