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Irrigation of the cultivated area with groundwater from vertical drainage wells

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Abstract. In recent years, there has been a shortage of water resources in the basins of the Amu Darya and Syrdarya rivers, which is the result of the development of new lands for irrigation and the inappropriate use of water and land resources.

A side effect of irrigation and land reclamation is the increasing flow of collector-drainage waters every year, which leads to a deterioration in the land reclamation state and pollution of water resources, which can lead to the ecological disaster of land and water resources. Currently, in the Republic of Uzbekistan, from the total volume of water resources of the Amu Darya and Syrdarya rivers, up to 68% is used for irrigation. Of this volume on the Republic territory, about 12% of collector-drainage waters of deteriorated quality are formed. With a shortage of water resources, they are used for irrigation. But irrigation with saline waters can lead to a deterioration in the land reclamation state. In this regard, new irrigation technologies are proposed, which can save both irrigation water and it is advisable to use underground pumped water for irrigation.

Field experiments were carried out in the farm "Khozhilkhon-hozhi" in the farm named after A. Niyazov, Kuva district, Fergana region. A feature of the soil conditions in this farm is the small thickness of the covered fine earth, underlain by highly permeable gravel, strong and increased water permeability, with a deep groundwater level (GWL> 3 m).

Large water losses are observed during irrigation. The calculation task was to determine how many hectares of land can be irrigated from one vertical drainage well, taking into account the irrigation time, inter-irrigation period, etc.

The water-salt balance of the reclaimed lands for 2017-2019 was compiled. The water-salt balance showed that water supply and filtration from canals and atmospheric precipitation play the main role in the inlet part. In the consumable part, the main place is occupied by evapotranspiration and drainage flow. In general, a negative balance is formed on the territory annually by the type of a small salt carryover within 2.85 t / ha. On the territory of the farm and the experimental plot, cotton of the S-6524 variety was sown, the flow rate of the well is 30 l / s, the furrow consumption is 0.5 l / s. The composition of hypothetical salts in the pumped-out waters is calculated

After the first irrigation of our field, the pumped-out water is diverted to the neighboring fields, while the first inter-irrigation period is 20 days. In the interval of these 20 days until the second irrigation of the cotton of the

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original field, it is possible to irrigate the same fields 5 hectares 8 times, in total 40 hectares of land.
The experiments showed that irrigation with pumped water from vertical drainage wells did not have a negative impact on the yield of cotton. And the use of the recommended irrigation technology will reduce the shortage of irrigation water and improve the ecological situation of water resources.

1 Introduction

The development of the use of water resources for irrigation and industrial needs leads to a shortage of fresh water and a deterioration in the land reclamation state. A side effect of irrigation and land reclamation is the increasing flow of collector-drainage waters every year, which leads to a deterioration in the land reclamation state and pollution of water resources.

Currently, in the Republic of Uzbekistan, from the total volume of water resources of the Amu Darya and Syrdarya rivers, up to 68% is used for irrigation. From this volume on the Republic territory, about 12% of collector-drainage waters of deteriorated quality are formed; the salinity of these waters ranges from 2 g/l to 10 g/l. Depending on the mineralization, the toxicity of salts in drainage waters also changes. Collector-drainage waters up to 2 g/l contain up to 20% toxic salts, including salts of chlorine, sodium and pollutants - phenols and petroleum products. With an increase in mineralization up to 16-20 g / l, toxic substances make up 50% of the total composition of drainage water salts.

Many scientists from different countries of foreign countries and Central Asia had experience in working with drainage waters. The works of the following authors are devoted to the establishment of the general reserves of groundwater and the possibility of using them for water supply and irrigation of crops, as well as the assessment of the replenished operational reserves: N. Reshetkina; H. Yakubov, G. Mavlyanova, S. Mirzeva, N. Plotnikova, M. Zaparia, L. Krasilshchikova; S. Mukhamedzhanova; V.Usenko, M. Chaban, I. Trukhan, A. Usmanov, T. Bekmuratova, R. Ikramov, M. Khamidov, Sh. Mukhamedzhanov, A. Karimov, A. Salokhitdinov and others [1-7].

Assessment of the quality of various natural waters and the results of determining their applicability for irrigation of agricultural crops indicate the possibility of using saline waters for irrigation and leaching of saline lands

According to most studies, to obtain a high and stable yield, the permissible concentration of salts in soil solutions with a chloride-sulfate composition of salts typical for most of the irrigated soils of Central Asia should not exceed 6-7 g/l.

At a concentration of 6-12 g/l, the yield of cultivated crops is satisfactory.

An increase in the concentration of soil solutions beyond 10-12 g/l causes inhibition of most agricultural plants. At a concentration of 20-25 g/l and above, their growth and development are suspended. At the same time, the concentration of soil solutions for Fergana conditions with a pronounced sulfate salinity - up to 10-13 g/l does not have a physiologically harmful effect on a crop such as cotton [8-12].

An analysis of the above literature data shows that when using drainage water in certain regions with different climatic, hydrogeological, soil and agromeliorative conditions against the background of various crops and drainage, a satisfactory crop yield was obtained with different degrees of irrigation water salinity. The permissible limit of applicability ranges from 2 to 5 g/l, depending on the chemical composition of water and irrigation conditions.

Many researchers - V.A. Kovda, V.V. Egorov, D.M. Katz, I.S. Rabochev, N.M. Reshetkina and others; Kh.I. Yakubov, L.L. Korelis, A.Usmanov, T.U. Bekmuratov, R.K. Ikramov, M.A. Yakubov and others note that when using saline pumped out and collector-drainage waters for irrigation and obtaining satisfactory crop yields, it is necessary to create a flushing irrigation regime [13-18].

Even though many scientists were engaged in the irrigation of collector and drainage waters, irrigation with groundwater pumped from vertical drainage wells in the zone of their pinching was not considered.

2 Methods

For scientific research, the statistical method and the method of conducting field experiments at the experimental site were used.

3 Results and Discussion

To improve the ecological situation of water resources, to improve the reclamation state of irrigated lands, field experiments were carried out. The field study aimed to irrigate with pumped water without discharging it into the drainage network**.**

For this, it was necessary to study the example of a specific farm. Field experiments were carried out in the farm "Khozhilkhon-hozhi" in the farm named after A. Niyazov, Kuva district, Fergana region. A feature of the soil conditions in this farm is the small thickness of the covered fine earth, underlain by highly permeable gravel, strong and increased water permeability, with a deep groundwater level (GWL> 3 m). Large water losses are observed during irrigation [18-30].

The field research task was to determine how many hectares of land can be irrigated from one vertical drainage well, taking into account the irrigation time, the inter-irrigation period. To carry out field studies, it was necessary to calculate the water-salt balance of the territory.

Table 1. Actual general water-salt balance in WUA conditions "AND. Niyazov "(average for 2017-2019)

№	Elements of water-salt balance	Water, m^3 / ha	Salt, t / ha
1	Water supply (gross)	8030	5.46
2	Precipitation	1680	0.67
3	Filtering from channels	3280	2.23
4	Evapotranspiration	7820	-
5	Discharges from the fields	1930	1.31
6	Underground inflow and outflow	1840	0.74
7	Drainage drain	6610	10.64
8	Changes in moisture and salt reserves	-1530	-2.85

The water-salt balances of reclaimed lands compiled by us for 2017-2019 showed that the main role is played by water supply and filtration from canals and atmospheric precipitation in the inlet part. In the consumable part, the main place is occupied by evapotranspiration and drainage flow. In general, a negative balance is formed on the territory annually by the type of a small salt removal within the range of 2.85 t / ha (Table 1).

On the territory of the farm and the experimental plot, cotton of the S-6524 variety was sown, the flow rate of the well is 30 l / s, the furrow flow rate is 0.5 l / s, the value of the longitudinal slope is 0.012, the number of simultaneously irrigated furrows is 20 pcs.

Along the length of the longitudinal irrigated area, there are three irrigated areas separated by furrows; the number of simultaneously irrigated furrows is 20. Water from the head water intake is taken in portions from furrows connected to irrigation. Watering starts with filling 20 furrows of the upper section. Then the second section is refueled. With 20 furrows, it has a water intake of 10 l / s, the discharge from the left section is 2 l / s (20 %), and in the second section, 4 furrows are additionally provided due to the discharge.

After the first irrigation of our field, the pumped-out water is diverted to the neighboring fields, while the first inter-irrigation period is 20 days. In the interval of these 20 days until the second irrigation of the cotton of the original field, it is possible to irrigate the same fields 5 hectares 8 times, in total 40 hectares of land.

During the growing season, irrigation rates were 900-1200 m3 / ha. Watering was assigned according to humidity 70-70-65% of HB. In experiments using the SANIIRI methodology, the following questions were studied: change in the water-physical properties of the soil during irrigation of cotton with pumped water; study of the salinity of pumped out and ditch water and chemical composition; change in the content of salts in the aeration zone according to the variants of the experiment; dynamics of the level and mineralization of groundwater; changes in the elements of the water-salt balance; study of the effect of water mineralization on the yield of cotton.

The irrigation rate of the main crop, cotton, for the experimental plot was calculated using the formula of S.N. Ryzhov:

$$m = (W_{nv} - W_f) \cdot 100 \cdot \gamma \cdot h + k, \; m3/ga \quad (1)$$

here W_{nv} is the smallest soil moisture capacity,% of the mass; Wf is the actual soil moisture before irrigation,% of the mass; γ is bulk density of soil, g / cm3; h is calculated layer, m; k is water consumption for evaporation during irrigation (10%) of moisture deficit in the calculated layer. The soil on our site is medium loamy. Irrigation and irrigation rates supplied from vertical drainage and control wells irrigated with ditch water are given in Table 2.

Table 2. Irrigation and irrigation rates in the experimental and control field

Options	highest moisture content			Irrigation rate
	70 %	70 %	65 %	
Arychna water	900	1100	1150	3150
Pumped water	950	1150	1200	3300

Irrigation and irrigation rates for the two options were close in terms and rates that were used in production conditions. To study the quality of the pumped water, water samples were taken from vertical drainage wells. The salinity of the pumped-out water ranged from 1.2 to 3.1 g / l. Sulfate ions prevail in the composition of anions, magnesium and sodium prevail in the composition of cations. Based on statistical processing of materials of chemical analysis of pumped water, a graph of the dependence of anions and cations on the value of mineralization was obtained, Figure 1.

The composition of hypothetical salts in the pumped-out waters was calculated, the results of which made it possible to reveal the dependence of the sum of non-toxic CaSO4, Ca (HCO3) 2 and the sum of toxic (MqSO4, Na2SO4, NaCL) salts on water salinity, Figure 1. From the calculated calculations, it can be seen that with an increase in water salinity over 1.6-1.8 g / l, the amount of toxic salts increases, which were approximately equal with mineralization of 1.2-1.4 g / l.

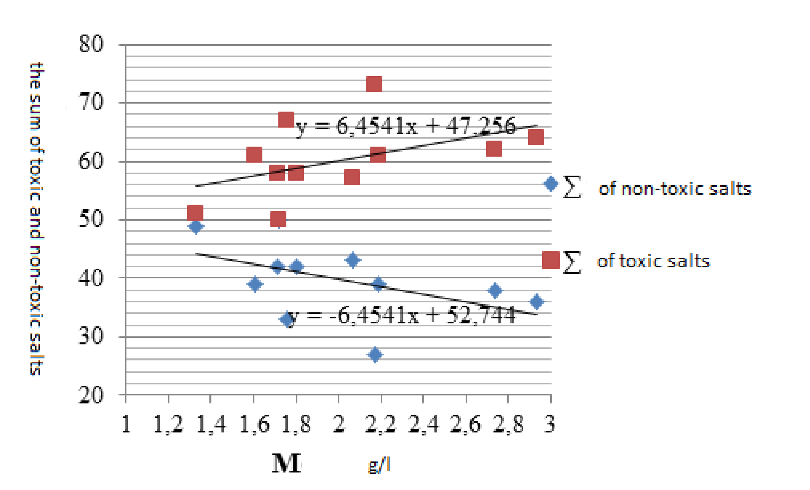

Fig. 1. Sum of toxic, non-toxic salts

According to the classification of suitability for irrigation, it was shown that these waters are suitable for irrigation (Table 3).

Table 3. Assessment of the quality of ditch and ground water used for irrigation by various methods

Assessment methods	River water with average mineralization of 0.680 g / l	Groundwater with average mineralization of 2.540 g / l
According to M.F. Budanov	0.33	0.69
According to A.M. Mozheiko	24.90	40.91
Collar T.K.	2.84	1.40
According to Antipov-Karataev I.N. and Kader G.M.	38.92	64.81

4 Conclusions

The results of the experiments showed that changes in the water-salt regime of soils and irrigation with low-mineralized pumped water ($M_{otk}^{sr} = 1.5 - 2.5$ г/л) against the background of the adopted regime and norms of irrigation, normal agrotechnical and organizational methods did not have a negative impact on cotton yield.

On the experimental site, an average yield was achieved in the range of 26.4-26.5 c / ha. On the control plot, with irrigation ditches, the yield was slightly higher: 26.7-27 c / ha; that is, the difference in plant productivity in the two plots was small.

A field experiment showed that after the first irrigation of our field, the pumped water is diverted to the neighboring fields; if the first inter-irrigation period is 20 days, then before the second irrigation of cotton, the same fields can be irrigated 5 ha 8 times, i.e. 40 ha of land. The new irrigation method shows that the use of these technologies will reduce the shortage of irrigation water and improve the ecological state of water resources.

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