Problems of climate change and efficient use of water resources in the Aral Sea region

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Abstract. This article presents the results of scientific research on climate change in the Aral Bay region due to global climate change and increasing water scarcity, as well as the development of cotton irrigation methods taking into account soil-hydrogeological conditions. In the Republic of Karakalpakstan, which is located in the Aralboyi region, global climate change papametplapin Bip diversity and T-test analysis revealed an increase in acocida air hapopathy by 1.42°C, and the scientific-based irrigation procedure of cotton "Methodology of conducting field experiments" of the Scientific Research Institute of Cotton Selection, Seeding and Cultivation Agrotechnologies (2007)" on the basis of the VIII hydromodule with the largest area in the region was developed for the region, and it was found that irrigating cotton 4 times in the 1-2-1 scheme with irrigation norms of 623-882 m3/ha and seasonal irrigation norms of 2789-2867 m3/ha is highly effective.

1 Introduction

The impact of global climate change on agriculture is high, as agriculture, especially irrigated agriculture, is one of the most weather-dependent sectors of the economy. Today, the irrigated areas in the world are 299,488 million. is a hectare. More than 50% of the irrigated areas belong to China, India, USA, Pakistan and EU countries.

In the world, great attention is being paid to research and development aimed at the development of technologies for the management of water resources and their efficient use. In particular, it is of particular importance to carry out scientific research aimed at the development of new irrigation technologies that save water resources using cheap and chemical and technical means.

As a result of climate change, the area of glaciers in Central Asia has decreased by about 30% over the last 50-60 years. According to forecasts, the volume of glaciers will decrease by 50% when the temperature increases by 20C, and by 78% when it warms by 40C. According to estimates, by 2050 water resources in the Syrdarya basin are expected to decrease by 5% and in the Amudarya basin by 15%. The total water deficit in Uzbekistan until 2015 was more than 3 billion cubic meters, by 2030 it may reach 7 billion cubic meters, and by 2050 it may reach 15 billion cubic meters[3,4].

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The results indicate that slightly saline areas would generally be reduced in compensation for an increase in moderately and highly saline areas [11].

B.C.Mambetnazapov carried out the hydromodule development of the cultivated plant of the Republic of Karakalpakstan, and in this way developed the method of crop cultivation in the cotton rotation complex [7].

According to M.K. Khamidov's report, the seasonal irrigation standards of cotton in the Khorezm region were 3300 - 6300 m3/ha in the hydromodule regions, 4200 - 7000 m3/ha in the northern region of the Republic of Karakalpakstan, and 3400 - 6400 m3/ha in the southern region [9].

M.Khamidov [8], the irrigation system of the main region was developed and recommendations were made for the irrigation system of the Khorezm region.

2 Methods

The field, labopathological research and phenological characterization of cotton breeding were carried out in the "Field testing program" (UzPITI 2007) of the Scientific Research Institute of Cotton Breeding, Planting and Agrotechnology. ” manual and statistical analysis were performed on WinQSB-2.0 data type.

3 Results and Discussion

Based on the purpose of the research, the changes in the air pollution data and the cultivated area in the Republic of Karakalpakstan in the Aral Bay region in the period of 1937-2020 were analyzed. It was found that with the increase of air pressure, the evaporation from the soil increases, and as a result, the absorbed area in the area increases (Fig. 1).

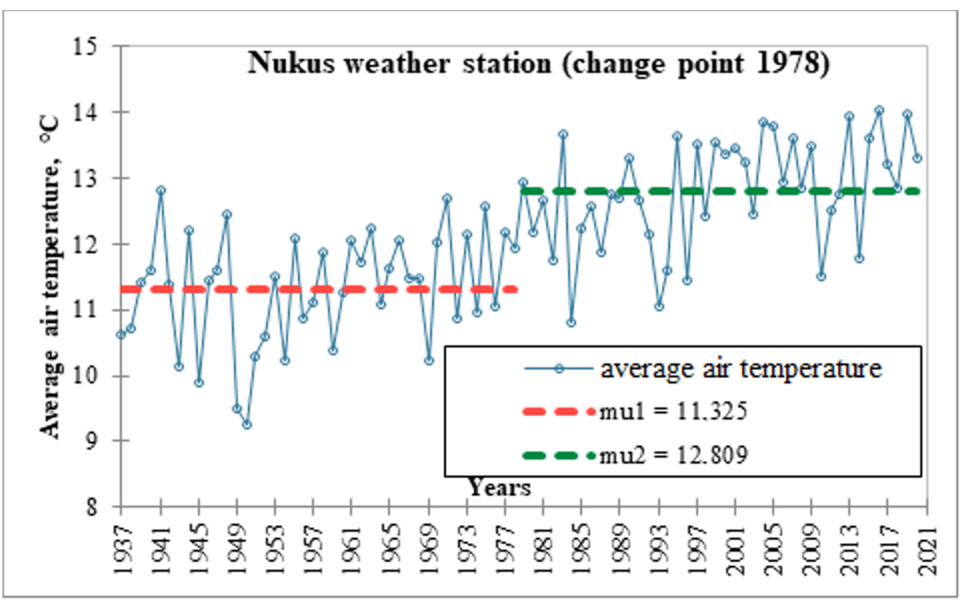

Fig. 1. Variation of average air temperature in the Republic of Karakalpakstan based on the Homogeneity test

From this graph, it can be seen that during the period 1979-2020, compared to the period of 1937-1978, the total air temperature increased by 1,424°C.

According to the T-тест analysis, the total air temperature increased by 1.37°C during the period 1991-2020 compared to the period 1937-1990 (Figure 2).

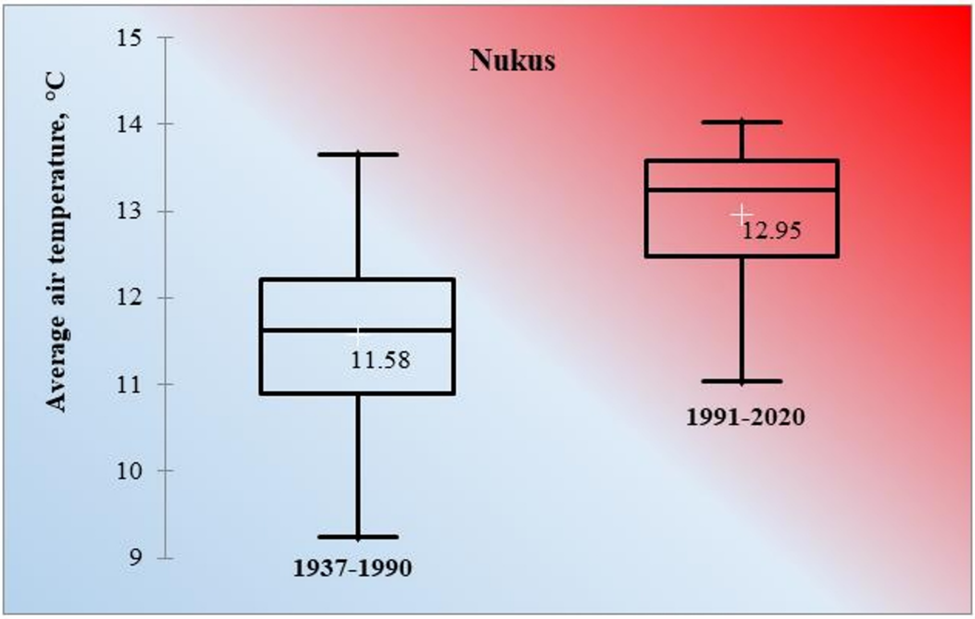

Fig.2. Changes in average air temperature in different periods

3.1 Irrigation method of cotton

In 2018-2020, field experiments on the study of the optimal irrigation method of cotton in the main VIII hydromodule region of the southern districts of the Republic of Karakalpakstan were conducted on the irrigated lands of the "Reimbay Boshlyk" farm in the Beruniy district. In the researches, the method of watering the cotton variety "Sultan", the effect of the irrigation method on the salinity of the soil, the level of seepage water and their mineralization, the growth, development and productivity of cotton, and the economic efficiency of the method of watering cotton were studied. Water for irrigation of agricultural crops is delivered to the fields through branches and arrow ditches, and the crops are irrigated. The soils of the farm are moderately saline. Research was conducted in the experimental field based on the following system. (Table 1):

Table 1. Field experiment system

№	Pre-irrigation soil moisture in % relative to limited field moisture capacity	Irrigation rate, m^3/ha
1	Production control	Actual measurements
2	70-70-60	According to the moisture deficit in the 70-100-70 cm layer
3	70-80-60	
4	70-80-60	The moisture deficit in the 70-100-70 cm layer is increased by 30%.

When irrigating cotton, the soil moisture before irrigation is 70-80-60% compared to the limited field moisture capacity, cotton was irrigated once at the rate of 633-643 m^3/ha during the germination-flowering period, and 623-693 m^3/ha during the flowering period. cotton was irrigated twice with the norms and during the ripening period it was irrigated once with the irrigation norm of 855-882 m^3/ha (Table 2).

Table 2. The method of watering cotton (2018-2020 years)

№	Irrigation periods, days	Irrigation rates, m^3/ha	Irrigation scheme	Seasonal irrigation standards, m3/ha
1	25-26	1139 - 1271	1-2-1	4678-4744
2	23-27	665-942	1-2-1	3335-3432
3	17-24	623-882	1-2-1	2789-2867
4	20-27	843-1132	1-2-1	3711-3772

As can be seen from the table, the seasonal irrigation rate was 2789-2867 m^3/ha, or 1877-1889 m^3/ha of river water was saved compared to the control option. The period between cotton waterings was equal to 17-24 days.

3.2 The influence of the irrigation method on the salt regime of the soil

At the beginning of the growing season, the amount of chlorine ions in the arable layer (0-30 cm) of the soil of control option 1 of the experiment was 0.010-0.012% by weight of the soil, and 0.009-0.011% in the 0-100 cm layer of the soil (Fig. 3). At the end of the growing season, the amount of chlorine ions in the fertile layer of the soil was 0.023-0.024% by weight of the soil, and in the active layer of the soil was 0.017-0.020%. At the beginning of the growing season, the dry residue in the soil layer of the soil was 0.192-1.96%, and in the 0-100 cm layer of the soil, it was 0.167-1.72% (Fig. 3). At the end of the growing season, the amount of dry residue in the fertile layer of the soil was 0.401-0.412%, and in the active layer of the soil, it was 0.352-0.362%. Seasonal salt accumulation coefficient in the plowed layer: 2.0-2.40 by chlorine ion and 2.01-2.15% by dry residue, 1.82-1.90% in the 0-100 cm layer, respectively, and 2 was 05-2.18%.

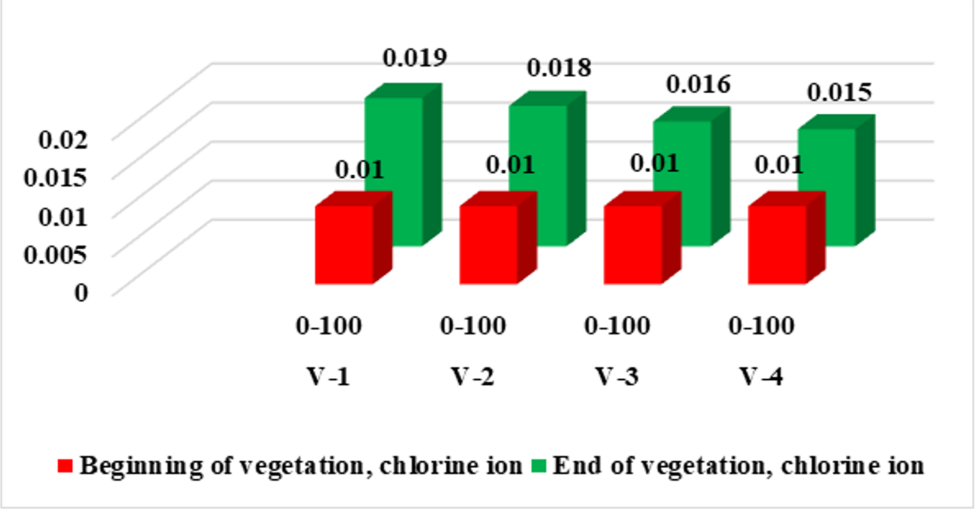

Fig. 3. Change of chlorine ion in the soil of the experimental field, %

In the experiments, the optimal salt regime of the soil was observed in the 4th option. In this variant, the amount of chlorine ion in the arable layer of the soil of the experimental field at the beginning of the growing season was 0.010-0.012%, and in the 0-100 cm layer, it was 0.009-0.011%. At the end of the growing season, the amount of chlorine ions in the tilled layer was 0.017-0.018%, and in the active layer of the soil was 0.014-0.016%. Dry residue in the soil layer was 0.192-0.196% and 0.341-0.354%, respectively. Dry residue in the active layer of the soil was 0.167-0.172% at the beginning of vegetation and 0.248-0.289% at the end. The seasonal salt accumulation coefficient is 1.50-1.80% of chloride ion in the arable layer, 1.74-1.83% in the dry residue, 1.40-1.67% in the 0-100 layer, and 1 It was equal to 1.73-48%.

According to the analysis of the influence of irrigation procedures on the soil salt regime, salt accumulation was observed in the 0-100 cm layer of the soil where cotton roots are located at the end of the growing season in all options. Salt tillage accumulated more in the 0-30 cm layer than in other layers. The rate of salt accumulation was lower in the options irrigated with irrigation rates designed to compensate for the moisture deficit in the one-meter soil layer compared to the control options.

In order to determine the change in the level of seepage water and mineralization of the experimental field, monitoring wells were installed in all options, where the level of seepage water was measured every 10 days, and the obtained water samples were chemically analyzed. In general, based on the results of the study of the dynamics of the seepage water level in the experimental field, the following can be concluded: the period of the deepest settlement of the seepage water from the surface of the ground in the experimental field is in October and November, and the period closest to the surface is in the growing season of cotton - in the months of June, July and August. in the experimental field and in the adjacent area, irrigation works were carried out, irrigation systems were operated with a large load, and leakage losses were high (Fig. 4).

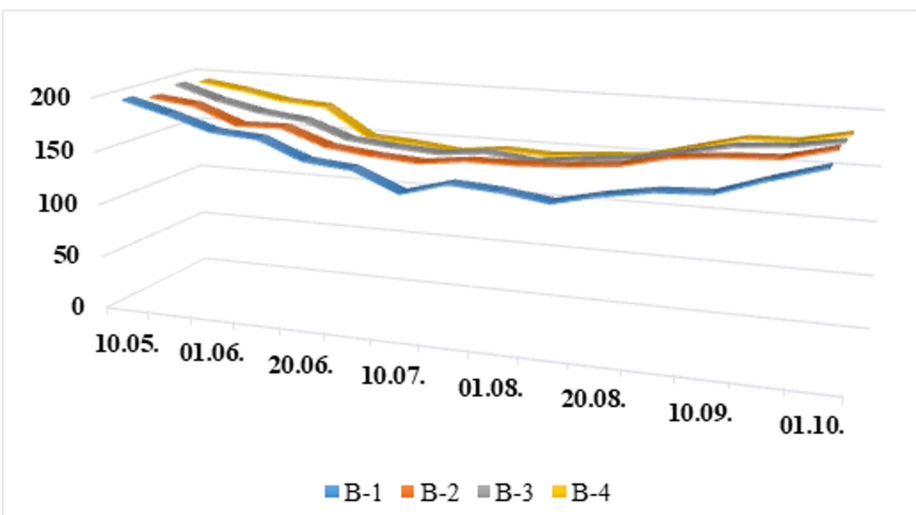

Fig. 4. The change of the level of water in the experimental field, cm

The mineralization of seepage water in the experimental field is 2.16-2.41 g/l at the beginning of the growing season, and it is weakly mineralized (1-3 g/l). In options 2 and 3, which were irrigated with irrigation rates designed to cover the moisture deficit of the active soil layer, the mineralization of seepage water changed relatively little at the end of the growing season. In control variant 1 and variant 4, which was irrigated by increasing the moisture deficit by 30%, mineralization of seepage water increased to 2.32-3.85 g/l by the end of the growing season, as cotton was irrigated with large irrigation rates, that is, together with irrigation water to seepage water it was observed that the water-soluble salts present in the soil were added (Fig. 5).

In the control version of the experiments, as a result of irrigation of cotton with large irrigation rates, as a result of excess water consumption and leaching of salts and other toxic substances from the soil into the seepage water, the mineralization of seepage water was higher than in other options. In option 3, as a result of irrigating in the order of 70-80-60% relative to the limited field moisture capacity, excess water consumption and leaching of toxic salts and other substances from the soil into seepage water was relatively small.

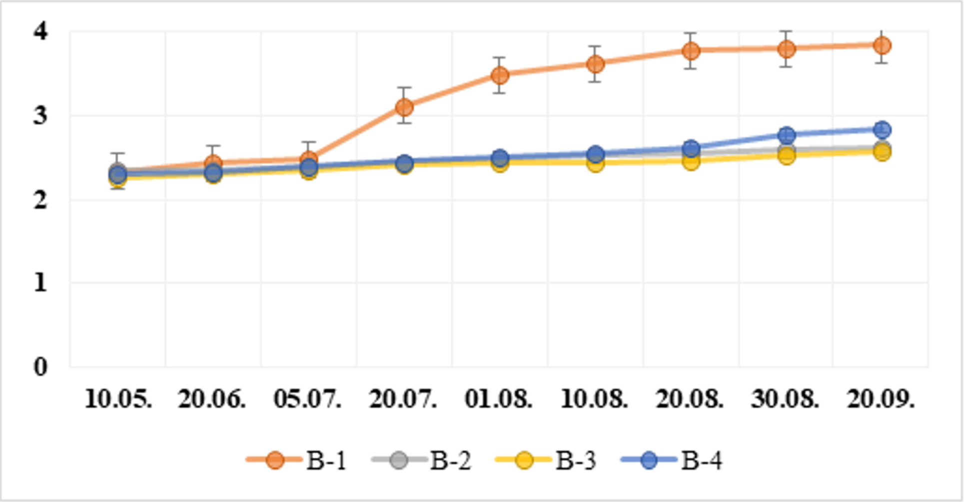

Fig. 5. Changes in the mineralization of the experimental field sizot waters

The results of phenological observations on the effect of irrigation regimes on the growth and development of cotton are presented in Table 3. In the 3rd version of the experiment, the best indicators of cotton growth and development were obtained. As of September 1, the height of the cotton was 99.3-100 cm, the yield branches were 10.3-11.0 pieces, the number of bolls was 9.9-10.7 pieces, and the number of opened bolls was 2.1-2.6 pieces. , compared to the control option, the number of branches increased by 0.5-0.7, the number of pods increased by 0.5-0.8, and the number of pods opened on September 1 increased by 0.4-0.5.

Table 3. Effect of irrigation regimes on growth and development of cotton (2018-2020 years)

Options	Seedling density, thousand pieces/ha	With real leaves, number	Plant height, cm			
	1.06	1.06	1.06	1.07	1.08	1.09
1	99.3	3.5	9.8	36.4	58.3	97.6
2	100.0	3.6	10.4	35.9	47.3	82.4
3	99.9	3.6	10.4	37.2	51.2	89.0
4	99.5	3.4	10.1	37.0	51.9	92.4

Continuation of table № 2.

Crop branches, number		Number of pods, pcs			Seedling thickness g_i, thousand pieces / ha
1.07	1.08	1.08	1.09	The one opened in 1.09	1.09
6.3	10.3	5.7	9.9	2.1	96.7
6.5	10.6	5.9	10.3	2.2	97.6
6.7	11.0	6.4	10.7	2.6	98.4
6.6	10.6	6.2	10.3	2.3	97.5

4 Conclusions

1. Based on the analysis of the climatic parameters of the southern region of the Republic of Karakalpakstan, it was determined that the air temperature increased by 1.42°C.

2. At the beginning of the experiments to determine the irrigation method of cotton in the conditions of climate change. It was 1.39 g/cm3. At the end of the growing season, soil volume mass increased in all variants under the influence of cotton care and different irrigation regimes. The least compaction of the soil was in the 3rd variant of the experiment and was equal to 0.01-0.02 g/cm3.

3. One of the main hydromodule regions of the southern districts of the Republic of Karakalpakstan - in the VIII hydromodule region, in order to obtain a cotton yield of 38.5 t/ha from cotton, keeping the soil moisture before cotton irrigation at 70-80-60% compared to the limited field moisture capacity, 623-882 m3 Irrigation 4 times in 1-2-1 scheme with irrigation rate of /ha, seasonal irrigation rates were found to be 2789-2867 m3/ha.

4. In the experimental field, the level of seepage water at the beginning of vegetation was on average 192-198 cm, during the vegetation period it was 126-159 cm, and at the end of vegetation it was 180-188 cm. The mineralization of syzot waters is 2.16-2.41 g/l at the beginning of the growing season, and it is weakly (1-3 g/l) mineralized. In options 2 and 3, which were irrigated with irrigation rates designed to cover the moisture deficit of the active soil layer, the mineralization of seepage water changed relatively little at the end of the growing season. In option 4, where cotton was irrigated with large irrigation rates, the mineralization of seepage water increased to 2.32-3.85 g/l towards the end of the growing season, that is, it was observed that water-soluble salts present in the soil were added to seepage water along with irrigation water.

5. At the beginning of vegetation, the amount of chlorine ions in the soil in the plowed layer (0-30 cm) of the control variant was 0.010-0.012%, and in the 0-100 cm layer of the soil was 0.009-0.011%. At the end of vegetation, the amount of chlorine ions in the 0-30 cm layer was 0.023-0.024%, and in the 0-100 cm layer was 0.017-0.020%. At the beginning of the growing season, the dry residue in the arable layer was 0.192-1.96%, and in the active layer of the soil, it was 0.167-1.72%. At the end of vegetation, the dry residue in the 0-30 cm layer was 0.401-0.412%, and in the active layer, it was 0.352-0.362%. The coefficient of seasonal salt accumulation in the arable layer: 2.0-2.40 according to chlorine ion and 2.01-2.15 according to dry residue. In the active 0-100 cm layer of the soil, this coefficient was 1.82-1.90 and 2.05-2.18, respectively.

6. In the 3rd variant of the experiment, as of September 1, the height of the cotton was 89.0 cm, the number of bolls was 10.7 and the number of opened bolls was 2.6. The growth and development was good compared to the other options of the experiment, and the number of bolls compared to the control option By 0.8 pieces and the number of opened cysts increased by 0.5 pieces.

7. When irrigating cotton, when the soil moisture before irrigation is 70-80-60% compared to the limited field moisture capacity, its yield is 38.5 tons/ha, the income from the sale of the crop is 15549.7 thousand soms/ha, the total expenses are 11459, 0 thousand soums/ha, the conditional net profit was 4090.7 thousand soums/ha, and the profitability level was 35.7%.

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