Solutions for the rational use of water in the conditions of the Republic of Uzbekistan

Sagit Kurbanbaev¹, Zakir Turlibaev² and Yulduz Urazimbetova²

¹ Karakalpak branch office of the Scientific Research Institute of irrigation and water problems, Karakalpakstan, Uzbekistan
² Karakalpak Slate University, Karakalpakstan, Uzbekistan

E-mail: zakir_18_89@mail.ru

Abstract. The article studies data on the use of water in the territory under consideration and, on their basis, suggests ways of their rational use. Recommendations are given for the rational use of water, these are mainly measures to increase the efficiency of the on-farm network, improve the technique and technology of furrow irrigation, and introduce advanced systems of equipment and technology for irrigation.

1. Introduction
At present, as in the future, the main limiting factor to improve the production of agriculture further in this large region of the lower reaches of the Amu Darya is the limited free flow of the Amu Darya water. It should also be noted that the suspension of the development of new lands in the Amu Darya basin as a whole, including the Republic of Karakalpakstan, which has taken place in recent years, cannot persist in the future, since population growth and, accordingly, the need to provide food as well as the need for growth the economy of the republic requires a slight increase in the rate of development of irrigated lands through the reconstruction of old irrigated lands. On the other hand, it is also known that the water resources of the river basin are exhausted and distributed over the republics, i.e. limits are set for individual regions.

Therefore, at the same time, by reducing the value of specific water consumption, it is necessary to carry out a number of measures for water conservation and to gradually achieve their introduction into production.

2. Materials and methods
The study uses a method that allows the loss of water from the on-farm network and allows you to determine the flow rate using the following method:

\[ Q_s - Q_h = \sum Q_{b} + \sum Q_{sbr} \]  

Where: \( \Sigma \) is total water losses in the investigated section of the canal; \( Q_b \) - \( Q_h \) is water flow in the upper and lower sections; \( Q_{sbr} \) is water discharge discharged in the investigated area.
3. Results and Discussion

Taking into account the peculiarities of the natural and climatic conditions of the Republic of Karakalpakstan, at the same time, by reducing the value of specific water consumption, it is necessary to carry out a number of comprehensive measures for the economical use of water supplies, namely:

- Conduct planning (capital and operational).
- Increasing the efficiency (efficiency) of the channels.
- Improving the technique and technology of furrow irrigation.
- Introduction of perfect systems of irrigation technology (drip irrigation, etc.).

Saving water by leveling fields.

It is known that most of the areas of the Republic of Karakalpakstan are old-irrigated with a primitive irrigation and reclamation system. These lands are characterized by the lack of planning of irrigated areas. So in some areas, the difference in the marks of one field reaches up to 30 - 40 cm (within 3 - 4 hectares), which requires the supply of a huge amount of water.

Long-term studies carried out on the territory of the Republic of Karakalpakstan show that if the difference in marks on one check (4 ha) is ± 35 cm, then due to this there is an overconsumption of water of the order of 1420 m$^3$/ha.

Table 1. Overconsumption of water during the growing season at different levels of check planning.

| Irrigation rate of cotton, m$^3$ | Overconsumption of water m$^3$/ha and irrigation rates with different differences in marks in receipts, cm |
|---------------------------------|------------------------------------------------------------------------------------------------------------------|
| 4000                            | 4000 4300 4550 4670 5420                                                                                         |

Table 2. Water losses in on-farm canals, which are on the balance of farmers, as well as the expected water savings in the case of engineering measures, are given in table 2.

As can be seen from the data in the table, at the first stage, it is possible to increase the efficiency from 0.65 to 0.73 only by arranging a trough network on group irrigation ditches and on other links by carrying out reconstruction on earthen channels.
Table 2. Measures to improve the efficiency of the on-farm network (in the cotton growing area).

| No. | Channels                      | Existing efficiency | Efficiency improvement measures | Efficiency after reconstruction |
|-----|------------------------------|---------------------|---------------------------------|--------------------------------|
| 1   | Group sprinklers             | 0.84                | Tray network device             | 0.96                           |
| 2   | District sprinklers          | 0.90                | Earthen bed                     | 0.91                           |
| 3   | Temporary sprinklers         | 0.85                | Earthen bed                     | 0.84                           |
| 4   | Average efficiency           | 0.65                |                                 | 0.73                           |

The only way to achieve a water saving of 220 m$^3$/ha is to increase the efficiency of on-farm canals (in the cotton-growing zone).

Saving water through improved technology.

Features of the local conditions of the Republic of Karakalpakstan, the following irrigation technologies which were tested on experimental plots can be recommended.

- Ordinary traditional watering, which is practiced on farms (watering from one side).
- Irrigation through the furrow.
- Backwatering, water supply from both sides of the furrow, by cutting single-breasted temporary sprinklers.

The main disadvantages of the ordinary irrigation used in the production, which ultimately leads to excessive consumption of irrigation water, are high labor expenses, long duration of irrigation, a large volume of vertical filtration.

Furrow irrigation is successfully applied on heavy soils, and this method of irrigation improves soil aeration.

The last option, counter irrigation with concentrated water supply. With this option, watering is carried out from both sides through single-breasted temporary sprinklers. Water supply is carried out simultaneously, while the furrow length and irrigation time are reduced by 1.5 - 2.0 times. A condition for this is a good leveling and zero slope. According to the data of field observations of the experiments carried out using this technology, the following results were obtained.

Table 3. Water saving with different options for furrow irrigation experiment.

| Variants                      | Irrigation rates, m$^3$/ha | Water saving, m$^3$/ha |
|-------------------------------|-----------------------------|------------------------|
| 1. Traditional (control)      | 3682                        | 0                      |
| 2. Watering through the furrow| 2670                        | 1012                   |
| 3. Counter, forced watering   | 3290                        | 392                    |

Saving water through the introduction of perfect irrigation systems.

One of the most effective approaches for the rational use of water for irrigation is the use of drip irrigation, which is widely used in world experience, especially where there is a deep shortage of water.

Conducted in 2020 - 2021 In various zones of the Republic of Karakalpakstan, experiments on the use of drip irrigation systems for irrigating tomatoes, cotton plants, orchards have shown that, subject to technical and operational requirements, this technology gives a high economy of water resources (table 4).

Along with the great advantages of drip irrigation, there are a number of disadvantages, such as the relatively high cost of construction in modern conditions of the transition of farms to market relations. This is the main deterrent to the introduction of this irrigation system in general in Uzbekistan and in particular in the Republic of Karakalpakstan.
Table 4. Water saving due to the use of the drip irrigation system on the territory of the farm of the Nukus region.

| Traditional irrigation rate of cotton (for the VII hydro modular region), m³/ha | Irrigation rate when using a drip irrigation system, m³/ha | Saving water resources, m³/ha |
|---|---|---|
| 4850 | 3925 | 925 |

4. Conclusion

It is known that the problem of water conservation and economical use of water includes the implementation of a set of organizational, agro technical and technical measures. Along with this, the above measures are currently a priority from the point of view of economical use of water resources for the conditions of the Republic of Karakalpakstan.

Table 5 summarizes the data on saving water resources in the implementation of the above measures.

Table 5. Measures for the rational use of water.

| Types of events | Water saving, m³/ha |
|---|---|
| Field layout | 1420 |
| Improving the efficiency of on-farm canals | 220 |
| Introducing counter irrigation | 392 |
| Introducing drip irrigation (cotton) | 925 |
| Total: | 2957 |

As can be seen from the data in the table, only by introducing technical measures at the first level, it is possible to save 2957 m³/ha of water during irrigation.

Despite the implementation of certain works aimed at the economical use of water resources, such as the introduction of advanced irrigation equipment and technology, the reconstruction of canals and collectors and other complex measures, we still have a large supply of water resources and, if desired, this reserve can be additionally increased to 3 - 4 thousand m³/ha, which will make it possible to increase the area of irrigated land as a whole in the Republic of Karakalpakstan up to 10-15 thousand hectares.

References

[1] Dospexov B A 1979 Field experiment methodology (Moscow: Kolos)
[2] Irrigated agriculture 1965 (Tashkent: Uzbekistan)
[3] Issues of decoration in the lower reaches of the Amu Darya. Proceedings of the Aral-Caspian complex expedition 1956 (Moscow: Academy of Sciences of the USSR)
[4] Romanov V M and Ivancova T I 1974 Promising methods and irrigation techniques (Moscow: Kolos)
[5] Improvement of water-saving technologies and progressive irrigation technology on irrigated lands of Central Asia 1989 (Tashkent)
[6] Ramazanov A and Yakubov X 1988 Industrial and water-charging irrigation (Tashkent: Mexnat)
[7] Pashkov N N and Dolgachev F M 1985 Hydraulics fundamentals of hydrology (Moscow: Energoatomizdat)
[8] Rozanov N P 1985 Hydraulic structures (Moscow: Agropromizdat)
[9] Djamankaraev S Dj 1993 Improving the operation of irrigation systems in the Republic of Karakalpakstan (Nukus: Karakalpakstan)
[10] Glazovskiy N F 1991 *Aral crisis* (Moscow)

[11] Abdirov Ch A, Konstantinova L G, Kurbanbaev E and Konstantinova L G 1966 *Surface water quality of the downstream Amudarya river* (Tashkent)

[12] Tuchin A I, Gramiko K V and Ruziev I B 2003 Environmental problems of the Southern Aral Sea region and proposals for its rehabilitation. *Materials of the Central Asian International Scientific and Practical Conference, Almaty*

[13] Turlibaev Z T, Kurbanbaev S, Karimova O and Baymuratov R 2021 Efficient and rational use of irrigation water in the conditions of the Republic of Karakalpakstan. *II International scientific conference "Building mechanics, hydraulics and hydraulic engineering" (CONMEHIDRO-2021), Tashkent*

[14] Turlibaev Z T and Kurbanbaev S 2021 Technical justification for the use of dual regulation of the groundwater level (sub-irrigation) in the conditions of the Republic of Karakalpakstan. *II International Scientific Conference "Building Mechanics, Hydraulics and Hydraulic Engineering" (CONMEHIDRO-2021), Tashkent*

[15] Shamraeva V, Mironyuk V, Savinov E, Rudenko L, Morkovkin D and Kolosova E 2022 Creation of a Digital Model of Federal, Regional or Intermunicipal Public Roads. *Lecture Notes in Networks and Systems 432* 247–255

[16] Zhichkin K, Nosov V, Zhichkina L, Dibrova Z and Cherepova T 2019 Development of evaluation model effectiveness of modern technologies in crop production. *IOP Conference Series: Earth and Environmental Science 315(2) 022023*