Basis of cotton irrigation cultures taking into current natural conditions and water resources (on natural conditions of the Republic of Uzbekistan)

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Abstract. The article considers a method of comparative assessment of agricultural irrigation norms and other irrigation methods calculated by other methods and comparison with the results of field research through the improved international Food and agriculture organization (FAO) manual for natural conditions of the Republic of Uzbekistan, based on the calculation of evaporation taking into account bioclimatic factors.

1. Introduction

Consistent reforms are being carried out in the Republic of Uzbekistan and in the world on the effective use of land and water resources, improvement of water management systems, modernization and development of water facilities.

At the same time, the shortage of water resources is increasing year by year due to global climate change, population growth and economic sectors, their demand for water is increasing year by year.

The average annual volume of water used in Uzbekistan is 51-53 billion cubic meters, including 97.2% from rivers and streams, 1.9% from collector networks, and 0.9% from groundwater, which is 20% less than the allocated water limit.

Therefore, the sustainable supply of water to the population and all sectors of the economy in the Republic in 2020-2030, improving the reclamation of irrigated lands, the widespread introduction of market principles and mechanisms and digital technologies in water management, ensuring reliable operation of water facilities and improving land and water resources their responsibilities motivate today’s dedicated professionals to strive for a common goal. [1; 2; 3; 4, 5].

2. Methods

In the Republic of Uzbekistan Scientific Research Institute of Cotton Breeding and Seed Production Agrotechnologies (SRICBSPA), Research Institute of Grain and Legumes, Irrigation and Water Problems Research Institute (IWPRI), Research Institute of Vegetables and Potatoes of Uzbekistan in the Republic of Uzbekistan Review of many years of experience in irrigation of agricultural crops, comparative assessment of irrigation regimes and their scientific analysis. [11; 12; 14; 16].
3. Results and Discussion

Today, various normative documents are used in the design of irrigation networks in agriculture and in determining the norms of irrigation of crops. These normative documents are based on the results of field research conducted 35-40 years ago. Currently, the mineralization of irrigation water is often 0.9-1.9 g/l. [1, 2] In addition, to date, the calculation of irrigation standards does not take into account the planting technologies of winter wheat, the impact of salt-resistant and early-maturing cotton varieties on irrigation standards.

Hydromodule uses different scales of zoning by water management design institutes, agricultural and water management organizations. For example; Hydromorphic soils are divided into 4 hydraulic modules in Mediumhydraulic cotton and 3 hydromodule regions in SRICBSPA recommendations, 2 hydraulic modules in Mediumhydraulic cotton and 3 hydromodule zones in SRICBSPA recommendations. In addition, in these two normative documents, irrigation norms also differ in the same hydromodular areas. [5, 8]. For example, for Mirzachul area on Mediumhydraulic cotton (Ts II-B “v” 4-hydromodule region) the irrigation rate of cotton is 6000 m3, for SRICBSPA for 4 hydromodule region - 7500 m3, for 3 hydromodule regions “Mediumhydraulic cotton” SRICBSPA recommends irrigation standards of 6800 m3/ha, respectively.

Today, in the design of irrigation networks, irrigation norms are calculated on the basis of hydromodule zoning data based on the average values of groundwater depth during the growing season, based on ME data. According to the terms of the project, the part involved in the formation of the amount of evaporation in the hydromodule zoning (V.E.Shreder, I.K.Vasilev, T.A.Trunova, 1977) depends on the lithological shear of the soil, water-physical properties, the optimal depth of groundwater. Such simplified approaches are not theoretically acceptable and have not been approved anywhere as a normative document. [7].

Although these parameters are included in the FAO international methodology, both normative documents do not take into account irrigation techniques and technology. In practice, calculations for irrigation regimes and methods are given in the 1987 "Hydromodule zoning and irrigation regimes for agricultural crops." The timing and duration of irrigation are equated with the norms associated with the productivity of tractors in the production conditions of the soils of the tractor-field brigades of collective farms and state farms of the previous period. The normative documents of Mediumhydraulic cotton provide only the norms of irrigation and their percentage distribution by months.

In determining the irrigation regime in the current conditions, when half of the irrigated lands are saline, it is necessary to take into account the formation of reclamation regimes under certain soil-hydrogeological conditions and artificial drainage of lands. Wet water and seed water also affect the rate and timing of irrigation during the growing season, which in turn affects the rate and timing of irrigation. Irrigation norms also affect productivity and crop yields, which should be taken into account when regulating water consumption. In order to develop a plan for water use in the context of farms, it is necessary to take into account the technical parameters of irrigation networks in determining the irrigation regime and irrigation schedule. [9, 10, 18, 19, 20].

Calculation of one-time and seasonal irrigation norms according to FAO method and SROPWAT program to assess the efficiency of water use in irrigation networks, to determine the criteria for water use in the future, to determine the criteria for water use, as well as the specifics of water management. allows you to determine. It would be expedient to use the calculation of irrigation standards according to the FAO method, which is unique for irrigated areas around the world, in the Republic of Uzbekistan with the necessary adjustments based on field experience. At present, different soil and climatic conditions, duration of the growing season, anthropogenic factors in the rational use of irrigation water, the order of irrigation of agricultural crops in the irrigated areas of the country require consideration of other factors.

The above-mentioned norms were calculated and analyzed by the experts of the Mediumhydraulic cotton Design and Research Institute, SRICBSPA recommendations and field studies conducted in Mirzachul for the last 10-15 years, as well as irrigation standards for early cotton varieties currently grown in these areas by the international FAO method (1-table). At the same time, according to the
results of field research conducted by G.A. Bezborodov at the Jizzakh experimental station of PSUEAITI in 2001-2005, the irrigation norms of cotton variety "An-Boyovut-2" at the rate of 2.0-2.5 meters during the growing season Groundwater level (GWL) 1800-2735 m3/ha formed.

According to the results of field research conducted by H.Makhsadov, M.Mamasoliev, S.Uralov and O.Khojabekov at the Jizzakh experimental station of SRICBSPA in 2009-2011, during the GWL vegetation, 2.0-2.5 meters of cotton An-Bayaut-2, Sultan and Irrigation regimes of Pakhtakor-1 varieties were studied. As a result of the study, irrigation regimes were studied in 65–65–60 and 70–70–65% of Boundary field moisture capacity (BFMC), respectively. At the same time, pre-irrigation moisture was 65-65-60%, cotton was irrigated 2 times during the growing season, and 70-70-65% 3 times. At the same time, the irrigation rate in 1950-65% compared to BFMC was 1950 m3/ha, and in 70-70-65% - 2350 m3/ha (see Table 1). [13, 15, 17].

According to the results of field research conducted by B.T. Amanov in Pakhtakor and Zarbdor districts of Jizzakh region in 2015-2016, the 1st experiment was conducted at the Jizzakh experimental station located in Pakhtakor district of SRICBSPA (semi-hydromorphic groundwater level 1.5-3.0 m) and the 2nd experiment Zarbdor Irrigation regimes of Pakhtakor-1 and An-Bayaut-2 varieties of cotton were studied at the farm “Algaritim Bunyodkor” in the district (groundwater level in the morphor mode > 5 m). As a result of the study, irrigation regimes were studied in 65–65–60 and 70–70–60 percent compared to BFMC. At the same time, the pre-irrigation humidity was 65-65-60% during the cotton growing season. At the same time, the rate of irrigation in the 1st experimental field is 1820 m3/ha, in the 2nd experimental field - 3850-3900 m3/ha, in the 2nd experimental field - 2260-2290 m3/ha, in the 1st experimental field - 65-65-60% - 4300 m3/ha in the experimental field (see Table 1).

According to Mediumhydraulic cotton, irrigation norms are recommended for 4800 m3/ha for conditions with light mechanical composition of 1-2 m of soil, for 6000 m3 / ha for conditions of GWL 2-3 m, for conditions with light mechanical composition of soil. At GWL 2-3 m, irrigation norms are recommended at 5700 m3/ha in conditions with medium mechanical soil composition, and at 48S m3 / ha at GWL 2-3 m, and in conditions with heavy mechanical soil composition.

According to SRICBSPA recommendations, irrigation norms for cotton for IV hydromodule regions are 7500 m3/ha, for hydromodule I regions 7800 m3/ha, for hydromodule regions VIII 3400 m3/ha, for hydromodule V regions 5100 m3/ha, for hydromodule II regions 7100 m3/ha, 3800 m3/ha for hydraulic module IX, 6100 m3/ha for hydraulic module VIII, 6800 m3/ha for hydraulic module VIII. According to the improved FAO method, the vegetation period of cotton was 155 days, which was 6700 m3/ha for the IV hydromodule region and 7050 m3/ha for the I hydromodule region. 3050 m3/ha for hydraulic module VIII, 4600 m3 / ha for hydromodule V, 6400 m3/ha for hydromodule II, 3400 m3/ha for hydraulic module IX, 5500 m3/ha for hydraulic module VI, and for hydraulic module III 6100 m3/ha. [2, 3, 4, 9, 10].

The improved international FAO methodology is detailed and covered in the previous article. [2]. At the same time, the fast ripening of AN-Boyovut-2 cotton is 114-118 days. At the same time, the hydromodule IV was 4500 m3/ha for the region, and the hydromodule I was 4700 m3/ha for the region. 2200 m3/ha for hydraulic module VIII, 3300 m3/ha for hydromodule V, 4600 m3/ha for hydromodule II, 2600 m3/ha for hydraulic module IX, 3500 m3/ha for hydraulic module VI, and for hydraulic module III 4700 m3/ha.
Table 1. Experiments on fast-ripening varieties of cotton to compare the improved method of calculation in the field and irrigation

| № | Hydromodule district | GWL, m | According to the recommendations of the normative documents developed by "Mediumhydraulic cotton regions "v" | The norm developed by SRICBSPA is in the needs on the recommendations of field research on irrigation of fast-ripening varieties of cotton | Field vegetation period for fast-ripening varieties, days | Cotton on an improved methodology | Irrigation regime of Pakhtakor-1 variety of cotton according to the improved methodology |
|---|----------------------|--------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------------|--------------------------------------|----------------------------------------------------------------------------------|
| 1 | VII                  | 1-2    | 4800                                               | -                                                                              | -                                | -                                    | -                                                                                |
| 2 | IV                   | 2-3    | 6000                                               | 7500                            | 119                               | 4500                                 | 4650                               |
| 3 | I                    | >3     | -                                                  | 7800                            | 119                               | 4700                                 | 4850                               |

Mechanical composition of soil (light)

| № | Hydromodule district | GWL, m | According to the recommendations of the normative documents developed by "Mediumhydraulic cotton regions "v" | The norm developed by SRICBSPA is in the needs on the recommendations of field research on irrigation of fast-ripening varieties of cotton | Field vegetation period for fast-ripening varieties, days | Cotton on an improved methodology | Irrigation regime of Pakhtakor-1 variety of cotton according to the improved methodology |
|---|----------------------|--------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------------|--------------------------------------|----------------------------------------------------------------------------------|
| 1 | VIII                 | 1-2    | -                                                  | 3400                            | 119                               | 2200                                 | 3300                               |
| 2 | V                    | 2-3    | 5700                                               | 5100                            | 1800-2735/1820-2290\(^{1}\)        | 3500                                 | 3500                               |
| 3 | II                   | >3     | -                                                  | 7100                            | 3850-4300\(^{1}\)                 | 4600                                 | 4300                               |

Mechanical composition of soil (medium)

| № | Hydromodule district | GWL, m | According to the recommendations of the normative documents developed by "Mediumhydraulic cotton regions "v" | The norm developed by SRICBSPA is in the needs on the recommendations of field research on irrigation of fast-ripening varieties of cotton | Field vegetation period for fast-ripening varieties, days | Cotton on an improved methodology | Irrigation regime of Pakhtakor-1 variety of cotton according to the improved methodology |
|---|----------------------|--------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------------|--------------------------------------|----------------------------------------------------------------------------------|
| 1 | IX                   | 1-2    | -                                                  | 3800                            | 119                               | 2600                                 | 3650                               |
| 2 | VI                   | 2-3    | 4800                                               | 6100                            | 119                               | 3500                                 | 4600                               |
| 3 | III                  | >3     | -                                                  | 6800                            | 119                               | 4700                                 | 4950                               |

Note. \(^{1}\)-Bezborodov G.A. on; \(^{2}\)-Maxsadov X.E. on; \(^{3}\)-Amanov B.T.

4. Conclusions
It is the timely, reliable (correct) development of one-time and seasonal irrigation norms in the current period of water scarcity. This method, developed by Penman-Monteit, was confirmed by the FAO Commission as unique and valid and proposed for practical use [3; 4; 6; 8].

Therefore, today in the regions of the Republic have been created varieties of agricultural crops resistant to rapid ripening, drought and soil salinity, which are taken into account in the improved methodology we offer [2].

In these varieties, the standard evapotranspiration of the crop from sowing to harvest is reduced due to the shortening of the growing season. This leads to a decrease in the rate and order of irrigation. In
this regard, we conducted research taking into account new fast-ripening varieties. Using the international FAO methodology adapted to local conditions, we calculated the norms of one-time and seasonal irrigation of agricultural crops in Jizzakh and Syrdarya regions, and compared the theoretical and field research conducted by scientists of the Republic (see Table 1). This methodological approach shows that at the level of modern development of computer technology, special computer programs, it is possible to calculate the irrigation regime and the required norm for each point of irrigated land, so we conclude that hydromodular zoning may not be necessary.

References
[1] Amanov B T 2017 Substantiation of the order of the calculations and specifications crop irrigation Currently European Sciences review Scientific journal 1–2 pp 174-177.
[2] Amanov B T Gadaev N N Ahmedjonov D G Zhaparkulova E 2020 Mathematical calculations of water saving during furrow irrigation of cotton using a screen from an interpolymer complex International Scientific Conference on Modelling and Methods of Structural Analysis 2019, MMSA 2019; Moscow; Russian Federation; 13-15 November 2019 Journal of Physics: Conference Series 1425(1) 012120
[3] Arifjanov A M Akmalov Sh Akhmedov I Atakulov D 2019 Evaluation of deformation procedure in waterbed of rivers. XII International Scientific Conference on Agricultural Machinery Industry. IOP Conf. Series: Earth and Environmental Science 403 012155
[4] Arifjanov A M Fatxullaev A M 2020 Natural Studies for Forming Stable Channel Sections International Scientific Conference on Modelling and Methods of Structural Analysis 2019, MMSA 2019; Moscow; Russian Federation; 13-15 November 2019 Journal of Physics: Conference Series 1425(1) 012025
[5] Arifjanov A M Otaxonov M Samiev L Akmalov Sh 2019 Hydraulic calculation of horizontal open drainages Construction the formation of living environment 2019 (FORM-2019) XXII International scientific conference E3S Web of Conferences 97 05039
[6] Arifjanov A M Rakhimov K Abduraimova D Akmalov Sh 2019 Transportation of river sediments in cylindrical pipeline XII International Scientific Conference on Agricultural Machinery Industry. IOP Conf. Series: Earth and Environmental Science 403 012154
[7] Bespalov N F Malabaev N I Mambetnazarov B S Kuchkarov D K 1992 Reclamation and irrigation of cotton crop rotation (hydromodular zoning and irrigation regimes for agricultural crops in the regions of the Republic of Uzbekistan) Tashkent 191 p
[8] Dzhurabekov I Kh 1987 Hydro-modular zoning and irrigation regime for agricultural crops in the regions of the Republic of Uzbekistan
[9] FAO 2000 materials on irrigation and drainage 24 “Water consumption of agricultural crops” Scientific information center of the Interstate Commission for Water Coordination (SIC ICWC) Tashkent 127 p
[10] FAO 2001 publications on irrigation and drainage 56 “Evapotranspiration of plants” Scientific Information Center of the Interstate Commission for Water Coordination (SIC ICWC) Tashkent 296 p
[11] Fatxulloev A Gafarova A Hamraqulov J 2019 The importance of mobile applications in the use of standard water measurements. International Conference on Information Science and Communications Technologies: Applications, Trends and Opportunities ICISCT 9011816
[12] Fatxulloev A Gafarova A 2019 Study of the process of cultivation in soil fertile irrigation channels. «Construction the formation of living environment 2019 (FORM-2019)» XXII International scientific conference. E3S Web of Conferences 97 05025 https://doi.org/10.1051/e3sconf/20199705025.
[13] Fatxulloev A Abduraimova D Otakhonov M Atakulov D Samiev L 2020 Method designing of open drainages IOP Conference Series: Materials Science and Engineering 883(1) 012047. IOP Publishing doi:10.1088/1757-899X/883/1/012047
[14] Fatxulloev A Gafarova A Otakhonov M Allayorov D 2020 The hydraulic efficiency of the soil
channels IOP Conference Series: Materials Science and Engineering 883(1) 012042. IOP Publishing doi:10.1088/1757-899X/883/1/012042

[15] Ikramov R K 2015 Clarification of irrigation regimes for agricultural crops and hydromodular zoning of irrigated lands is an urgent problem Agriculture of Uzbekistan 3 p 32

[16] Schroeder V R Safonov V F Vasiliev P K 1970 Estimated values of irrigation norms for agricultural crops in the basins of the Syrdarya and Amu Darya rivers Compiled by the USSR Ministry of Water Resources Tashkent pp 7-12, 110-111.

[17] Schroeder V R Vasiliev I K Trunova T A 1977 Hydro-modular zoning and calculation of irrigation norms for cotton in an arid zone Issues of design and efficiency of irrigation and drainage systems in Central Asia collection of scientific papers 8 pp 28-41

[18] Serikbaev B Butayarov A 2020 Operational responsibility and operational reliability of cotton drip irrigation systems IOP Conference Series: Materials Science and Engineering 883(1) 012037

[19] Sherov A Soliev B 2020 Protection of recovery projects and developed areas from flooding IOP Conference Series: Materials Science and Engineering 883(1) 012094

[20] Sherov A Urinboev S 2020 Innovative technologies in the effective use of water resources. IOP Conference Series: Materials Science and Engineering 883(1) 012144