GEOINFORMATION TECHNOLOGIES FOR THE EFFICIENT USE OF WATER RESOURCES

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ABSTRACT

In this article, the research work of the 80s of the XX century aimed at making changes to the hydromodul zoning of the irrigated lands of the Khorezm oasis, the distribution of irrigated lands by hydromodul regions and the determination of scientifically justified irrigation methods for each hydromodul region. In the context of today's climate change and the ever-increasing water shortage in the Republic, it is important to conduct this research. In addition, it provides information on the results of research and study of soil and hydrogeological conditions of the region, as well as the determination of irrigated areas of the oasis by the new hydromodul regions.

Irrigated lands of Khorezm region are soil-climatic zone – to the steppe zone, three soils within this zone-meliorative region, irrigated lands belong to 6: IV, V, VI, VII, VIII and IX temperate zones according to the mechanical composition of the soils in the aerated layer, the data of soil-lithological fortifications and the average multi-year indicators of groundwater level in the vegetation period, using by ArcGIS software, the first time Hydro-module maps of districts of the Khorezm region: Khiva, Gurlan and Kushkupir were created.

In irrigated areas VII, VIII and IX, which are widespread in the region, pre-irrigated soil moisture retains 70-80-60% of the ChDNS and holds the body at 3856 m^3 / ha (VII), 2789 (VIII) and 2203 m^3/ha (IX). when irrigated according to seasonal irrigation rates - 35.0; Cotton yield of 38.9 and 39.8 st/ha is the minimum for cotton production: 55.4; 71.7 and 110.2 m^3 of river water are used.

KEYWORDS: Hydromodul zoning, hydromodul region, irrigated lands, geo information technology, ArcGIS software, soil, mechanical composition, groundwater, cotton, irrigation regime, irrigation rate, seasonal irrigation rate, phenology, productivity, water shortage.

INTRODUCTION

Decision of the President of the Republic of Uzbekistan dated February 7, 2017 № PF-4947 "On the Strategy of Action for the Further Development of the Republic of Uzbekistan" Expansion of production of ecologically clean products, significant increase of export potential of agrarian sector. Decrease the area under cotton and grain crops, optimize the area under cultivation, and create new potato, vegetable, food and oil crops, as well as new intensive gardens and vineyards. Strengthening land reclamation, development of land-reclamation and irrigation facilities, implementation of intensive methods in the agricultural sector, first of all modern water and resource-efficient agro-technologies".

The problem of global climate change is topical on the human agenda, and not only the average annual rise in temperature but also the whole geotechnical changes, the rise of the global oceans, the melting of glaciers and perennial glaciers, the steady flow of rivers, the flow of rivers and other related changes.

Glacial melting in the mountainous regions due to global warming and their reduction may result in a 25-30% reduction in river flows, particularly in the Amu Darya and Syrdarya and Zarafshan regions, causing serious problems in the region, with annual average mineralization in the lower Amudarya river can be increased by 1.5 times.

The observations of the temperature dynamics regime in Uzbekistan over the last 50 years have shown that the maximum temperature growth rate is 0.22 degrees Celsius per year and the minimum is -0.36. Therefore, in 20 years the average annual temperature in the north of the republic will increase by 2-3 degrees, and in the south - by 1 degree.

Climate change causes water evaporation from water surfaces by 10-15%, and 10-20% more water consumption due to increased plant transpiration and irrigation rates. This results in an average of 18% increase in non-renewable water consumption. This, of course, complicates further growth of agricultural production.

During the years of independence, the water system in the country has changed dramatically. Earlier in September, the Khorezm oasis stopped receiving water from the rivers and the canal and drainage networks were inspected and the reconstruction work carried out prior to the start of salinization. Currently, the irrigation network operates uninterruptedly throughout the year, thanks to the use of the cotton-winter wheat rotation system. The load on the collector-drainage networks is overloaded.

This, in turn, affects the process of soil formation in the Khorezm oasis, and there is an increase in the area of hydromorphic soils in the region. Therefore, the scientific and research work carried out in the 1980s to address changes in the hydromodul zoning of irrigated lands of the Khorezm oasis, the distribution of irrigated lands by hydromodul regions, and the determination of scientifically based irrigation procedures for each hydromodul region. This is relevant in the context of growing water shortages.

Hydromodul zoning of irrigated lands is a taxonomic unit of the area, the purpose of which is the rational use of land and water resources, the application of scientifically based irrigation procedures, and the high yield of crops.

Basic principles of hydromodul zoning: Central Asia developed by V.M.Legostaev, B.S.Konkov and G.P.Geltser in 1932-1951 on the basis of the mechanical composition of the soil and the location of groundwater [3].

In 1948-1957, S.N.Ryzhov, B.V.Fedorov and V.E.Yermenko improved the basic principles of zoning and divided Central Asian lands into 10 hydromodul districts.

Further improvements were made in 1968 by the former Institute of Sredazgiprovodkhlopok (UzGIP LLC) (Schroeder et al.) Apart from the above, they identified hydrogeological and land reclamation areas. (Figure 1)

These are:

- deep groundwater has a good flow and does not participate in soil formation (groundwater inflow area);
- the groundwater near the surface is well-drained but difficult to discharge, which is involved in soil formation (Groundwater Flood Zone);
- Lar Areas that do not have a permanent surface water level, but which can change depending on the natural conditions in the area, which are difficult to flow and drain from outside (the groundwater distribution area).
- Schroeder & c. (1968) argue that although the groundwater levels and the mechanical composition of the soil are the same, the irrigation regime varies with the hydrogeological and land reclamation [3].

Hydromodul region - part of soil-reclamation area, which determines the thickness of the soil layer, mechanical composition, their location in the aerial zone, water-physical properties, groundwater level, and the order of irrigation of hydrocarbon crops is characterized by its proximity to

According to this zoning, irrigated lands of Khorezm region belong to one soil-climatic zone - desert zone, and three soil-land-reclamation zones within this zone. These are:

- avtomorphic soils with deeper than 3 meters of groundwater level;
- semi-hydromorf soils with 2-3 meters of groundwater level;
- hydromorf soils with 1-2 meters of groundwater level.

At present, the soil thickness, mechanical composition and ground condition in irrigated lands of irrigated lands in Khorezm region have been analyzed according to the data of the Regional Reclamation Expedition under the Amudarya Irrigation Systems Basin. The map of the administrative regions of the region and districts (scale 1: 50000) and the observation wells used in the expedition were used. Based on the data of soil-lithological fragments from the "passport" of observation wells and average observations of ground water level for each observation well of the Regional Reclamation Expedition, the areas of Khiva, Gurlan, Shovot and Kushkupir districts of Khorezm region are: IV, V, VI, VII, VIII and IX may be subdivided into hydromodul regions. (Table 1)

Table 1. Initial distribution of irrigated land in Khorezm region by hydromodulator regions, %

№ T/p	Districts	Irrigated area, thousand	monitoring wells, piece	observable area, thousand area	Hydromodul regions					
					IV	V	VI	VII	VIII	IX
1	Khiva	19.81	191	18.36	1.5	0.5	3.2	15.5	47.8	31.5
2	Gurlan	30.36	227	30.36	1.8	4.5	0.1	31.2	41.5	19.9
3	Kushkupir	31.11	225	31.11	3.0	4.0	4.1	10.0	53.9	25.0
4	Shovot	28.95	205	28.95	1.0	1.0	-	10.0	30.0	58.0

In recent years, the transition from card-to-paper to digital-card mapping, that is, to computer-based mapping technology using graphical information systems, has been rapidly developing. Many types of data change over time, making it difficult to use a simple paper card. Today, the automated system can only guarantee the reception of urgent information and its relevance.

Modern GIS is considered to be an automated system for mapping spatial data, drawing conclusions and monitoring, combining model and computational functions with a large number of graphical and thematic databases and able to work on a database.

This technology of map making is today a process that is universal - firstly, and secondly, very rapidly developing, covering all spheres of human activity. Today, manufacturing companies and organizations are working hard to convert cards and plans from paper to digital.

Map of regional and district administrative territories (scale 1: 50000), soil-lithological section data from the expedition observation wells and "passport" of observation wells, and average annual water-per-centimeter computer average for the first time, maps of the primary distribution of irrigated lands in Khiva, Gurlan and Koshkupir districts of Khorezm region by hydromodul regions were created (Figures 1-3).

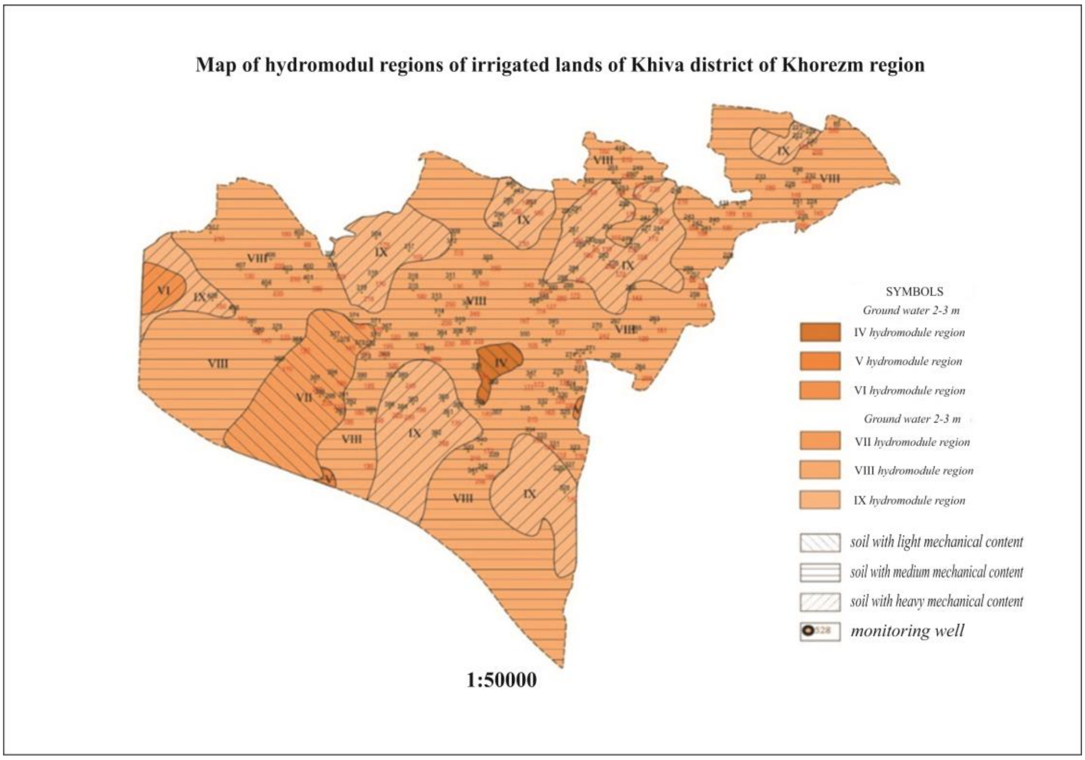

Figure 1. Map of hydromodul regions of irrigated lands of Khiva district of Khorezm region

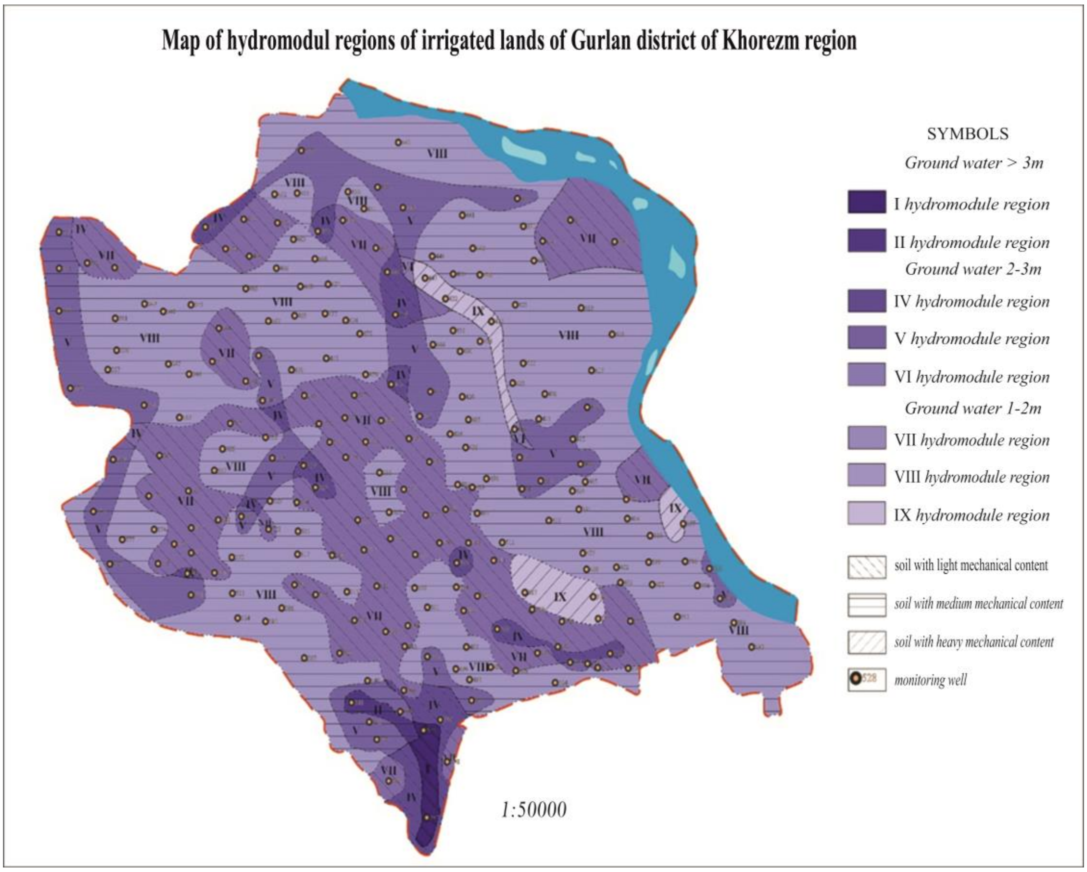

Figure 2. Map of hydromodul regions of irrigated lands of Gurlan district of Khorezm region

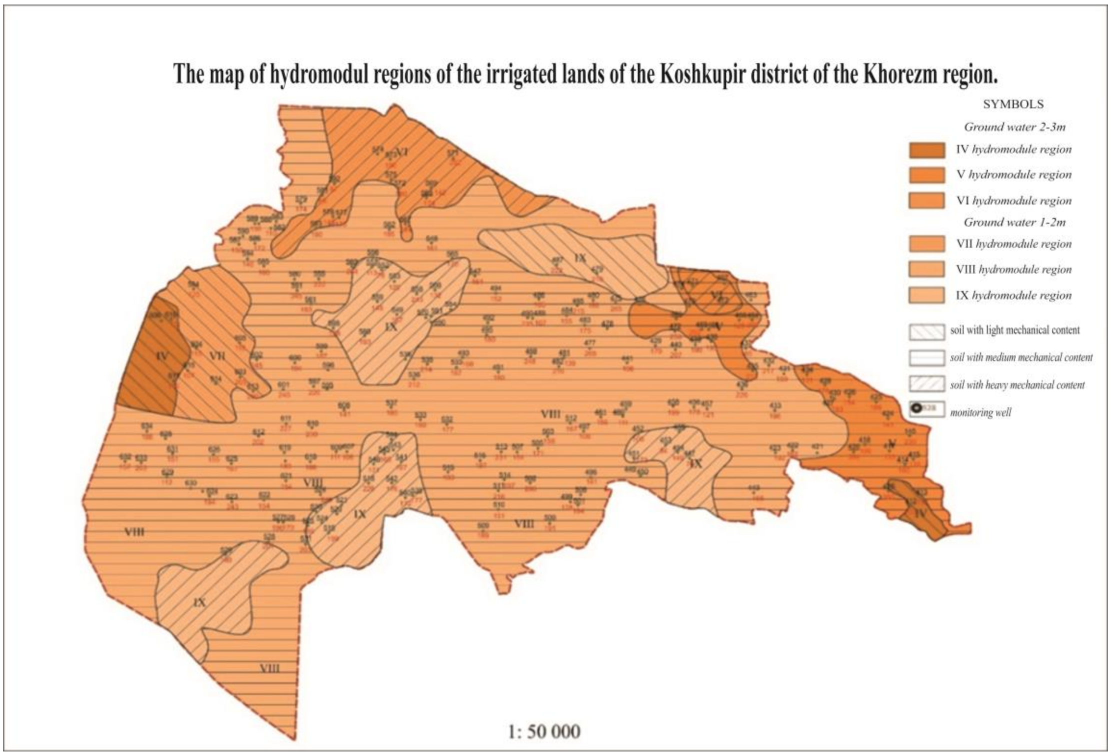

Figure 3. The map of hydromodul regions of the irrigated lands of the Koshkupir district of the Khorezm region.

Scientific-based irrigation procedures of the cotton. Irrigated lands of Khorezm region mainly belong to 3: VII, VIII and IX regions, for these conditions, field research on the determination of cotton's science-based irrigation procedures was carried out on the basis of PSUEAITI methodology.

Research activities Heavy sand (Experiment 1) of the Ergash Ruzimov farm (IX hydromodul region) in Shovot district, Khorezm region in the lightly irrigated (Experiment 3) irrigated lands of the Tulkin Mirzabek Asilbek farm (VII hydromodul region). The collector-drainage networks have been established on all farms, and irrigation systems are engineering. For agricultural irrigation, water is supplied to the fields through horns and canals, and crops are irrigated. The soil of the farm is weak and moderately saline.

Field experiments were performed on the following system (Table 2):

Table 2. Field Experience Implementation System

№ т/р	Pre-irrigation soil moisture, in% to ChDNS	Irrigation rate, m3 / ha
1	Production Control	Actual measurements
2	70-70-60	On moisture deficit in 70-100-70 cm layer
3	70-80-60	On moisture deficit in 70-100-70 cm layer
4	70-80-60	The moisture deficit in the 70-100-70 cm layer was increased by 30%.

Irrigation of cotton. In the cultivation of agricultural crops, the irrigation regime should be based on specific climatic conditions, and water regimes for each plant species. Agricultural crops respond differently to the biological conditions of the water supply. However, all plants have the maximum yield if their water demand is continuously met throughout their growth and development.
The irrigation rate is defined by the following formula.

$$m = 100 \cdot h \cdot J \cdot (W_{ЧДНС} - W_{хн}) + K \quad м^3/га$$

$W_{чднс}$ – limited field moisture capacity,%;
$W_{хн}$ - actual pre-irrigated moisture content of soil weight,%;
J – soil weight, g / cm3;
h – calculated layer value, m;
k – Irrigation water consumption, m3 / ha (10% of moisture insufficient in the sediment layer).
In the experimental field, the cultivated grasses were watered according to the established humidity. The amount of irrigation, timing and amount of irrigation water in each crop variation varied significantly (Table 3).

Table 3. Irrigation of cotton

№ T/p	Variants	Irrigation norms, m3 / ha	Irrigation scheme	Seasonal irrigation rate, m3 / ha
Experiment 1	1	1109-1289	0-2-1	3644
	2	992-1024	0-3-0	3025
	3	714-760	0-3-0	2203
	4	967-1205	0-2-1	3160
Experiment 2	1	1142-1276	1-2-1	4744
	2	664-956	1-2-1	3422
	3	623-865	1-2-1	2789
	4	836-1139	1-2-1	3711
Experiment 3	1	1025-1144	1-3-1	5395
	2	625-878	1-3-1	4002
	3	600-768	1-4-1	3856
	4	723-985	1-3-1	4033

Table 4 summarizes the study of the effects of irrigation regimes on cotton yields. According to the table, in the experimental field of Experiment 1, cotton yield of 35.6 c / ha was obtained from the cotton variant of Khorezm-127 and more than -102.4 m3 of river water was used for the cultivation of 1 centner of cotton.
Option 3 had the highest yield of 39.8 c / ha, with the least amount of river water consumed: 55.4 m^3 per 1 centner.

In Experiment 2, a control crop yielded 34.8 c / ha and more than 136.3 m3 of river water was used for the production of one centner of cotton.
Option 3 had the highest yield of 38.9 c / ha and the lowest water consumption was 2789m3 per 1 centner.

In Experiment 3, the cotton variant of the Khorezm-127 cotton type yielded a yield of 30.8 c / ha, with the average water consumption of 175.2 m3 per 1 centner compared to the other options. Option 3 had the highest cotton yield of 35.0 c / ha and the minimum amount of water required to produce one centner of cotton was 110.2 m3.

The results of the research, the implementation of irrigated irrigation in scientifically-based irrigation procedures, provided the economies of the usual seasonal river water supply, providing the highest yield of the cotton varieties “Khorezm-127”.

Table 4. Influence of irrigation procedures on cotton yield

Variants	Average productivity, st/ha	T/ha in relation to control	Seasonal irrigation rate, m^3/ha	River water per 1 t of cotton, m^3
Experiment 1				
1	35,6	0,0	3644	102,4
2	37,8	+2,2	3025	80,0
3	39,8	+4,2	2203	55,4
4	38,6	+3,0	3160	81,9
Experiment 2				
1	34,8	0,0	4744	136,3
2	36,6	+1,8	3422	93,5
3	38,9	+4,1	2789	71,7
4	37,6	+2,8	3711	98,7
Experiment 3				
1	30,8	0,0	5395	175,2
2	33,2	+2,4	4002	120,5
3	35,0	+4,2	3856	110,2
4	33,8	+3,0	4033	119,3

RESULTS

The following conclusions can be drawn from the research on the development of scientifically justified irrigation systems of cotton in the alluvial soils of the Khorezm oasis:

1. Irrigated lands of the Khorezm region belong to one soil-climatic zone - desert zone, three soil-land-reclamation zones within this zone. It belongs to the regions VI, VIII and IX hydromodul.

2. According to the primary distribution of irrigated areas of the Khorezm region by hydromodul regions, the level of ground water in the main irrigated areas during the growing season is 1-2 meters, with 34.1% of the total area being VII, 30.3% VIII and 32.6% IX.

3. ArcGIS was used to calculate soil-lithological fragment data and average annual groundwater levels for each observation well using the ArcGIS program, and the distribution of irrigated lands in Khiva, Gurlan and Koshkupir districts of Khorezm region.

4. In irrigated field IX, which is common in the region, pre-irrigated soil moisture content is 700- 750 m3 / ha and seasonal irrigation of 2203 m3 / ha, keeping soil moisture pre-irrigation at 70-80-60% against ChDNS. At average irrigated crop yield of 39.8 c / ha, the minimum amount required for cotton production is: 55.4 m3 of river water.

In case of water irrigation in the VIII hydromodul region, the pre-irrigated soil moisture content is 70-80-60% against ChDNS, with the irrigation rate of 600-900 m3 / ha and seasonal irrigation of 2789 m3 / ha according to the scheme 1-2-1. 71.7 m3 of river water was used for cotton production.

In case of water irrigation in the VII hydromodul region, pre-irrigated soil moisture content is 70-80-60% against ChDNS, with irrigation rates of 600-800 m3 / ha and seasonal irrigation rate of

3856 m3 / ha according to Scheme 1-4-1. / ha, 110.2 m3 of river water was used to produce one centner of cotton.

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