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IMPROVING THE EFFICIENCY OF USING WATER RESOURCES ON RICE SYSTEMS

Abstract. Gradual reduction of water resources indicates a threat of severe water shortage at the turn of 2020-2030, which, of course, generally affects national security issues. As you know, Kazakhstan is located in the lower reaches of large transboundary rivers. Therefore, the availability of water largely depends on the state policy of neighboring states, on the development of their economies and population growth. Consequently, the issues of regulating the use of water resources set among the priorities to find ways and means of rational use of irrigation water, the selection of crops and varieties of plants that are resistant to water stress. The solution of these tasks is directly related to the preservation of the country's food and environmental security.

Key words: water resources, irrigation regime, mineralization, saturation, irrigation water.

Introduction. The wide development of land improvement in the developed countries of the world ensures their stable state and development of the agro-industrial complex, food security and significant volumes of agricultural exports. Thus, the restored land in percentage of arable land: in the US - 39%, England - 80%, China - 55%, Germany - 45%.

Currently, the state of seized lands on the territory of the Republic of Kazakhstan and Russia is extremely unfavorable; the depreciation of fixed assets of irrigation systems exceeds 70%, which leads to significant losses of water in irrigation canals.

Engineering rice irrigation systems in the Kyzylorda region were first developed and put into operation in our region in the mid - 1950s. They provide a two-way regime of soil moisture with the help of irrigation and discharge channels of the first, second and subsequent orders.

The low level of technical condition of irrigation systems significantly worsens the conditions for effective use of water and land resources, which leads to a significant shortage of agricultural products (table 1).

The coefficient of culvert capacity of bulk channels is very low, and at the same time irrigation water losses amount to 31% (table 2).

The distinctive ability of the channels of rice irrigation systems is that 10 to 50 m^3/s of water is transported through these in-farm canals. Therefore, there are no opportunities for using standard means of water accounting: weirs, water meter thresholds, water-measuring trays. In these conditions, the only means of water accounting is the use of fixed cross-sections with the measurement of water consumption by the "speed-area" method. For flow measuring instruments located on channels in the earth channel, measures should be taken to eliminate the possibility of erosion and deformation of the channel section; including:

a) on canals with a throughput of up to 25 m^3/s - covering the channel along the entire perimeter with reinforced concrete slabs or solid concrete in a section of the length specified in the technical documentation, but not less than one channel width at the top;

b) on channels with a throughput of 25 to 100 m^3/s - the anchoring of the bottom of the channel in the form of a belt of reinforced concrete slabs, monolithic concrete or cobblestone tanks of not less than 5 m [1].

Table 1 – Technical condition of irrigation canals and collectors in the Kyzylorda branch of RSE "Kazvodkhoz" (Kazakh water industry)

Names of channels	Total length by shape	State, km		
		satisfactory	unsatisfactory	
			km	%
Republic property				
Trunk channels Kelintubinskiy	88,5	67,26	21,24	24
Novoshielsky	181,2	138,71	43,49	24
Kyzylorda right bank	50,2	38,15	12,05	24
Kyzylorda left bank	406,75	309,13	97,62	24
Kazalinsky right bank	38,95	29,6	9,35	24
Kazalinsky left bank	99,17	75,37	23,8	24
Total	**864,77**	**657,22**	**207,55**	**24**
Inter-farm channels: Sumagar	31,7	22,19	9,51	30
Taipakkol	6	4,2	1,8	30
Kandyaral	26,8	18,76	8,04	30
Kurkureouik	20,5	14,35	6,15	30
Sunak ata	68,65	48,06	20,59	30
Novosolotobe	32	22,4	9,6	30
Botabye	67,9	47,53	20,37	30
Jetikol –zharma	66,1	46,27	19,83	30
Koksu	30	21	9	30
Zhanadariya	957,8	670,46	287,34	30
Zhanaryk	28,9	20,23	8,67	30
Aitek	78,4	54,88	23,52	30
Basykara	32,7	22,89	9,81	30
Sauranbay	6	4,2	1,8	30
Total	**1453,45**	**1017,42**	**436,03**	**30**
Total through the channels	**2318,22**	**1674,64**	**643,58**	
Collectors				
Zhanakorgan district: C-1	52,5	31,5	21	40
C-2	88,3	52,98	35,32	40
Shieli district::C-1	32,1	19,26	12,84	40
C-3	53,2	31,92	21,28	40
C-4	30	12	18	40
C-9	31,8	19,08	12,72	40
Nansai	6,5	3,9	2,6	40
Shieli-Talikol	103	61,8	41,2	40
Kyzylorda city: Koksu	50,2	30,12	20,08	40
Syrdarya region: SC-12	28,2	16,92	11,28	40
SC	57,4	34,44	22,96	40
NC	51,4	30,84	20,56	40
Zhalagashsky district: SC -16	27,1	16,26	10,84	40
NC -15	5,7	3,42	2,28	40
SC	92,1	55,26	36,84	40
NC	67,7	40,62	27,08	40
EKC Karmakshi	42,1	25,26	16,84	40
WKC	38,1	22,86	15,24	40
Kashkansu	15,7	9,42	6,28	40
SC-1	38,3	22,98	15,32	40
C-2 Kazaly	38,5	23,1	15,4	40
C-2-1	34,1	20,46	13,64	40
C-2-2	11,9	7,14	4,76	40
Total	**995,900**	**591,54**	**404,36**	**40**

Table 2 – Channels and facilities on state irrigation systems

No	Name of state irrigation systems	Year of commis-sioning	Head water intake		Trunk channels		Facilities on trunk and inter-farm canals	
			type of water intakes with indication of automation availability	through-put	total length, km reset	mounting and cladding length, km	total	of them equipped with water-measuring devices
Branch Zhanarkorgan water sector								
1	Kelintobe	1969	without dam	102		88,5	8	8
2	Sumagar	1975	without dam	15		31,7	1	1
3	Sunakata	1950	without dam	40		26,15	4	4
4	Taipakkol	1953	without dam	15		6,0	3	3
5	Kurkureuk	1962	without dam	12		20,5	3	3
Total				**184**		**172,85**	**19**	**19**
Branch Shieli water sector								
1	Novoshielsky	1941	without dam	120	20,4	0,18	28	
2	Kamystykak	1986	without dam	10	42,5	0,11	6	
3	Novosolotube	1972	without dam	14	32	0,04	2	
4	Koksu	1958	without dam	18	30	0,02		
Total				**162**	**124,9**	**0,35**	**36**	
1	MMC	1951	without dam	25	15,4		5	5
2	Zhana-Aryk	1983	without dam	15	18,9		2	2
3	Sauranbai	1976	without dam	6			1	1
Total				**46**	**34,3**		**8**	**8**
Branch Syr Darya water sector								
1	Aitek	1963	dam	60	28	0,1	1	1
2	Zhetikol – zharma	1947	Without dam	15	33,6		12	12
3	left-bank main canal -9	1975	dam	15			8	8
4	left-bank main canal -11B	1963	dam	10			5	5
5	Zhana -Aryk	1984	Without dam	11,5	10		1	1
Total				**111,5**	**71,6**	**0,1**	**27**	**27**
Branch Zhalagash water sector								
1	Left branch	1961	dam	44			12	12
2	left-bank main canal -main canal -17A	1963	dam	9,2				
3	left-bank main canal -15B	1983	dam	10				
4	Aitek	1961	dam	16	22,7		8	8
5	Shonyk	1970	dam	10			3	3
Total				**89,2**	**22,7**		**23**	**23**
Branch Karmakshy water sector								
1	Kuraily	1960	dam	37,5			6	6
2	Hauryzbay	1960	Dam	14,9			2	2
3	Balazharma	1960	Dam	60			2	2
4	Right branch	1960	dam	8			6	6
Total				**120,4**			**16**	**16**
Branch Kazaly water sector								
1	MMC	1946	dam	70	19,5		7	7
2	Baskara	1946	dam	10	32,7		5	5
3	left-bank main canal	1957	dam	100	64,17		10	10
Total				**180**	**116,37**		**22**	**22**

The main source of irrigation of crops, cultivated crops in the Kyzylorda region is the Syrdarya river. A complex situation has developed in the water basin of the Syrdarya river. The aggravation of the water management situation in this region in recent years has further exacerbated the problem of providing the population, industry and agriculture with clean water. Pollution of the Syrdarya river with collector-drainage and sewage water complicated the ecological situation in the region, worsening the sanitary conditions of life and health of people.

The water consumption of the sectors of the economy of Kazakhstan averages 32.5 km^3 per year, including 27.5 or 85% of surface sources and the remaining volume, 5 km^3 of underground, as well as sewage. If to speak in the context of industries, then the largest consumer of water resources is agriculture, -75 percent of the water used.

At the same time, more than half of this volume (table 3) is used in the Aral-Syrdarya basin - 53 percent. Further in Balkhash-Alakol, - 20 percent, and in the Shu-Talas basin - 16 percent, that is, where irrigated agriculture is traditionally developed. The volume of water use by the municipal and domestic sector is about 5 percent.

Table 3 – Main indicators of the use of water in the Syr Darya River in Kyzylorda region (according to the data of RSE "Kazvodkhoz", Kyzylorda city) testing of agricultural crops

№	Years	Water flowed through the region total	Water abstraction from surface water sources	Water Limit	Including		Expended			
					agri-cultural needs	ecologist and other needs	regular irrigation plots thousand hectares	accumulation of lake systems and other	total water losses	received to the Aral sea
1	2001	11855	3855	4580	3700	880	148	1880	2518	3563
2	2002	19495	5125	4280	3200	1080	147,5	2630	3060	8641
3	2003	20402	5974	4280	3200	1080	159,8	1755	2931	9764
4	2004	20874	5182	5098	4138	960	152,6	1686	2854	10106
5	2005	22194	7497	4858	3878	980	152,6	2443	2320	9888
6	2006	16020	5286	5309	4398	911	153,8	2560	1371	6759
7	2007	17394	5426	4632	3652	980	153,3	3344	1958	6619
8	2008	11128	4259	4200	3300	900	144,4	2618	512	3690
9	2009	15167	5085	4853	3620	1233	153,1	4396	1527	4108
10	2010	25944	5541	5804	4127	1677	147,2	7818	3338	9198
11	2011	10982	5036	5931	4054	1877	150,5	1260		4636
12	2012	16604	4939	5239	3919	1320	159,5	4644	2392	4588
13	2013	13685	4786	5509	4189	1320	157,5	2487	2265	4106
14	2014	16656	5157	5572	4252	1320	160,1	3707	2597	5134
15	2015	14353		5578	4255	1320	160,1			
16	2016	14685	4653	5429,9	4159,9	1270	169,27	3030	2103	5149

Gradual reduction of water resources indicates a threat of severe water shortage at the turn of 2020-2030, which in the end, as a whole, affects national security issues of the country.

As you know, Kazakhstan is located in the lower reaches of large transboundary rivers. Therefore, the availability of water largely depends on the state water policy of neighboring states, on the development of economies and population growth. For the rational use and protection of water resources, adopt the National Plan for Integrated Water Resources Management.

And on its basis: to carry out full rehabilitation and improvement of the existing water infrastructure, introduce new water-saving technologies, automated control systems for production processes in the water sector.

Water consumers do not appreciate the water they receive, as in the developed countries the average water consumption on irrigated land does not exceed 5-7 thousand cubic meters per 1 hectare per season, while our producer uses water for rice cultivation of basic crops from 13 to 17 thousand, and when growing rice it reaches 26 thousand cubic meters per hectare [2].

Kazakhstan adopted a method for growing rice, based on the continuous flooding of its crops with a layer of water. With such irrigation technology, irrigation water consumption for rice cultivation far exceeds the biological requirement of plants in moisture, a significant part of which is lost to filtration and groundwater recharge.

For the development of the rice subcomplex in the agroindustrial complex of Kazakhstan, the task is to improve the technology of rice cultivation, as well as the interaction of agrotechnical and meliorative measures that ensure the implementation of the concept of combining the principles of greening and biologization of the rice production system.

Under the regime of rice irrigation, it is customary to understand the amount of water supplied over the periods and phases of plant development in order to obtain a high grain yield. As already noted, rice is cultivated throughout the growing season with full or periodic flooding of checks with water, but the transpiration coefficient is low: 400-500 units of water are used to form units of dry matter. The greater need for rice in water grown with full flooding of checks, due to low waterlogging of plant tissues. If wheat and barley have one to four parts of water per unit of dry matter, and rice has only two or three parts. The main feature of rice plants is the adaptability of the stem to rapid growth, since prolonged flooding and the presence of leaves under water can oppress a green plant, despite the fact that in the aerial organs it contains 80-90, and in the roots 95-97% water [3] .

Violation of the irrigation regime causes dehydration of tissues in rice plants, the assimilation activity of which deteriorates, yields of grain decrease. The best growth and development of rice plants are possible only with the maintenance of an optimal layer of water in the check during the growing season. The given layer of water favorably influences the microclimate of the rice field; it seems fully possible to conduct agro technical measures against annual weeds [4].

The horizontal nature of the surface of the check is an indispensable condition for the very possibility of cultivation of flooded rice. It largely determines the intensity of pre-harvesting rice lodging and loss of grain during harvesting, damage to plants by diseases and pests, irrigation rate, and most importantly, rice harvest. On small checks, as a result of repeated soil treatments in a flooded state, the surface of the checks is leveled with high accuracy. At present, there is a requirement that in 95% of the area the surface of the rice field has a height variation within 5 cm. More than 5% of the area is allowed to deviate. However, after the first year of development as a result of sedimentation of the soil on piling and loosening on cuts, further deterioration of the degree of accuracy of planning occurs [5].

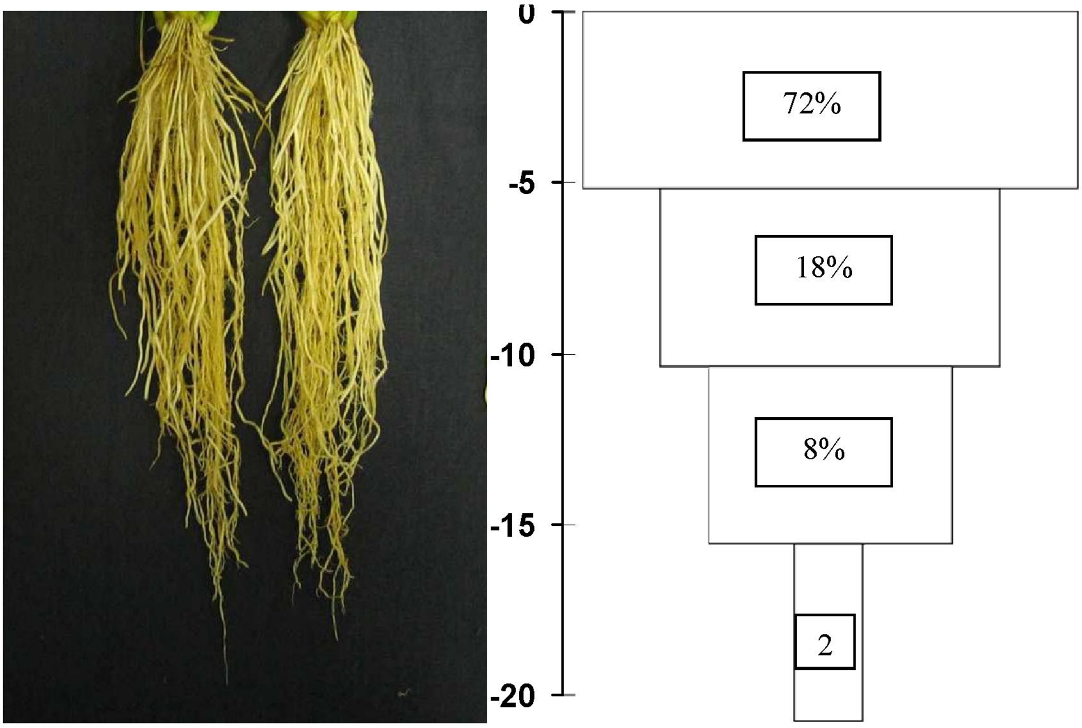
The low efficiency of current water management in rice irrigation systems is also explained by the fact that it is aimed at achieving intermediate, immediate aims that do not provide a holistic solution to water management problems, while sustainable water use should be based on the balance of economic, social and environmental interests of the region [6, 7].

The solution of this "triune" task based on the integrated use of water resources, of which water conservation is an integral part, increasing the productivity of irrigated land and irrigated water in rice irrigation systems are necessary for the sustainable development of the agrarian sector of the economy, social progress, food and environmental security of the country.

In 2015-2016 years., the restoration of degraded lands with rice sowing, the depth of flooding of the rice field, the effect of the fertilizer dose on the yield of rice were studied. A test was also conducted of rice varieties under drip irrigation conditions.

The main aim of our research is to reveal the maximum yields of rice with minimum costs of irrigation water. In 2017, an innovative irrigation of rice was taken in the experimental plot. The irrigation technology consisted in providing water with the depth of distribution of the root system of rice. The bulk of rice roots is located in the upper horizons of the soil at a depth of 10-20 centimeters. Growth of roots, as is known, creates the possibility of more complete use of soil moisture and available forms of mineral elements due to the constant development of new soil areas. In moist soil, the absorption of substances occurs as a result of contact of the root hairs with soil particles with the participation of soil solution. An important condition for such activity of the roots is an increased rate of respiration. The results of observations indicate that the roots in the moist soil breathe much more intensively than under flood conditions. This pattern is established not only for the seedling phase, but also for the subsequent phases of vegetation.

Field research were accompanied by observations, records and measurements performed in compliance with the requirements of the methodological field experiment (B.A Dospekhov, GF Nikitenko, V.N Pleshakov, and others). And "The program and methodology for setting up experiments and conducting studies on programming crop field crops. "The water-physical and agrophysical properties of the soil were determined by the methods of A.N. Kachinsky and A.A. Rohde, total water consumption- A.H. Kostyakova, irrigation standards for drip irrigation - A.N. Kostyakov in the modification of I.P. Kruzhilina and other irrigation terms were determined by lowering the soil moisture to the pre-threshold, and also using the bioclimatic evaporation method. Phenological observations were carried out on specially designated dynamic sites according to the method of the state variety testing of agricultural crops.



The International Rice Research Institute has developed a simple tool to help farmers when it is for irrigation of rice. They found that when the water level in the pipe dropped from the soil surface to 15 cm, ensure a good harvest. This pipe can be made of plastic pipes 30 cm high, 15 cm in diameter and larger, with perforation from all sides (figure 1).

It (tube for water) is installed on the rice field, allows you to monitor the water level under the surface of the soil. This irrigation technology was applied on the experimental site of the Kazakh scientific research institute of rice growing named after I.Zhakhaev.

The study was conducted jointly with the scientists of the Institute. On May 13, 2017 on a check with an area of 0.2 hectares, the seeds of the Syr Aru rice were sown. Flooding checks produced on 13-16.05.2017. After the emergence of rice, a pipe was inserted before the end of the milk ripeness. When the water level fell below 15 cm, water was supplied. Before the experiment was laid, samples of the soil were sampled, and also water from decontamination of water for chemical analysis (tables 4, 5).

To determine the water balance in the trial plot, weights of Ivanov were installed, as well as Zaitsev's evaporation vessels. The level of groundwater was determined from the wells-piezometers. According to the chemistry, the water of sulfate-hydrocarbonate sodium salinity and in rice pouches is within the permissible range. During the vegetation of rice, phenological observations were carried out on the development phases behind the growth of green and dry mass, the growth and development of the root system (Figure 2).

Figure 1 – Simple perforated pipe

Table 4 – Results of joint soil chemical analyzes, Kazakh Rice Research Institute of rice growing from 25.04.2017. plot of Karaultobe

№	Horizon, Cm	pH	mV	Dense residue, %	Anions, % / mg. eq per in 100 g of soil					Cations, % / mg.eq in 100g of soil		Amount of salts, %	Type of salinity
					CO_3	HCO_3	Cl	SO_4	Ca	Mg	Na	%	%
1	0-20	8,38	-68	0,860	0,000	0,070	0,053	0,480	0,1	0,048	0,084	0,835	Sulphate
					0,000	1,150	1,5	10	5	4	3,650		Medium saline
2	20-40	8,69	-86	0,340	0,000	0,046	0,053	0,144	0,025	0,039	0,017	0,324	Chloride-sulphide
					0,000	0,750	1,5	3	1,25	3,25	0,750		Slightly saline
3	40-60	8,64	-83	0,200	0,000	0,024	0,036	0,072	0,03	0,009	0,015	0,186	Not saline
					0,000	0,400	1	1,5	1,5	0,75	0,650		
4	60-80	8,67	-85	0,200	0,000	0,031	0,028	0,082	0,03	0,012	0,012	0,183	Not saline
					0,000	0,500	0,8	1,7	1,5	1	0,500		
5	80-100	8,69	-86	0,220	0,000	0,037	0,021	0,091	0,025	0,015	0,014	0,203	Not saline
					0,000	0,600	0,6	1,9	1,25	1,25	0,600		

Table 5 – Mineralization of the water of the experimental site Karaultobe (2017 year)

Name	Month	HCO_3	Cl	SO4	Ca	Mg	Na+K	Sum of salts
2017								
Irrigation canal	May	0,390	0,095	0,339	0,140	0,084	0,080	0,994
	June	0,390	0,145	1,436	0,280	0,159	0,307	1,884
	July	0,390	0,120	1,239	0,210	0,126	0,339	2,229
	August	0,315	0,105	1,058	0,200	0,144	0,192	1,856
Rice Checks	May	0,150	0,090	0,454	0,090	0,036	0,161	0,906
	June	0,120	0,095	1,167	0,110	0,099	0,353	2,521
	July	0,120	0,100	0,748	0,090	0,162	0,059	1,219
	August	0,330	0,130	1,216	0,220	0,192	0,175	2,099
Drainage	May	0,270	0,085	0,461	0,130	0,060	0,115	0,986
	June	0,540	0,235	3,234	0,460	0,300	0,810	5,308
	July	0,420	0,130	2,032	0,090	0,132	0,863	3,457
	August	0,450	0,140	2,210	0,250	0,252	0,556	3,633

To measure the flow of water over the weir of Ivanov, which has a trapezoidal cutout is determined by the formula:

$$Q = mb\sqrt{2g}H^{\frac{3}{2}} \tag{1}$$

where (m=0,42) or when measuring H in m,

$$Q = 1.86bH^{\frac{3}{2}} \tag{2}$$

where Q is the flow, l/s; b – width of the threshold, cm; H – head over the overflow threshold, cm.

The value of the pressure is determined by the rail mounted on the weir shield. Zero rake division is set at the level of the weir threshold. For the convenience of determining the water costs according to the level of the rail, the values of the water flow for the Cipoletti weirs are summarized in Table 6.

Table 6

Level on the railH (cm)	HF-50 flow rate Q (l/s)	HF-75 flow rate Q (l/s)	Rack level H (cm)	HF-50 flow rate Q (l/s)	HF-75 flow rate Q (l/s)
3,0	5,0	–	16,5	64,0	94,0
3,5	6,0	–	17,0	61,0	98,0
4,0	7,0	–	17,5	70,0	103,0
4,5	9,0	–	18,0	73,0	108,0
5,0	10,0	16,0	18,5	76,0	114,0
5,5	12,0	18,0	19,0	79,0	120,0
6,0	14,0	21,0	19,5	82,0	124,0
6,5	16,0	23,0	20,0		128,0
7,0	18,0	26,0	20,5		132,0
7,5	20,0	30,0	21,0		136,0
8,0	22,0	33,0	21,5		140,0
8,5	24,0	36,0	22,0		145,0
9,0	26,0	39,0	22,5		150,0
9,5	28,0	42,0	23,0		154,0
10,0	30,0	46,0	23,5		160,0
10,5	32,0	49,0	24,0		166,0
11,0	35,0	52,0	24,5		170,0
11,5	37,0	55,0	25,0		175,0
12,0	40,0	59,0	25,5		180,0
12,5	42,0	63,0	26,0		186,0
13,0	44,0	66,0	26,5		191,0
13,5	47,0	70,0	27,0		197,0
14,0	50,0	74,0	27,5		202,0
14,5	52,0	78,0	28,0		208,0
15,0	55,0	82,0	28,5		214,0
15,5	58,0	86,0	29,0		220,0
16,0	61,0	90,0	29,5		225,0

Figure 2 – Components of the irrigation norm of rice

The research of the actual costs of irrigation water was carried out by directly determining all the quantities included in the water balances of the field and checks, which were compiled on the basis of the Zaitsev equation [12]:

$$10 \cdot O_c + O_p = \Delta W + E + \Phi_в + \Phi_б + C, \quad (3)$$

where O_p – irrigation norm of rice, m^3/ha; O_c - atmospheric precipitation, mm; ΔW – saturation of soil zones, m^3/ha; E – total water consumptionm^3/hectare; $\Phi_в$ – vertical filtration, m^3/ha; $\Phi_б$ – lateral filtration or outflow, m^3/ha; C – surface discharge, m^3/ha.

The creation of a flooding layer is taken into account by the total evaporation, filtration and discharge. The initial saturation is determined by the formula, m^3/hectare:

$$\text{W} = \text{HP}(\omega_п - \omega_н), \quad (4)$$

where H – thickness of the soil layer from the surface to the mean water table before irrigating, m; P – average porosity of the soil layer H,%; $\omega_{п-}\omega_н$ – total and pre-determined $\omega_{п-}\omega_н$ moisture of the layer, H% duty cicle.

Surface fault $S_f = 100$ nh, (5)

where n is the number of fault per irrigation period; h – is the average depth of the fault layer, cm.

This allowed in each case to calculate the discrepancy, which is an indicator of the correspondence of the theoretical balance scheme and the degree of accuracy of the performed experimental measurements.

In vessels with a bottom without plants, evaporation from the free water surface of a flooded rice field (E) was taken into account. In vessels with a bottom and plants, rice-evaporation, transpiration (E + T); in vessels without a bottom - evaporation and vertical filtration (E + FB). Taking into account the different combination of water flow in the vessels, it was possible to determine each component of the water balance separately: evaporation, transpiration, and vertical filtration.

Precipitation falling from March to June to determine the water balance is indicated in the table (7).

Table 7 – Agroclimatic indicators of an automated weather station (Demonstration site of the Kazakh Rice Research Institute), 2017

Month	Air temperature, °C		2017 agricultural production, year					
			Average daily air temperature °C			precipitation, mm		
	max	min	mid-monthly	medium-long-term	+, - to medium-long-term	per month	medium-perennial	+, - to medium-long-term
March	+26,8	-3,6	10,2	2,5	+7,2	21,8	16	+5,8
April	+31,0	+1,2	15,5	13,2	+2,5	40,8	16	+24,8
May	+36,6	+9,8	22,12	20,1	+1,87	24,0	15	+9
June	+40,2	+15,0	27,11	26,4	+1,0	12,8	11	+1,8
July	+42,2	+18,2	28,7	27,5	+1,2	1,2	5	-3,8
August	+41,3	+14,4	27,6	24,2	+2,2	10	2	+8

Summary data on the water balance of rice fields during the vegetation periods of 2017 are given in table 8.

Table 8 – Water balance of the rice check

Balance elements	Innovative irrigation	
	m^3/ha	%
Water supply	20100	99,45
Precipitation	111	0,55
Total	20211	100
Soil saturation	3550	18,27
Evapotranspiration	7800	40,14
Reset	1500	7,72
Filtration flow and outflow to the drainage	6580	33,86
Total	19430	100
Disparity	781	4,01

The discrepancy between the irrigation norm and the constituent elements in the experiments is 2.5-4.3%, the permissible limits for conducting field studies are 7-8%.

The level of groundwater is determined in piezometers, which pipes are with a diameter of 50 mm and a length of 2-5 meters, depending on the depth of groundwater. To install the piezometers with an iron drill, a hole is drilled in the ground with a diameter slightly larger than the pipe itself to the level of groundwater. Then a pipe is inserted into this hole and buried.

To take groundwater samples, a special iron cup is lowered into the piezometer, tied on top by a rope, with a volume of approximately 38 cm^3 and a mass of 0.3-0.4 kg. When this cup is lowered into the piezoemeter, it reaches its groundwater level due to its mass, submerges in water and, when it is removed, it takes with it ground water in a volume of slightly less than 38 cm^3. These actions are repeated until the volume of groundwater required for analysis is collected.

To determine the level of groundwater, it is necessary to take the so-called "cracker", which is an iron stopper with an iron ring to fix the centimeter line. After fixing the "clapper" to the centimeter ruler, it is lowered into a piezometer. When in contact with the ground water surface, the "cracker" produces a sound signal in the form of cotton, this may mean that it has reached the groundwater level. For greater accuracy, this hole is made several times and the average value is calculated. After the measurement, the data is recorded in a log, then measuring the height of the piezometer from the ground, it is taken away from the depth of the groundwater, thereby obtaining the groundwater table from the ground surface (table 9).

Table 9 – Groundwater level of the pilot site

Date of water withdrawal	Depth	Sum of salts g/l
5.05.2017	2,2	0,668
16.06.2017	2,3	1,316
10.07.2017	2,5	1,205
15.08.2017	2,4	1,333
9.09.2017	2,8	1,417

The account of biological productivity was carried out in the phase of full ripeness of grain by the method of sampling sheaves from the subway in 3-fold repetition, and the economic harvest by continuous harvesting in all variants and replicates.

Usually, the density of plant standing is established after emergence and before harvesting. The first one makes it possible to determine the completeness of the shoots, which is characterized by the influence on their appearance of soil condition, agro-practices, the quality of seeds, primarily the energy of germination and vitality.

The second definition of the density of standing of plants before harvesting gives the material for establishing the thinning of crops during the growing season:

Completeness of shoots is determined by the formula:

$$X = a\ 100 / в, \qquad (6)$$

where X is the fullness of seedlings; a – number of plants per 1 quart meter during full sprouting; в – number of seeds actually sown in 1 sq/m.

In order to take into account the shoots and the density of standing of plants, two adjacent rows should be inserted into the trial plots in the case of continuous sowing, one row with a wide-row or two rows of tape with band sowing. Test sites are usually placed along the diagonal of the plot area of the plot so that the plants are in the rows of all rows. The total area of samples at the plot should be equal to or equal to 1 square meter (table 10).

Table 10 – Biometric indicators and rice yields of Syr Aruy (2017)

Sheaf analysis	Sheaf number									
	1	2	3	4	5	6	7	8	9	**average**
Height of plants, cm	98	100	102	95	98	102	99	101	103	**99,78**
Number of plants in a sheaf, pieces	92	98	92	95	90	92	93,0	95	90	93
Number of productive stems, pieces	140	150	150	150	148	150	145	155	150	**148**
Length of main panicle, cm	18	19	20	18	19	18	19	18	19	**18**
Grain weight on main panicle, g	3,5	3,6	3,6	3,6	3,8	3,6	3,5	3,2	3,5	3,6
Total weight, g	10,2	11,2	12,0	11,0	10,8	10,9	11,2	11,0	11,5	**11,08**
Number of grains on one panicle, pieces	85	80	90	95	98	90	92	95	96	**91,22**
Weight of 1000 grains, g	32,0	32,5	32,10	32,5	32,10	32,5	32,62	32,5	32,5	**32,36**
Productivity, c/ha	49,0	54,0	49,0	49,0	49,40	49,0	50,0	50,0	50,0	**50,70**

The irrigation norm of rice under constant flooding with the change of water in rice pouches (1500 m^3/ha during the emergence of rice) is 24,350 m^3/ha, and with the water-saving irrigation of the shift - 19 430 m^3/ha. At the same time, the irrigation norm was reduced by 20% compared to constant flooding. The calculation of rice productivity in the saline lands of rice systems is shown in table 11).

Table 11 – Rice productivity on saline lands of rice systems of Kyzylorda irrigation massif

Number of plants, pieces/m^2	Productive bushiness	Average length of panicle, cm	Average weight of grain from panicle, g	Weight of 1000 grains, g	Yield of rice, c/ha	Irrigation rate, m^3/ha	Water consumption, m^3/c
Constant flooding							
93	1,5	17	3,4	31,0	47,5	24300	511
Water-saving irrigation							
93	1,6	18	3,4	32,36	50,70	20150	409

According to experts, the reserves of fresh water on the planet are currently about 3% of the total world ocean. These are rivers and fresh lakes, sources of groundwater, as well as atmospheric precipitation. Such limited moisture resources, on the one hand, population growth and the need for food, on the other, lead to the need for rational use of water reserves.

Water in the production of irrigated rice has been taken for granted over the centuries, but the "impending water crisis" may change the way that rice will be produced in the future. This technology reduces the flow of water, that is, the alternation of anaerobic-aerobic and a continuous aerobic state leads to the rational use of irrigation water.

When using the method of surface irrigation and proper land planning, even with strict observance of the technology, the efficiency of irrigation does not exceed 50%. And in practice, with traditional irrigation, which is used today in most crops, the efficiency is not more than 35%. This means that if you do not use modern technologies to irrigate crops, up to 65% of irrigation water is wasted .. Thus, the use of water-saving irrigation for irrigation of rice will save irrigation water by 20-30% when compared by constant flooding.

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КҮРІШ ЖҮЙЕСІНДЕ СУ ҚОРЛАРЫН ПАЙДАЛАНУ ТИІМДІЛІГІН АРТТЫРУ

Аннотация. Елдің қауіпсіздігін сақтау мақсатында 2020-2030 ж. судың қатаң тапшылығы су қорының бірте-бірте азаюының куәсі. Өздеріңізге мәлім, Қазақстан трансшекаралық өзендердің төменгі ағысында орналасқан. Сумен қамтамасыздандыру халықтың қоныстауы және экономиканың дамуына, көршілес мемлекеттермен мемлекеттік саясат жүргузуімен тығыз байланысты. Сондықтан, судың тапшылығына төзімді өсімдіктердің түрлерін таңдау, өсімдіктерге жұмсалатын суды тиімді пайдалану,сондықтанда су қорларын пайдалануын реттеу ең өзекті мәселенің табу жолы болып саналады.Бұл мәселенің шешу жолы тікелей елдің экологиялық және азықтық қамтамасыздығын сақтау болып саналады.
Түйін сөздер: су қорлары, суару режимі, тұздылығы, сіңіруі, маусымдық суару.

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ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ ИСПОЛЬЗОВАНИЯ ВОДНЫХ РЕСУРСОВ НА РИСОВЫХ СИСТЕМАХ

Аннотация. Постепенное сокращение водных ресурсов свидетельствует об угрозе жесткого дефицита вод на рубеже 2020-2030 годов, что, конечно в целом затрагивает вопросы национальной безопасности страны. Как известно, Казахстан расположен в нижнем течении крупных трансграничных рек. Поэтому обеспеченность водой во многом зависит от государственной политики соседних государств, от развития их экономик и роста народонаселения. Следовательно, вопросы регулирования использования водных ресурсов ставит в числе первоочередных задач поиск путей и способов рационального использования поливной воды, подбора культур и сортов растений, устойчивых к водному стрессу. Решение этих задач напрямую связано с сохранением продовольственной и экологической безопасности страны.
Ключевые слова: водные ресурсы, режим орошения, минерализация, насыщение, оросительная вода.

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