1.3. IRRIGATION REGIME AND CROPS WATER CONSUMPTION NORMS

There is information on 9 objects including: 4 - on winter wheat irrigation regime, 3- maize for grain and green mass and winter barley irrigation regime as well.

1.3.1. Irrigation regime and water consumption norms for winter wheat and barley

Winter wheat and barley relate to agricultural crops which irrigation regime and norms of water consumption are studied poorly. Reasons for such situation lie in cotton monoculture which exists for long period in Central Asia. At present time in the republics of Uzbekistan, Tajikistan and Turkmenistan cereals and, particularly, wheat are widely cultivated for providing population with food without its import from other countries.

It was thought that the high wheat yield could be achieved through 1 and 2 irrigations by norms 500-600 m^3/ha because of wheat growing practice within the rainfed lands or conditionally irrigated lands located in pre-mountains plains.

From this point of view there is an interest in information on wheat and barley irrigation regime and water consumption norms. Number of projects is limited - only 5 objects. Three winter wheat pilot plots, 1 barley plot were represented by automorphous soils and 1 plot ("Niyazov" collective farm) by half- automorphous soil. They are well drained by artificial drainage of close type including plot in Niyazov collective farm. Field investigations on the pilot plots 1.04. Uzb ("Tinchlic" collective farm), 1.03 Tajik ("Zemledelie" experimental site) and 1.05 Tajik (K. Marx collective farm) were carried out by means of ordinary methodology with various indices of pre-irrigation moisture 60,70,80% of full field water capacity. Experiments on the plot 1.08. Uzb (Niyazov collective farm) were conducted under various variants with changed number of waterings, irrigation norms and different norms of fertilizers application, as well as for the plot 1.03. Tajik. Duration of filed investigations are 3-4 years.

After winter wheat on the plot 1.05. Tajik. maize was sowed and after winter barley - maize for grain. Information on this crops will be analyzed in the following section.

Within the pilot plots investigations the optimal pre-irrigation moisture limits of full field water capacity under automorphous soils 70 x 70 x 70 and 70 x 70 x 60 were found under which the best indices of efficiency of irrigation regime and grain water consumption were achieved:

- Optimal norms for winter wheat on the plot 1.04.Uzb varied within the limits 650-960 and up to 702-710 m^3/ha over 1.03. Tajik and 1.05. Tajik and for winter barley -788 m^3/ha under 2-3 irrigations against 3-4 irrigations in other variants (table 1.3.1). In the control variants irrigation norms usually exceed norms in studied ones and equal 1000-1100 m^3/ha. Because of low soil moisture within the pilot plots 1 water recharge irrigation by norm 900-1100 m^3/ha was conducted during sowing;
- Winter barley irrigation with depth, under the optimal variant, 788 m^3/ha was conducted after vegetation, in other variants, where depth is 550 m^3/ha, irrigation was applied twice;
- Moisture after waterings under the optimal irrigation regime varied within the limits 98-99,5% of full field water capacity, on other variants it was 100,5 % and more, i.e. part of irrigation water was spent for percolation.

- Low irrigation norms on the plot 1.04. Uzb were 3650 against 4090 m^3/ha under control, and on the plots 1.03. Tajik and 1.05. Tajik - 2092 and 1422 respectively under the optimal pre-irrigation moisture. Winter wheat yield is 40-43 c/ha. Wheat yield on the plot 1.04. Uzb under optimal irrigation was 52-58 c/ha. Crop yield under control sites and other variants does not exceed 26-38 c/ha over the plots 1.03.Tajik, 1.05.Tajik and 1.04. Uzb -48 c/ha. Winter barley irrigation norm under irrigation regime with variants of pre-irrigation moisture 70 x70 x 70 was 788 m^3/ha, in control variants - 1100 m^3/ha;
- For wheat and barley yield unit lowest water expenses are required. For winter wheat cultivation water expenses (over the plots 1.05. Tajik and 1.03. Tajik) varied from 33 to 49,7 m^3/c and to 62,6 (over the plot 1.04. Uzb), in other variants and control- to 54, 44 and 84 m^3/c respectively. Specific expenses under optimal regime for winter wheat yield unit were 17,6 m^3/c, in variant 80 x80 x80 - 24,6 m^3/c.

Wheat and barley water requirements could be covered not only by irrigation water, but from other sources: precipitation, soil water stock and ground waters if sites are located within hydromorphous and half-hydromorphous soils. According to above over the pilot plots of winter wheat and barley water consumption is much higher than irrigation norms. In the optimal variant it is 5500 m^3/ha (1.04. Uzb); 4885 m^3/ha (1.03.Tajik); 4492 m^3/ha (1.05.Tajik); and 3848 m^3/ha (1.05.Tajik) on winter barley (table 1.3.1).

Water consumption under control and other variants on 40,1% (1.04.Uzb); 23,7% (1.03.Tajik) and 13% (1.05.Tajik) is higher than under the optimal variant. Specific water expenses for wheat yield unit cultivation under optimal irrigation regime varied from 94.3 m^3/c(1.04.Uzb) to 116,5(1.03. Tajik) for wheat and 86,5 m^3/c for barley.

In total volume of winter grain crop water consumption the share of water supply constitutes 50% for 1.04.Uzb; 42,8% -1.03.Tajik; 30,2%- 1.05.Tajik and 20,4 % - (1.05.Tajik on barley). Small share of water supply in total water consumption over the plots of Tadjikistan is caused by meteorological conditions, i.e. increased share of precipitation which is 54,4%-56%, but for plot 1.04. Uzb. it is equal 34%.

Table 1.3.1

Main results of field investigations of irrigation regime and water consumption norms for winter wheat and barley

# #	Indicators of water consumption regime elements assessment	Codes of pilot projects and options of wheat irrigation regime							
		1.04.Uz. Tinchlik, Tashkent province				1.03.Tad. (SPA experimental plot)			
		control	60x70x60	70x70x60	80x80x60	according to recom-mendations	60x60x60	70x70x60	80x80x80
1.	Irrigation norm, m^3/ha	1100-1500	750-1000	650-960	700-1100	783	702	697	604
2.	Number and scheme of irrigation	3	3	4	4	1	1-2	2-3	3-4
3.	Moisture after irriga-tion, %	99,5-100,5	99-100,5	98-90	99-100,8			98-98,5	99,5-100,6
4.	Irrigation norm, m^3/ha	4090	-	3650	3600	2952	1405 31,5	2092	2416 38,6
5.	Yield, c/ha	48,4	45,3	58,3	52,8	19	22,6-40,4	42,1	29-48,3
6.	Specific water ex-penses per production unit on irrigation norm, m^3/c	84,5	-	62,6	-	155,4	44,6	49,7	62,6
7.	Water consumption, m^3/ha	7768		5500		6046	4519	4885	5180
8.	Specific water ex-penses per production unit on irrigation norm, m^3/c	160,5		94,3		318,2	143,4	116,0	134,1
9.	Share of irrigation norm in a volume of water consumption, %	52,6		66,4		12,9	31,1	42,8	46,6

# #	Indicators of water consumption regime elements assessment	Codes of pilot projects and options of wheat irrigation regime						
		1.05.Tad. (collective farm K.Marx)				1.05.Tad. (collective farm K.Marx - barley)		
		according to recom-mendations (control)	60x60x60	70x70x70	80x80x80	according to recom-mendations	70x70x70	80x80x80
1.	Irrigation norm, m^3/ha	1033	976	710	480	550	788	550
2.	Number and scheme of irrigation	2	1	2	4	2	1	2
3.	Moisture after irriga-tion, %	99,5-100,5	99,7-101	98-99,2				
4.	Irrigation norm, m^3/ha	2065	976	1422	1916	110	788	1100
5.	Yield, c/ha	38,2	34,7	43,2	40,2	39,1	44,5	44,7
6.	Specific water ex-penses per production unit on irrigation norm, m^3/c	54,0	28,1	32,9	47,7	28,4	17,7	24,6
7.	Water consumption, m^3/ha	5070	4252	4492	4862	3901	3848	3792
8.	Specific water ex-penses per production unit on irrigation norm, m^3/c	132,7	122,5	103,9	120,9	99,8	86,5	84,8
9.	Share of irrigation norm in a volume of water consumption, %	40,7	22,	31,6	39,4	28,5	20,5	29,

Experiments on determination of influence of depth of irrigation, irrigation norms and norms of mineral fertilizers on winter wheat crop yield were established differently on the pilot plot of Niyazov collective farm, Fergana oblast, which is located on half-hydromorphous soils (1.08.Uzb). Duration of investigations - 3 years, 1995-1997. Wheat sort-"Yanbash". Sowing terms 3-rd ten-days period of September and 1-st - 2-nd ten-days period of October. Investigation variants according to years:

- 1995 - 4 variants with depth of irrigation from 1100 to 1290 m^3/ha, number of waterings during vegetation from 2 to 4 with nitrogen fertilizers application - 85-250 kg/ha, phosphorus- 50 kg/ha. Irrigation norms were 2350 m^3/ha - 3640 m^3/ha from which 375- 565 m^3/ha are released;
- 1996 - 7 variants. Number of waterings up to 4 by depth 744-1080 m^3/ha. Irrigation norm - 3720 m^3/ha from which 563 m^3/ha are released. Nitrogen application norm were from 100 to 300 kg/ha + 50 kg phosphorus;
- 1997- 5 variants. Number of waterings -3-4 by depth 940-1302 m^3/ha from which losses for surface release were 840 m^3/ha.

In all variants the water recharge irrigations by depth 1200-1400 m^3/ha were applied before or after sowing. Sowing was carried out over cotton harvesting.
Results show that on old cultivated lands poor with nutrient elements, lowest winter wheat yield was obtained under the variants without fertilizers, though water factor was kept at the same level. Winter wheat yield in these variants varied from 23 c/ha (1997) to 32,7 c/ha (1995) (table 1.3.2.)Water expenses for yield unit varied within the limits 111,3 - 163 m^3/ha.

While nitrogen norm increasing from 85 kg/ha + 50 kg/ha phosphorus gradual winter wheat yield growth was observed. Under nitrogen application by norm 300 kg/ha+ 50kg/ha phosphorus the highest wheat yield was obtained. Crop yield achieved 59 c/ha under irrigation norm 2790 m^3/ha and 57,3 c/ha under norm 3728 m^3/ha. Water expenses for yield unit varied within the limits 47-65 m^3/ha, in other variants under much lower fertilizers application norms water expenses were 60-80 m^3/ha/c (table 1.3.2.).

On the old cultivated lands subjected to salinization fertilizers application plays significant role in crop yield increase. On the pilot plot "Zemledelie"(1.03.Tajik), which is located on typical gray soils, under nitrogen application by norm 100 kg + 60 kg/ha phosphorus + 60 kg/ha potassium yield growth was occurred. Further norm increase did not give expected results. (Table 1.3.2.).

In all variants over the plot 1.08.Uzb before watering pre-irrigation moisture in 100 cm layer varied within the limits 22-23% of dray mass, moisture after irrigation achieved 28-30% which corresponds to 65-70% and 99-100% of full field water capacity.

From the pilot plot 1.08. Uzb analysis is found that on slightly and medium saline lands of Central Fergana under ground water table 1,5-2,0 m and more grain crop sowing should be carried out in September -October. If sowing is executed on growing cotton, before sowing and simultaneously with sowing it is necessary to carry out between row cultivation. It creates mellow soil layer covering sowed crop seeds.

In order to obtain full value sprouts, it is necessary after sowing to conduct water recharge irrigation by depth 1200-14000 m^3/ha This amount of water fully moistens soil and, simultaneously, it is enough for slightly saline lands leaching. If during vegetation period ground water table is 1,5-2,0 m it is enough to conduct 2-3 waterings by irrigation norm 2400-3800 m^3/ha.

Table 1.3.2

Irrigation water expenses during growing period of wheat for production of 1 centner of wheat (1995-1997)

Options	Insertion of mineral fertilizers, kg/ha		Irrigation norm, m^3/ha	Including release, m^3/ha	Number of waterings	Yield, c/ha	Irrigation water expenses for production of 1 c of grain, m^3	
1.08.Uz Niyazov	nitrogen	phosphorus					total	minus release, m^3
1.	85	50	3640	565	3	32,7	111,3	94,0
2.	85	50	2350	375	2	34,7	67,7	56,9
3.	150	50	3640	565	3	36,4	100,0	84,4
4.	250	50	3640	565	3	48,4	74,6	63,0
middle	-	-	3317,5	517,5		38,15	88,4	77,1
1996								
1.	-	-	3720	563	4	23,60	157.6	133,8
2.	100	50	3720	563	4	47,15	76,7	66,9
3.	100	50	2790	354	3	46,98	59,4	51,9
4.	200	50	3720	563	4	51,76	76,9	62,9
5.	200	50	2790	354	3	51,19	54,5	47,6
6.	300	50	3720	563	4	57,30	65,0	55,1
7.	300	50	2790	354	3	59,00	47,3	41,3
middle		-	3321	473	-	47,85	76,06	65,6
1997								
1.	-	-	3728	800	3	22,95	163	127,6
2.	150	20	3728	800	3	44,13	84,5	66,3
3.	200	20	3728	800	3	53,26	78,5	62,1
4.	250	20	3728	800	3	53,26	70,0	54,0
5.	250	20	4673	800	4	53,62	87,1	72,2
middle	-	-	3917			44,28	86,6	76,4

Nitrogen and phosphorus application norm 2790 m^3/ha under the same irrigation norm plays important role for high grain crop yield obtaining within the lands of Central Fergana. Under nitrogen norm 100 kg/ha and phosphorus norm 50 kg/ha wheat yield 51,2 c/ha was obtained, and under nitrogen norm 300 kg/ha and phosphorus-50 kg/ha wheat yield was 59 c/ha. It means that lands of Central Fergana are very poor with nutrient elements and high norms of nitrogen fertilizers application is compensated by high crop yield.

Water balance over winter wheat and barley sites on automorphous soil (III water allowance rayon) is stable. Precipitation and water supply are main factors for inflow formation in balance of the pilot plots.

On the plot 1.04.Uzb precipitation share constitutes 32-34%, on other high elevated sites it fluctuates from 43 to 59,3% for wheat and from 54 to 62,8% for barley. Only on the plot 1.04. Uzb water supply share exceeds 50% , on other sites it is varied from 30 to 46,6% for wheat. Water supply for barley is 20,5-23,5%.

On all pilot plots the share of soil water use does not exceed 15-20% (table 1.3.3.) Water mainly is spent for total evaporation. According to information from the pilot sites during grain crop vegetation period the evaporation constituted 35,2-37,8%. Water balance of plot (1.08. Uzb), which is located on half-automorphous soil, is found negative with salt removal from root zone. Winter wheat bio- climatic coefficients for plot (1.03. Tajik) are represented on figure 1.3.1. Maximum crop yield indices over all variants of moisture deficit graphs with various norm of fertilizers application fit bio-climatic coefficients 0,2-0,4.