REGISTER OF RESEARCH ON IRRIGATION AND DRAINAGE

QUESTIONNAIRE

A	**Project title:**
Irrigation Regime in the System of the All-The-Year-Round Use of Irrigated Arable Lands.	

B	**Topic n^{o} : 1**	Sub-topic n^{o}: 2
1)	1	Technical field n^{o}: 1
2)	Category n^{o}: 01	

C	**Project location**	
Country: Republic of Tajikistan		Area : 2,0 ha
Gissar district, «Karl Marx» collective farm		

D	**Duration of the project:**		
Year in which the project was started: 1994		Project completed:	1996
		Dates of Expertise:	1994, 1995, 1996

E	**Organizations and technical staff involved**	
1	Supervisor/project coordinator: Yarash Ergashevich Pulatov	%
	Organization: SPA «Zemledelie» Address: Gissar district, Sharora settlement telephone: 31-15-97 fax: E-mail:	Staff resources 70
Other counterparts:	Organizations Surname First name	
1	SPA «Zemledelie», Sulton Shodmonov	15 %
2	SPA «Zemledelie», Partov Davlyatov	15 %
3		%
4		%
Other collaborators:	man-years	

F	**Funding agencies**	
	Full name or acronym	Percentage of project finance provided
1	Tadjik Agricultural Academy	100 %
2		%

G	Summary of research project

1 *Objective and technical fields*:

Improvement of water use through optimization of the irrigation regime and determination of crop water requirements in the system of the all-the-year-round use of irrigated arable lands. Objectives: elaboration of the biologically optimal irrigation regime of crops (winter wheat, barley, maize grown for grain and silo) guaranteeing maximum and profitable yield and high efficiency of water and land resources use.

2 *Scientific and technical approaches:*

Study of soil water-physical properties; soil moisture; irrigation regime; water requirements; water balance; growth, development and productivity of crops on the basis of a series of field, lysimetering and laboratorial studies. Studies included improvement of water use planning and management, and the scientifically grounded recommendation on the irrigation regime and raising the productivity of irrigated lands.

3 *Environment characteristics:*

The collective farm is situated in Gissar valley at the height of 960 m above sea level. Climate is subtropical. Maximum temperature in July is 43-44^{0}C, minimum temperature is -24-30^{0}C. In July average monthly temperature is maximum (27,0-28,2^{0}C). Average annual temperature is 12,8-15,1^{0}C. Annual precipitation is 475-797 mm (average precipitation is 629 mm), 80% of it fall in winter and spring. Relative air humidity is 46-53%, duration of a frost-free period is 220-240 days. Average annual wind speed is 1,5-2,8 m/sec. During a year evaporativity varies from 1311 to 1680 mm, average evaporativity is 1503 mm. Water balance deficit (evaporativity minus annual precipitation) is 974 mm. Topsoils include mountain, brown, calcareous, dark gray, meadow-gray soils, in some places there are meadow-bog soils. On 10,6% of the territory the depth of water table is 2 m. Ground waters are fresh, salinity is less than 1 g/l. Source of irrigation is Big Gissar Canal, water chemical composition is favorable, water salinity is 120-650 mg/l. Soils of the collective farm are brown-calcareous, volume weight in 0-100 cm soil layer is 1,42 g/cm^3, specific weight is 2,64 g/cm^3, the least moisture capacity is 19,6% of the mass of absolutely dry soil. The second testing plot is situated on meadow-gray soils where in 1 m soils layer volume weight is 1,30 g/cm^3 and specific weight is 2,71 g/cm^3. The least moisture capacity is 26,0% of the mass of absolutely dry soil.

4. *Parameters of Pilot Projects and Technical Solutions:*

The area of the testing plots was 2,0 ha each. There were 16 fields in each plot. Land use efficiency was 0,90. Irrigation was made through furrows from a surface earthen network, canal efficiency was 0,85-0,90, specific length of canals was 55 m/ha. Canal capacity was 200-280 l/sec. Irrigated furrows were 100 m long. Inclination was 0,009. Plots were tetragonal with an internal canal on the left side.

5 *Methodology:*

Field and lysimetering natural studies and laboratorial analyses on moisture movement; irrigation regime; ground waters; growth, development, water requirements and productivity of crops were made. The plots were provided with accounting equipment. Systems analysis of results was used. For elaboration of optimal irrigation regimes for winter wheat of autumn sowing (1st yield) and maize grown for silo (2nd yield) the testing plot with brown-calcareous soils was used. For winter barley (1st yield) and maize for grain (2nd yield) the second testing plot with meadow-gray soils was used. The following irrigation variants were compared: irrigation according to agrarian recommendations (control); irrigation according to soil moisture - 60, 70, 80% of the normal soil moisture.

6 *Results*:

Results showed that depending on preirrigation soil moisture number of water gifts for wheat varied from 1 to 4, actual depth of irrigation was 976-2065 m^3/ha. Different irrigation regimes proved their considerable influence on winter wheat yield. On the plots without irrigation the yield was 2,88 t/ha; on the plots irrigated on agrarian recommendations (2 water gifts with the depth of irrigation of 2065 m^3/ha) the yield was 3,82 t/ha. The highest yield of grain (4,32 t/ha) was on the plots with irrigation according to soil moisture - 70% of the normal soil moisture. Two water gifts were made with the depth of irrigation of 1422 m^3/ha. Comparing with the control plot the yield was 0,5 t/ha or 13,1% higher; 45,2% of irrigation water was saved.

During irrigation of wheat it was discovered that if preirrigation soil moisture was increased from 60 to 80% and more, number of water gifts increased from 3 to 8, the irrigation norm increased from 3034 to 4421 m^3/ha. The highest yield of maize silo mass (46,46 t/ha) was obtained with the moisture equal to 80% of the normal soil moisture. For keeping to this regime 8 water gifts were made with the actual irrigation norm of 4421 m^3/ha. Yield was more than 7,6 t/ha higher, 1040 m^3/ha of irrigation water was saved. Thus, in the system of intensive use of arable lands for obtaining 2 harvests per year (first harvest - grain and straw of winter wheat, second harvest - maize silo mass) total irrigation water expenditures were on the average 5843 m^3/ha, which was 1683 m^3/ha less than water expenditures determined in agrarian recommendations.

It was discovered that the optimal irrigation regime for winter barley (1^{st} harvest) on meadow-gray soils is irrigation according to soil moisture - 70% of the normal soil moisture. The yield under this irrigation regime was 4,5-5 t/ha of grain. Total barley water requirements with optimal water supply was 3848 m^3/ha. Water consumption coefficient was 864 m^3/t, specific expenditures of irrigation water were 177 m^3/t. Optimal irrigation regime for maize grown for grain (2^{nd} harvest) is irrigation according to soil moisture of 70-70-70% of the normal soil moisture. The yield under this regime was 6,5-7 t/ha of maize grain.

In the system of the all-the-year-round use of irrigated arable lands for obtaining 2 harvests per year it is possible to obtain total yield of 11,5-12 t/ha of grain, with specific expenditures of irrigation water on the average equal to 450 m^3/t. For these conditions a bioclimatic coefficient K_I was determined for calculation of the irrigation norm: it was 0,17-0,29 for winter wheat and 0,15-0,21 for winter barley. Relation between grain yield and the bioclimatic coefficient was determined. Coefficients of precipitation use were found, which had particular values for calculation of water balances.

Study of total crop water requirements in the system of the all-the-year-round use of irrigated arable lands showed the following: the main balance income for the first harvest (wheat and barley) was precipitation (49÷63%) and the irrigation norm (20÷39%); for the second harvest (maize) the main balance income was the irrigation norm (63÷86 of the total water consumption). Balance percentage of moisture used from soil stock was 9÷37% for the first harvest and 14÷35% for the second harvest. The following curvilinear close relation between yield of wheat grain and total water consumption was found: $Y=0,1(-15,5\ X^2 + 146,7X - 302,4)$, where Y is yield of grain (t/ha) and X is total water consumption (th. m^3/ha). Once yield was raised from 2,88 to 4,25 t/ha, total water consumption increased from 3,8 to 4,8 th. m^3/ha, i.e. yield increased by 47,6%, total water consumption increased by 26,3%.

Between yield of winter barley grain and total water consumption there is a close correlative relation ($\eta = 0,94 \pm 0,15$). This relation is expressed by an equation of a second degree parabola. Once total water consumption was raised from 3,0 to 4,1 th. m^3/ha, yield of winter barley grain increased from 3,3 to 4,2 t/ha. Further raising did not lead to increase of winter barley yield. Curvilinear relation between maize grain yield and total water consumption was found ($\eta = 0,91 \pm 0,11$). The relation between maize silo mass yield and total water consumption was linear ($\eta = 0,93 \pm 0,1$). Results of testing and introduction of the optimal crop irrigation regime in farms of the Republic on the area of 2140 ha showed, that keeping

to the regime yield increased on the average by 1,15 t/ha for maize grain, by 1,4 t/ha for wheat and by 1,12 t/ha for barley. Average profitability was 110-148 ruble/ha (in prices before 1990).

H	Suggested key-words		
1	Soil moisture	4	Water balance
2	Irrigation regime	5	Growth and development
3	Water consumption	6	Plant productivity

I	Most recent publications (maximum 3)			
1	Author(s): Ya. E. Pulatov, S.Shodmonov			
	Title: Optimal irrigation regime for winter wheat and maize on brown-calcareous soils of Central Tadjikistan			
	Publication details: Results of studies on optimization of the crop irrigation regime in the system of the all-the-year-round use of irrigated arable lands are shown. Practical recommendations on production are given.			
	Year of publication: 196	free access [•]	restricted [ ]	confidential [ ]
2	Author(s):			
	Title:			
	Publication details:			
	Year of publication:	free access [ ]	restricted [ ]	confidential [ ]