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# PROJECT

## Water Productivity Improvement on Plot Level

# REPORT

*Water productivity at demonstration plots and farms*

*(Inception phase: April 2008 – February 2009)*

**Project director**  
SIC ICWC

**Victor Dukhovny**

**Project director**  
IWMI

**Herath Manthrithilake**

**Regional project**  
**manager**

**Shukhrat Mukhamedzhanov**

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## **EXECUTORS**

### **I. Project regional group**

- |                                     |                               |
|-------------------------------------|-------------------------------|
| 1. Regional project manager         | Sh.Sh. Mukhamedzhanov         |
| 2. Agronomy consultant              | S.A. Nerozin                  |
| 3. Hydraulic engineering consultant | Sh.R.Hamdammov                |
| 4. Regional technicians             | I.I. Ruziev<br>G.U. Umirzakov |

### **II. Regional executors**

- |                    |   |
|--------------------|---|
| 5. Andizhan region | S.Ergashev, A.Ahunov,<br>I.Kushmakov                              |
| 6. Fergana region  | M.Mirzaliev, H.Umarov,<br>A.Rahmatillaev,<br>I.Ganiev, R.Begmatov |
| 7. Sogd region     | Z.Umarkulov, I.Halimov,<br>M.Saidhodzhiev                         |
| 8. Osh region      | S.A.Alybaev, K.Avazov,<br>Z.Kamilov                               |

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## 1. Introduction

Interaction of all the levels of water use from the main canal to a field is very important at achieving productive water use. Reforms of water sector are aimed at ensuring water user's (farmer) demand and fulfilling the crop physiological requirements. Improving of irrigation systems, their management and operation from river basins, large canals to the inter-farm level should be done taking into account a real conditions and requirements of the water consumer. The systems and structures should correspond to the real needs taking into account the own power and to be aimed at reception of the maximum water productivity and profit of the farmer.

We have to notice that this project (WPI-PL) has emerged on the basis of IWRM-Fergana project; its main objective is searching the organizational forms of interrelation of science and practice concerning the organizing, introducing and disseminating the best practices of irrigated agriculture. The specific of the project is that the process of introduction itself got the new direction with purpose of involving all the knowledges into practice of managing the water use and meliorative modes of soils.

Now, as a rule, excessive water is used at irrigation of crops. An actual volume of water use exceeds the norm in 2 times in some districts. The main losses thus fall not only at irrigational system that is in bad condition today, but also at irrigated field with low level of organization of irrigation. Unproductive losses are observed along whole the way from headwater fence to an irrigated field. The evaluation and analysis of actual water use show that the majority of farms have resources and real possibility for increasing the productivity of water resources.

It is possible to increase water productivity at field level without special investments by means of distributing the received experience on water and land productivity improvement to farms. It is necessary to notice, that land productivity is decreased mainly due to absence of knowledge at farmers on correct water use planning. That is why farmers of all the three republics require practical consultations on all the matters of agricultural production and irrigation. The majority of farmers have no knowledge on irrigation terms and norms. Studying of spent actions has shown that the most part of farmers commits considerable errors at irrigating the agricultural crops. Many farmers have no idea about their farms natural factors and melioration features that should be taken into account at planning the irrigation.

The purpose of the inception phase of the project «WPI-PL» is the estimation of water use at the selected demonstration fields and separate farms, the analysis of current situation and search of effective means of reducing the irrigation losses at a field level.

## 2. Water use productivity in Andizhan region

### 2.1 Irrigation mode for cotton at demonstration fields

In 2008, the project had covered 14 district polygons in Andizhan region. The total area under cotton formed 93,3 hectares, way of sowing at 4 fields - "under a film", at 10 fields - traditional sowing into smooth field. The chosen fields considerably differ from each other on soil conditions that is visible from the table 2.1. According to the table, polygons belong to various hydro module districts (HMD) from I-HMD to VI – HMD. According to HMD, the recommended irrigation mode for cotton is changed in a wide range: water requirement is changed from 5000  $\text{m}^3/\text{hectare}$  to 6400  $\text{m}^3/\text{hectare}$ , water rate from 800  $\text{m}^3/\text{hectare}$  to 1120  $\text{m}^3/\text{hectare}$ , and recommended quantity of irrigations from 5 to 8 for a vegetation.

The year 2008 was rather shallow on water supply, which affected the carrying out the irrigation works at fields of Andizhan region. Because of expected water shortage in Uzbekistan, administrations of Andizhan and Fergana regions restricted carrying out the first irrigation. Therefore, the first irrigation of cotton was conducted 15-20 days later than under recommended terms that negatively affected growth and development of plants at the initial stage and subsequently led to productivity decrease. The data obtained from farm fields of Andizhan region can serve as the examples: the first irrigation at farms «Dier Donier Fahrier», «Mirvali Hajdarov» of Furkat district was carried out only on 20.07.2008, at farm «Rustambek A» of Dangara district on 02.07.2008, at farm «Zhavohir Ikramov» of Baghdad district on 24.06.2008, at farm «Pulat Murod» of Tashlak district of Fergana region, at farm «Sadokat aja» and "Ugilhon" of Buz district on 28.06.2008, at farm "Alisher-1" on 20.06.2008 that testifies to an obvious delay of carrying out the initial irrigations.

In Andizhan and Fergana regions of Uzbekistan there formed a steady practice of delay of carrying out the first irrigation, that is based, as a rule, by so-called "hardening" of plants. This way is widely supported by region and district authorities and obligatory last years and BAIS often delay water supply for cotton. As a result, the first water arrives only in the middle or at the end of July and in some cases even later. Crops at such fields are obviously lag behind in development, plants undersized and have the oppressed appearance. From the point of view of biological requirement, delaying the irrigation during the vegetation period contradicts theory that is proved to be true by low yields received from such fields. Such way is possible and effective at lands with high ground water level only or at fields where water retention irrigations with big irrigation norms took place. It is possible to assume, that decrease in productivity of cotton in separate districts is connected in many respects to applying such a practice.

Similarly hardly are optimum terms of carrying out the second irrigation when at some fields the inter-irrigation period between the 1st and 2 irrigation formed 26-30 days. As a whole, it had been spent 5 irrigations at observed polygons with general water of 4,3-6,5 thousand  $\text{m}^3/\text{hectare}$  that provided planned level of yield except for farms where inter-irrigation period had been unfairly delayed.

Table2.1

**Data on polygons of Andizhan region (2008)**

№ № II/II	Districts	Water Users Associations	Farm (polygon)	Farm total area (h)	For polygon		HMD	Hydropost	Water source
					Cotton (h)	Wheat (h)			
1	Andizhan	"A.Numonov"	Orzu-Tashabbus	46,1	5	9	II	Cipolletti weir	Orol arik
2	Asaka	"Asaka zilol suvi"	Asaka Irrigatori	40,4	2	8	IV	Cipolletti weir	Koratepa canal
3	Altinkul	"Toshkent zilol suvi"	Baht imkon rivozh	60	12	12	III	Cipolletti weir	Kumakay arik
4	Balikchi	"Obod ulka"	Omadli Abdugaffar fajzi	10	7	3	III	Cipolletti weir	Uralbuva arik
5	Boz	"Solimahsum"	Abduvohid	29,2	6,2	12,8	IV	SANIIRI flume	Solimahsum koll.
6	Bulokbosh	"S.Kasimov"	Isakzhon Akiev	36,4	18,4	18	II	Cipolletti weir	SFC
7	Dzhalakuduk	"Beshtol"	Beshtol sardor omadi	30,9	5	5	I	Cipolletti weir	Beshtal arik
8	Ulugnor	"Ok oltin"	Ulugnor bahori	75,4	3	11,1	IV	Cipolletti weir	BAC, 74-h canal
9	Marhamat	"Tomchikul"	Aliev Davronbek orzusi	12	6	6	I	Cipolletti weir	SFC
10	Shahrihan	"SHahrihon Okkalmok"	Dilshoda	34,9	5	2	IV	Cipolletti weir	Nayman canal
11	Hodzhaabad	"Yusuf ota"	Yusuf ota	27,3	4	13,3	I	Cipolletti weir	Savay canal
12	Izbaskan	"A.Tillaboev"	Tillaboev dalasi	33,5	5,5	7	IV	SANIIRI flume	Kachal arik
13	Pahtaabad	"B.Usmanov"	Abdurahmon ota	10	6	4,5	II	Cipolletti weir	Miyan canal
14	Kurgantepa	"Kushtepa"	Berdiboj Chorvador.	39,9	8,2	8	III	Cipolletti weir	Tashlak canal
	<b>TOTAL</b>			<b>486</b>	<b>93,3</b>	<b>119,7</b>			

Table2.2

The summary table on irrigating the cotton at polygons of Andizhan region for 2008

№	Districts	Farm (polygon)	Area (h)	HMD	Recommended irrigation rate			Actual water supply			Quantity of cultivations, (times)
					irrigation rate (m <sup>3</sup> /h)	Quantity of irrigation	Average irrigation rate(m <sup>3</sup> /h)	Water volume for 1hectare(m <sup>3</sup> /h)	Quantity of irrigations	Average irrigation rate(m <sup>3</sup> /h)	
1	Andizhan	Orzu-Tashabbus	5	2	5900	7	843	5247	5	1049	6
2	Asaka	Asaka Irrigatori	2	4	6200	8	775	5486	5	1097	6
3	Balikchi	Omadli Abdugaffar	7	3	5600	5	1120	5790	5	1158	7
4	Boz	Abduvohid	6,2	4	6200	8	775	5807	5	1161	7
5	Bulokbosh	Isakzhon Akiev	18,4	2	5900	7	843	5293	5	1059	5
6	Dzhalakuduk	Beshtol sardori	5	1	6400	8	800	4324	5	865	5
7	Ulugnor	Tillabayev dalasi	3	4	6200	8	775	5493	5	1099	6
8	Marhamat	Ulugnor bahori	6	1	6400	8	800	5625	5	1125	6
9	Shahrihan	Berdiboj Chorvador	5	4	6200	8	775	6200	5	1240	6
10	Hodzhaabad	Aliev Davronbek	4	1	6400	8	800	5800	5	1160	6
11	Altinkul	Baht imkon rivozh	12	3	5600	5	1120	5908	5	1182	7
12	Izbaskan	Abdurahmon ota	5	4	6200	8	775	5920	5	1184	6
13	Pahtaabad	Yusuf ota	6	2	5900	7	843	6599	6	1100	7
14	Kurgantepa	Dilshoda	8,2	3	5600	5	1120	5877	5	1175	7

The real inter-irrigation periods in July and August, 2008 almost everywhere deviate from recommended terms to objective (shallow year, water rotation among inter-district and inter-farm canals) and subjective reasons (lack of mechanisms for inter-row processing, skilled watermen and ignorance of standards of irrigation mode by some farmers). It is recommended to spend 3-5 irrigations (depending on HMD) during flowering and vegetation phases for conditions of Andizhan and Fergana regions. However, the most part of farms has spent only two irrigations and only some spent irrigations within the recommended terms and norms.

The first (sprouting) irrigation was spent at the beginning of April: at polygon of Bulokbosh district (farm «Isakzhon Akiev») on 01.04.2008 with irrigation norm of  $610,2 \text{ m}^3/\text{hectare}$ ; at Boz district (farm "Abduvohid") on 01.04.2008 with irrigation norm of  $1206,3 \text{ m}^3/\text{hectare}$ ; at Izbaskan district (farm «Tillaboyev dalasi») on 09.04.2008 with irrigation norm of  $1282 \text{ m}^3/\text{hectare}$ ; at Shahrihan district (farm "Dilshoda") on 04.04.2008 with irrigation norm of  $1188 \text{ m}^3/\text{hectare}$ . The obtained materials say that farmers exceeded first irrigation norms in 1,3 – 1,5 times for various reasons (ignorance of irrigation norms, bad lay-out of fields, superfluous dumps from a field, etc.).

The first (sprouting) irrigation is the most difficult on technology among all the irrigations. It demands many inputs and carefulness at carrying out the irrigation, starting from preparing the main channels to sealing the head wall by paper or other material to avoid washout and adjust water discharge in a furrow. Clumps interfere water flow into a furrow; on occasion, the reason of non-uniform flow is straw left on the field. The furrow at the first irrigation shouldn't be deep, in comparison with the next irrigations.

There was overflow at carrying out the irrigations of cotton at separate polygons; it is well seen from the table 2.2 For example:

- at Hudzhaabad district polygon instead of recommended 8 irrigations with average irrigation norm of  $800 \text{ m}^3/\text{hectare}$ , there actually were 5 irrigations with average irrigation norm of  $1160 \text{ m}^3/\text{hectare}$ ,
- at Ulugnor district polygon instead of recommended 8 irrigations with average irrigation norm of  $775 \text{ m}^3/\text{hectare}$ , there actually were 5 irrigations with average irrigation norm of  $1099 \text{ m}^3/\text{hectare}$ ,
- at Andizhan district polygon instead of recommended 7 irrigations with average irrigation norm of  $843 \text{ m}^3/\text{hectare}$ , there actually were 5 irrigations with average irrigation norm of  $1049 \text{ m}^3/\text{hectare}$ ;

On the average on 14 polygons of Andizhan region it were spent on 2 irrigations less than it is recommended by irrigation mode, thus the average irrigation norm instead of  $868 \text{ m}^3/\text{hectare}$  has formed  $1118 \text{ m}^3/\text{hectare}$ . A principal cause of violation of technological recommendations is restriction and faults at water giving during the vegetation period that compels farmers to reinsure and overestimate irrigation norms. The facts show that, despite the water shortage, farmers overestimated the irrigation norm on 25-30 %, while the number of irrigations was reduced. Such practice leads to excessive water losses on dump and deep infiltration, especially at fields with easy mechanical structure and deep level of subsoil water ( $\geq 3\text{m}$ ).

The recommended irrigation norm on the average for polygons is  $6050 \text{ m}^3/\text{hectare}$ , actual norm has formed  $5688 \text{ m}^3/\text{hectare}$  that is caused by limited water delivery in 2008. In spite of the fact that the actual irrigation rate was close to those recommended, expansion of inter-irrigation periods and overestimate of irrigation norms brought to water stress for crops.



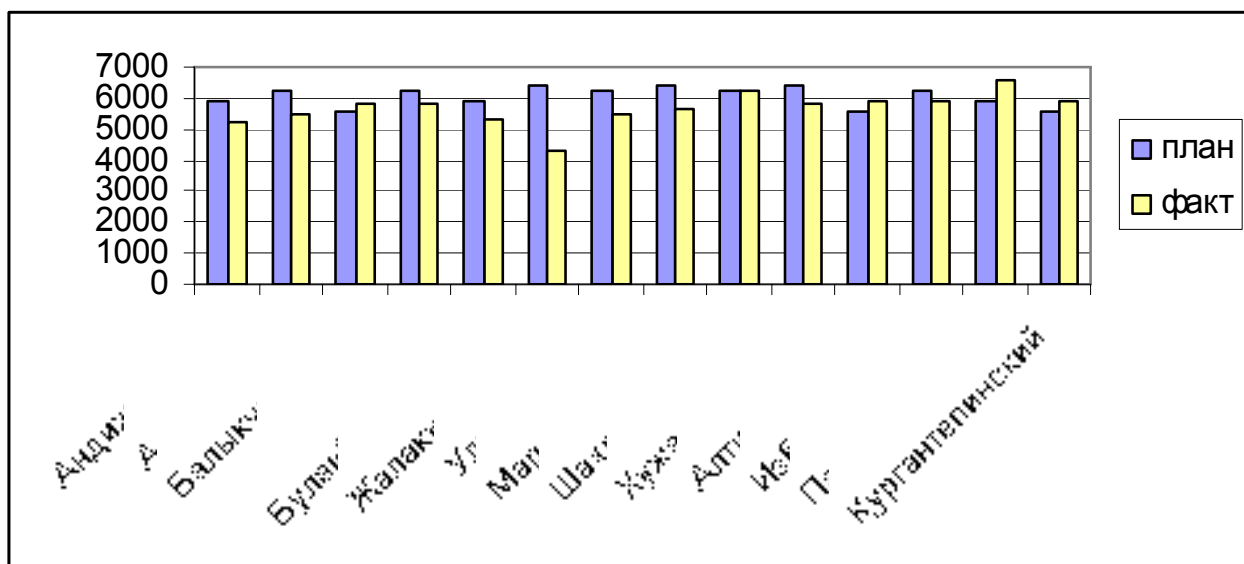


Fig.2.1 - Water use at irrigating the cotton in 2008 (plots of Andizhan region)

## 2.2 Irrigation mode for winter wheat at demonstration plots

The total area under winter wheat formed 119,7 hectares on which the following sorts of wheat were sowed: « Chillaki »- 6 fields, "Crumb"- 6 fields, "Plovchanka"- 1 field, "Nota"- 1 field. In the conditions of Uzbekistan, including Fergana valley, winter wheat is sowed in two ways: the first way - sowing on a smooth field (usually when the field has been sowed by wheat in previous year), the second way - sowing in cotton row-spacing, after the second harvesting of cotton. At the first way, sowing is spent after ploughing and leveling (malovaniye) with a special seeder with placement of seeds into soil. At the second way, crops are sowed in furrows of row-spacing and slopes, then by means of a cultivator seeds are mixed up with soil, then a sprouting irrigation is given. These ways of sowing give the different conditions (background) for the further carrying out the irrigations (various compaction of soil, various conditions for flow along the furrows, etc.).

Use of water in 2008 has begun right after sowing since sprouting irrigation was spent for reception of shoots of plants. It took place depending on sowing date: in Ulugnor district on 16.09.2007; in Boz district on 25.09.2007г.; in Kurgantepa district on 16.11.2007; in Asaka district on 13.11.2007. As practice has shown, sowing and carrying out the first irrigation at various fields differed almost on 2 month.

On some plots, the second irrigation was spent before winter. After the winter period, irrigations of winter wheat were spent from the end of February till the first decade of March. For example - at Izboskan district irrigation was spent on 26.02.2008; at Balykchi district on 09.03.2008, at Boz district on 08.03.2008г.

Summary table on irrigating the wheat at Andizhan region polygons for 2008

Table2.3

№	Districts	Farm (polygon)	Area (h)	Sort	HMD	Recommended irrigation rate			Actual water supply		
						irrigation rate (m <sup>3</sup> /h)	Quantity of irrigations	Average irrigation rate (m <sup>3</sup> /h)	volume of water supply (m <sup>3</sup> /h)	Quantity of irrigations	Average irrigation rate (m <sup>3</sup> /h)
1	Andizhan	Orzu-Tashabbus	9	Chillaki	2	3000	4	750	5597	4	1399
2	Asaka	Asaka Irrigatori	8	Chillaki	4	3000	4	750	5597	6	933
3	Balikchi	Omadli Abdugaffar	3	Chillaki	3	3100	4	775	3724	5	745
4	Boz	Abduvohid	12,8	Chillaki	4	3000	4	750	4248	4	1062
5	Bulokbosh	Isakzhon Akiev	8	Nota	2	3000	4	750	4115	4	1029
6	Dzhalakuduk	Beshtol sardori	5	Crumb	1	3500	5	700	4420	4	1105
7	Ulugnor	Tillabayev dalasi	11,1	Plovchanka	4	3000	4	750	5670	5	1134
8	Marhamat	Ulugnor bahori	6	Chillaki	1	3500	5	700	6612	6	1102
9	Shahrihan	Berdiboj Chorvador	2	Crumb	4	3000	4	750	5037	5	1007
10	Hodzhaabad	Aliev Davronbek	13,3	Crumb	1	3500	5	700	6417	6	1070
11	Altinkul	Baht imkon rivozh	12	Chillaki	3	3100	4	775	4190	4	1048
12	Izbaskan	Abdurahmon ota	7	Crumb	4	3000	4	750	5999	5	1200
13	Pahtaabad	Yusuf ota	4,5	Crumb	2	3000	4	750	4835	5	967
14	Kurgantepa	Dilshoda	8	Crumb	3	3100	4	775	5075	4	1269

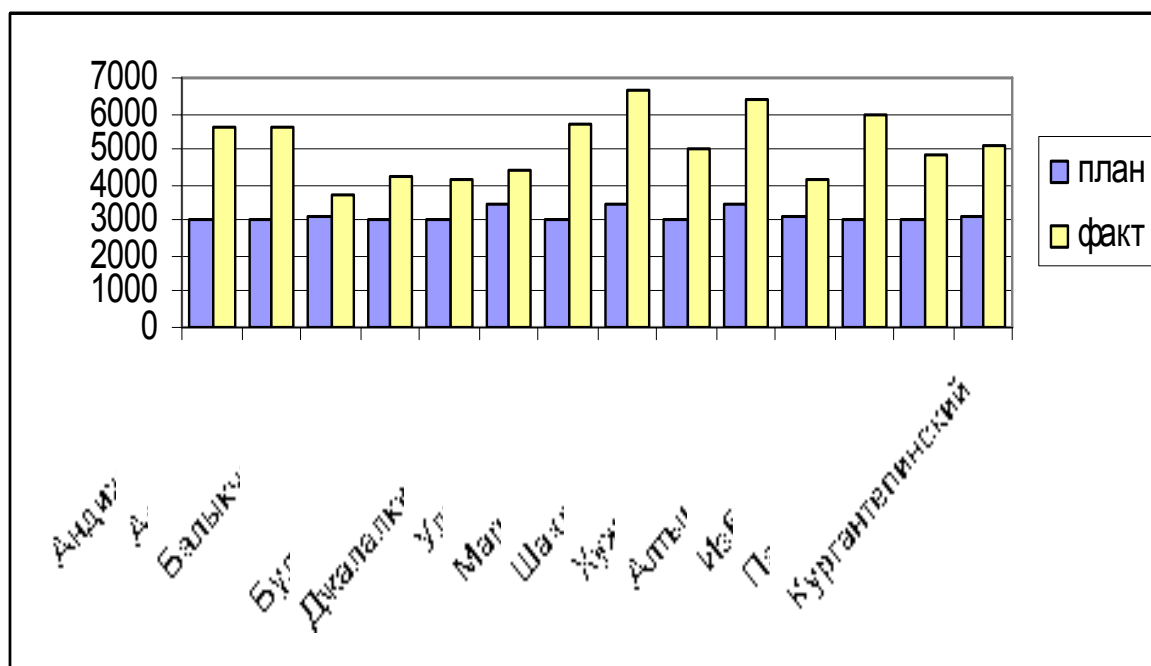


Рис 2.2 – Water use at irrigating the wheat (polygons of Andizhan region) for 2008.

According to the applied mode of irrigation, it is recommended for polygons of Andizhan region depending on HMD to irrigate winter wheat from 4 to 5 times with irrigating norm from 2900  $\text{m}^3/\text{hectare}$  to 3500  $\text{m}^3/\text{hectare}$ . The analysis results have shown, that the actual quantity of irrigations has made from 4 to 6 times, and the size of irrigation rate during the vegetation fluctuated from 3724  $\text{m}^3/\text{hectare}$  to 6417  $\text{m}^3/\text{hectare}$ . The recommended irrigation norm should be 700 – 800  $\text{m}^3/\text{hectare}$ , and the actual irrigation norm has made 1000 – 1100  $\text{m}^3/\text{hectare}$ . It shows that the recommended mode of irrigation is not maintained by separate farms, the irrigation norm is overestimated to 1,5-1,7 times, and irrigation rate in 1,3 – 1,4 times. It is necessary to specify that, in Uzbekistan the irrigation mode for various grades of wheat still is not studied, irrigation technology demands carrying out the special research work. As far as possible the project should try to solve these problems in the main phase in 2009-2010.

### 2.3 Water use productivity by polygons

Productivity of water is an indicator which characterizes "payment" for water by yield in physical or cost expression.

Materials on water use productivity at demonstration plots under cotton and winter wheat are presented in tables 2.4, 2.5. Average productivity of cotton has made 33.2 c/hectare, the greatest crop is registered at farm «Berdiboy chorvador» (37.4 c/hectare) and farm "Dilshoda" (36.0 c/hectare), the least one at farm «Beshtol Sardori» (25.6 c/hectare). The average irrigating norm has formed 5669  $\text{m}^3/\text{hectare}$ , and the greatest amount of submitted water is noted at farm «Abdurahmon ota» (6599  $\text{m}^3/\text{hectare}$ ), and the least irrigation norm at farm «Beshtol Sardori» - 4324  $\text{m}^3/\text{hectare}$ . Productivity of water use has made 0.58  $\text{kg}/\text{m}^3$  on the average, the greatest productivity was observed at farm «Berdiboy chorvador» (0.64  $\text{kg}/\text{m}^3$ ) and the least amount of production per  $\text{m}^3$  of water is noted at farm «Abdurahmon ota» (0.52  $\text{kg}/\text{m}^3$ ).

Table2.4

**Productivity of water use on districts, polygons and farms located near the polygons of Andizhan region (2008)**  
**Cotton**

№	Districts	District indicators			Polygons indicators			Farms indicators		
		Yield, c/h	Irrigation norm m3/hectare	Water productivity Kg / m <sup>3</sup>	Yield, c/h	Irrigation norm m3/hectare	Water productivity Kg / m <sup>3</sup>	Yield, c/h	Irrigation norm m3/hectare	Water productivity Kg / m <sup>3</sup>
1	Andizhan	28,3	7100	0,40	32,0	5247	0,61	26,0	5335	0,49
2	Asaka	28,7	6900	0,42	34,0	5486	0,62	30,2	5603	0,54
3	Balikchi	32,1	4200	0,76	33,2	5790	0,57	24,1	4578	0,53
4	Boz	28,6	5900	0,48	33,9	5807	0,58	26,2	5130	0,51
5	Bulokbosh	30,7	6900	0,44	29,9	5293	0,56	27,6	5172	0,53
6	Dzhalakuduk	26,6	6800	0,39	25,6	4324	0,59	23,4	4543	0,52
7	Izbaskan	32,8	5900	0,56	36,1	5920	0,61	31,8	5117	0,62
8	Ulugnor	18,4	6200	0,30	29,7	5493	0,54	20,6	5604	0,37
9	Kurgantepa	30,5	5900	0,52	37,4	5877	0,64	32,6	5872	0,55
10	Marhamat	29,9	6300	0,47	33,8	5625	0,60	23,7	5182	0,46
11	Altinkul	33,5	4900	0,68	35,9	5908	0,61	29,1	5993	0,49
12	Pahtaabad	31,1	6900	0,45	34,4	6599	0,52	30,4	6558	0,46
13	Hodzhaabad	28,7	6800	0,42	32,2	5800	0,56	23,4	5569	0,42
14	Shahrihan	30,2	5700	0,53	36,0	6200	0,58	31,3	5071	0,62
<b>Average</b>		<b>29,3</b>	<b>6171</b>	<b>0,49</b>	<b>33,2</b>	<b>5669</b>	<b>0,58</b>	<b>27,2</b>	<b>5380</b>	<b>0,51</b>

Table2.5

**Productivity of water use on districts, polygons and farms located near the polygons of Andizhan region (2008)**  
**Winter wheat**

№	Districts	District indicators			Polygons indicators			Farms indicators		
		Yield, c/h	Irrigation norm m3/hectare	Water productivity Kg / m <sup>3</sup>	Yield, c/h	Irrigation norm m3/hectare	Water productivity Kg / m <sup>3</sup>	Yield, c/h	Irrigation norm m3/hectare	Water productivity Kg / m <sup>3</sup>
1	Andizhan	59,3	5390	1,10	46,2	5597	0,83	43,5	5530	0,79
2	Asaka	59,2	6470	0,91	44,0	5592	0,79	42,2	6220	0,68
3	Balikchi	63,4	6380	0,99	59,0	3724	1,58	55,3	6346	0,87
4	Boz	58,9	6270	0,94	30,5	4248	0,72	37,4	6286	0,60
5	Bulokbosh	60,7	4980	1,22	59,0	4115	1,43	54,9	5683	0,97
6	Dzhalakuduk	61,9	5010	1,24	56,0	4420	1,27	50,3	5170	0,97
7	Izbaskan	62,5	4890	1,28	63,0	5999	1,05	57,6	6329	0,91
8	Ulugnor	45,2	7030	0,64	32,4	5670	0,57	23,9	5718	0,42
9	Kurgantepa	63,4	5020	1,26	50,0	5075	0,99	42,2	5030	0,84
10	Marhamat	63,1	5350	1,18	60,0	6612	0,91	50,5	6150	0,82
11	Altinkul	62,4	5950	1,05	62,0	4190	1,48	46,5	5782	0,80
12	Pahtaabad	63,1	5960	1,06	40,0	4835	0,83	37,2	5760	0,65
13	Hodzhaabad	57,2	5030	1,14	43,8	6417	0,68	40,1	6544	0,61
14	Shahrihan	57,2	5570	1,02	54,0	5037	1,07	47,4	5984	0,79
<b>Average</b>		<b>59,8</b>	<b>5664</b>	<b>1,06</b>	<b>50,0</b>	<b>5110</b>	<b>0,98</b>	<b>44,9</b>	<b>5895</b>	<b>0,76</b>

At farm «Berdiboy chorvador» where there was the highest water use productivity (0,64 kg/m<sup>3</sup>), actual irrigation norm (5877 m<sup>3</sup>/hectare) was close to the recommended (5600 m<sup>3</sup>/hectares) that resulted in high productivity of cotton (37,4 c/hectare) which has been reached at the cost of performing the technology requirements on crop cultivation (see the annex, item 18). WP at farm «Baht Imkon Rivozh» also has been proved by a high crop of cotton – 35,9 c/hectare, that at a little (only 300 m<sup>3</sup>/hectare against recommended on HMD) excessive irrigation norm of 5908 m<sup>3</sup>/hectare has allowed to receive productivity of 0,61 kg/m<sup>3</sup> (table item-2,19). At farm «Abdurahmon ota» water use productivity has formed only 0,52 kg/m<sup>3</sup>. It is due to the highest irrigation norm equal to 6599 m<sup>3</sup>/hectare (that on 1000 m<sup>3</sup>/hectare exceeded recommended for a zone – 5600 m<sup>3</sup>/hectare) and despite the reached productivity (34,4 c/hectare) WP has appeared the lowest. At «Ulugnor bahori» farm the water factor became the reason of low WP (0,54 kg/m<sup>3</sup>), however in this case water shortage during the vegetation (5493 m<sup>3</sup>/hectare against 6200 m<sup>3</sup>/hectare under HMD) has caused decrease in productivity of cotton to 29,7 c/hectare, on what rather low use of mineral fertilizers (570 kg/hectare against recommended 780 kg/hectare) and lack of manual labour (89 men-days/hectare for the vegetation) has affected also. At "I.Akiev" farm the reason of low efficiency of water use (0,56 kg/m<sup>3</sup>) was insufficient irrigation norm (5293 m<sup>3</sup>/hectare against 5900 m<sup>3</sup>/hectare recommended on HMD) and low amount of used mineral fertilizers (436 kg/hectare). Thus, data once again prove necessity to observe all technological recommendations at cultivating the crops, both concerning the water factor and an order (terms, norms, parameters of operations) of field works.

Productivity of wheat at polygons considerably varied by districts – from 32,3 c/hectare in farm «Ulugnor bahori» of Ulugnor district to 63,0 c/hectare at farm «Tillaboyev dalasi» of Izbaskan district, at average productivity on demonstration polygons equal to 50,0 c/hectare. The low irrigation norm is noted at «Omadli Abdugaffar» farm - 3724 m<sup>3</sup>/hectare, and the greatest norm at "Aliev Davronbek" farm - 6612 m<sup>3</sup>/hectare, at an average index on fields equal to 5110 m<sup>3</sup>/hectare. The high water productivity is registered at plots of Altynkul and Balykchi districts (1,48-1,58 kg/m<sup>3</sup>), the least crop per water unit is registered in Ulugnar district (0,57 kg/m<sup>3</sup>). The average index on polygons of Andizhan region on wheat has made 0,98 kg/m<sup>3</sup>. The lowest water use productivity is registered at «Ulugnor bahori» farm (0,57 kg/m<sup>3</sup>) where a principal cause was first of all obviously overestimated irrigation rate (5670 m<sup>3</sup>/hectare against 3000 m<sup>3</sup>/hectare recommended by HMD) which negatively affected efficiency of mineral fertilizers and resulted (on these light soils) in washout from an active zone of root system. It is necessary to note that almost all polygons of Andizhan region exceeded irrigation norms in 2008 at cultivation of wheat on 35-45 % and more. The average productivity has made high enough – 50 c/hectare, however in Boz district ("Abdulahid" farm) and in Ulugnar district («Ulugnor bahori» farm) productivity of winter wheat has made only 30,5 – 32,3 c/hectare that was connected not only to excessive water use, but also to violation of cultivation technology – full absence of measures against weeds, illnesses and wreckers, low norm of brought fertilizers.

#### **2.4 Efficiency of water use on farms located around the polygons**

Project involved in training on effective water and land resources use 235 farms of 14 districts in Andizhan region. Average productivity of cotton at farms involved has formed 27,2 c/hectare, the greatest productivity was reached at farms of Kurgantepa district - 32,6 c/hectare, low productivity was registered in Dzhalakuduk and Hodzhiabad districts – 24,4 c/hectare. At average irrigation norm equal to 5378 m<sup>3</sup>/hectare (an average on all farms), the greatest amount of the spent water for vegetation was noted in farms of Pahtaabad district - 6558 m<sup>3</sup>/hectare, the lowest irrigation norm at farms of Dzhalakuduk district – 4543 m<sup>3</sup>/hectare. It is necessary to say, that actual volumes of water submitted to pilot farms was defined by expert observations (irrigation dates, water discharge in a furrows, time of irrigation were fixed then the irrigation norm was roughly calculated) due to absence of water measuring devices

Parity between crop and water used for its creation, have caused the level of productivity of polygons. So the greatest efficiency of water use at cotton cultivation was registered in Izbaskan and Shahriha districts – 0,62 kg/m<sup>3</sup>, the least - in Ulugnar district – 0,37 kg/m<sup>3</sup>, average productivity on farms of Andizhan region has formed 0,51 kg/m<sup>3</sup>. The reason of low productivity of water and cotton in Ulugnar, Boz and Hodzhiabad districts (0,42 – 0,60 – 0,61 kg/m<sup>3</sup>) was that of low technological discipline – absence of measures of protecting the crops from weeds and wreckers, low doses of applied fertilizers, and also excessive water giving to farms.

On the farms cultivating grain crops, at average irrigation norm equal to 5895 m<sup>3</sup>/hectare and average productivity of 44,9 c/hectare, efficiency of water use at farms of Andizhan region has formed 0,76 kg/m<sup>3</sup> on average. The least indicator of WP is registered in farms of Ulugnar district (0,42 kg/m<sup>3</sup>), that is mainly caused by low yield of winter wheat (an average on farms 23,9 c/hectare) seeding of which was rare, strongly littered, badly fertilized and often affected by rust. At all the farms of Andizhan region overestimate in one and a half time of irrigation norm is observed, and in Hodzhiabad and Boz regions actually submitted norm exceeded recommended twice that has negatively affected indicators of water use efficiency (0,61 kg/m<sup>3</sup>). The best indicators of efficient water use (0,97 kg/m<sup>3</sup>) were registered at farms of Bulakbash and Dzhalakuduk districts because of of high productivity of grain crops (50,3-54,9 c/hectare) against the big water discharges (5170-5683 m<sup>3</sup>/hectare).

## **2.5 Agroeconomic indicators on district polygons**

Agroeconomic indicators of district polygons regional ranges (table 2.9) allow to assess the efficiency of agricultural production as a whole and to analyze distinctions among the polygons on separate elements in price expression.

First of all, it is necessary to note that cost of gross output which directly is connected with the received productivity, considerably differs on separate polygons. So, the greatest gain from the sold crop has been received at «Berdiboy Chorvador» farm - 1795855 sum/hectare, and the least - at «Beshtol Sardori» farm - 1079140 sum/hectare, at average cost of gross output (an average on all polygons) equal to 1487087 sum/hectare. The greatest expenses on production were at farm "Aliev Dovronbek" - 1084528 sum/hectare, the least expenses – at farm «Isakzhon Akiev» - 666696 sum/hectare, average expenses on production on all the pilot plots have formed 854072 sum/hectare.

Table 2.6

## Agro economic indices on district polygons of Andizhan region for 2008

## Cotton

№, № п./п.	District and farm	Yield (kg/hectare)	Cost of gross output (sum/hectare)	Cost of production (sum/hectare)	Common benefit (sum/hectare)	expenses (sum/hectare)	Net profit (sum/hectare)
1	Andizhan "Orzu Tashabbus"	3200	1459200	840975	618225	107233	510992
2	Asaka "Asaka Irrigator"	3400	1505000	808800	696200	110000	586200
3	Balykchi "Omad. Abdugaf"	3320	1510570	895220	615350	146000	469350
4	Boz "Abduvohid"	3390	1516032	806931	709101	152000	557101
5	Bulakbash "Isakzhon Akiev"	2990	1139455	666696	472759	75700	397059
6	Zhalalkuduk "Beshtol Sardori"	2560	1079140	686070	393070	68140	324930
7	Izbaskan "Tillabaev Dalasi"	3610	1743455	917430	826025	147910	678115
8	Ulugnar "Ulugnor Bahori"	2970	1175667	722010	453657	101000	352657
9	Kurgantepa "Berdiboy Chorvador"	3740	1795855	922406	873449	120000	753449
10	Marhamat "Aliev Davronbek"	3380	1582332	1084528	497804	48960	448844
11	Altynkul "Baht Imkon Rivozh"	3590	1638010	913989	724021	123588	600433
12	Pahtaabad "Abdurahmon ota"	3440	1479200	816500	662700	174000	488700
13	Hodzhaabad "Yusuf ota"	3220	1447300	889050	558250	171000	387250
14	Shahrihan "Dilshoda"	3600	1748000	986400	761600	138000	623600
	<i>Average</i>	<i>3315</i>	<i>1487087</i>	<i>854072</i>	<i>633015</i>	<i>120252</i>	<i>512763</i>



The reasons of such distinctions are separate components of common technological expenses. For example, at «Aliev D» farm in 2008 940 kg/hectare of fertilizers have been brought against 436 kg/hectare in "I.Akiev" farm, 200 kg/hectare of pesticides against 40 kg/hectare, 37 kg/hectare of seeds against 102 kg/hectare. In spite of the fact that as a whole on polygons of Andizhan region high enough results on productivity were received, monitoring allowed to reveal variety of technological infringements. At «Ulugnor bahori» farm it has been spent only 5 cultivations of cotton during whole the vegetation, at farm "I.Akiev" - 6 cultivations (according to the technological card it is necessary to spend 8 cultivations). At farm "I. Akiev" phosphoric fertilizers were completely not applied, only at 4 polygons (Asaka, Marhamat, Boz, Bulakbash districts) potash fertilizers were used (however it is necessary to recognize their norms as insufficient – 50 % - 70 % from recommended for a zone). Not everywhere measures on struggle against weed vegetation were effective enough («Beshtol Sardor» farm, «Ulugnor bahori» farm, «Yusuf ota» farm), losses in crop from wreckers and illnesses are registered on separate ranges («Beshtol Sardor», "I.Akaev", «Ulugnor bahori» farms). In some cases, it is necessary to note the quality of irrigation; at polygons of Boz and Asaka because of bad fields leveling small floodings of the separate sites located at the end of the field were observed. The facts say about necessity of permanent job of executors of the project with farmers; it is necessary to explain consequences of the errors admitted by them and try to correct them.

Various costs of the grown crop and expenses on have caused various level of the received incomes. The greatest net profit on cotton is received at Kurgantepa district («Berdiboy Chorvador» farm) – 753449 sum/hectare, the least profit - at Zhalakuduk district («Beshtol Sardori» farm) – 324930 sum/hectare, an average net profit on polygons of Andizhan region formed 512763 sum/hectare.

The general analysis of the indicators give the chance to draw a conclusion on the tendency of cotton productivity increase in comparison with average indexes on districts (33,2 c/hectare against 29,3 c/hectare) and also on water productivity improvement (0,58 kg/m<sup>3</sup> against 0,49 kg/m<sup>3</sup>) that despite increase in expenses on means of production finally leads to growth of incomes in the majority of district polygon farms. Undoubtedly, this is an achievement of the project since the chosen fields are pilot objects directly influenced by executors of the project (farmers of plots were trained at seminars, constantly received recommendations from trainers, adjusted technological operations in due time). Indicators of water productivity on farms located around the polygons, as a rule, concede results reached at polygons themselves, but they considerably exceed average district indicators on cotton fields (except for Balykchi and Altynkul districts). Unfortunately, the same tendency is not seen on grain cultures, moreover, productivity received at polygons and surrounding farms concedes statistical data on districts (average on 9,8 c/hectare at polygons and 14,9 c/hectare at farms). District indicators of water productivity also a little above (the average on 0,08 kg/m<sup>3</sup> on polygons and 0,3 kg/m<sup>3</sup> on farms). In this case it is necessary to check up once again official materials on districts, both on grain crops productivity (first of all) and amount of the used water, because such materials are treated to updating by the regional organizations.

### **3. Water use productivity in Fergana region**

#### **3.1 Irrigation mode for cotton at demonstration plots**

Plots differ from each other on soil conditions. According to the table 3.1 plots are divided according to hydro module districts (HMD) from I- HMD to VI – HMD. According to HMD the irrigation mode of cotton is varied in a wide range so the irrigation norm changes from 5300 m<sup>3</sup>/hectare to 7200 m<sup>3</sup>/hectare, by irrigation rate from 800 m<sup>3</sup>/hectare to 1120 m<sup>3</sup>/hectare, and recommended quantity of irrigations from 5 to 9 for a vegetation. Actual indicators of water giving have formed from 4857

$\text{m}^3/\text{hectare}$  to  $6183 \text{ m}^3/\text{hectare}$ , the average irrigation rate fluctuated from  $875 \text{ m}^3/\text{hectare}$  to  $1237 \text{ m}^3/\text{hectare}$ , and quantity of irrigations from 5 to 6 for a vegetation (including the sprouting one).

In 2008, the project covered 8 district plots of the Fergana region. The total area under cotton has formed 31,3 hectares, a way of sowing of all the fields was usual (without application of film coverings).

2008 has appeared shallow enough, that influenced carrying out the irrigation works on demonstration plots of Fergana region. Sprouting irrigation according to plots was spent in the beginning of May: at Altirik district («Ismoil artikov» farm) on 15.05.2008 with irrigation rate of  $1010 \text{ m}^3/\text{hectare}$ ; at Baghdad district («Lazizbek Ergashev» farm) on 23.05.2008 with irrigation rate of  $1235 \text{ m}^3/\text{hectare}$ . The data show that farmers for the various reasons exceeded the rate of sprouting irrigation in 1,3 – 1,4 times.

Over-discharge was also observed during vegetation of cotton. For example:

At plot of Baghdad district instead of the recommended 6 irrigations with average irrigation norm of  $883 \text{ m}^3/\text{hectare}$ , actually were 5 irrigations with average irrigation norm of  $1142 \text{ m}^3/\text{hectare}$ ;

At plot of Tashlak district instead of the recommended 8 irrigations with average irrigation norm of  $812 \text{ m}^3/\text{hectare}$ , actually were 5 irrigations with average irrigation norm of  $1237 \text{ m}^3/\text{hectare}$ ;

At plot of Kuva district instead of the recommended 6 irrigations with average irrigation norm of  $883 \text{ m}^3/\text{hectare}$ , actually were 5 irrigations with average irrigation norm of  $1073 \text{ m}^3/\text{hectare}$ ;

On the average on 8 ranges of the Fergana region it was spent on 2 poliva less, than it is recommended for the zone by irrigation mode, thus the average irrigation norm instead of  $884 \text{ m}^3/\text{hectare}$  has made  $1042 \text{ m}^3/\text{hectare}$ . The recommended irrigation norm for this HMD was equal to  $6100 \text{ m}^3/\text{hectare}$ , the actual average irrigation norm formed  $5509 \text{ m}^3/\text{hectare}$ .

The mentioned facts once again show, that despite the deficiency of water in shallow years, farmers overestimate irrigation norm on 25-30 %, which occurs against reduction of the recommended number of irrigations. Such practice leads to excessive losses of water on dump and deep filtration, especially on fields with easy mechanical structure and deep subsoil water level ( $\geq 3\text{m}$ ).

Table3.1

## Data on plots of Fergana region for 2008

№	Districts	WUA	Farms (polygons)	Total area (hectares)	Including polygons		HMD	Equipped with hydroposts	Water source
					Cotton (hectares)	Wheat (hectares)			
1	Besharik	"Rapkon Madaminov"	A. Mazhidov fayzi	6	–	6	VII	Cipolletti weir	Isfara
2	Altirik	"povilgon obi hayot"	Ismoil artikov	4	4	–	II	Cipolletti weir	SFC
3	Baghdad	"Kushtegirmon"	Lazizbek Ergashev	4	4	–	I	Cipolletti weir	Chink
4	Furkat	"Aminzhon Dehkonov"	Dilnurabonu	4	4	–	IV	Cipolletti weir	BFC
5	Yazyavan	"Ok oltin"	Dustlik	7	–	7	VII	SANIIRI flume	BFC
6	Dangara	"Dangara zargari"	Nasvali ota	2,6	2,6	–	VI	SANIIRI flume	Soh
7	Tashlak	"Komilzhon mirob"	Ergash ota	1,6	1,6	–	II	Cipolletti weir	SFC
8	Uchkuprik	"Kenagas sara mirobi"	Kakir zamin kurki	3,8	3,8	–	IV	SANIIRI flume	Soh
9	Ahunbabaev	"Ok tepa kirgizobod"	Ganizhon	6	–	6	VI	Cipolletti weir	SFC
10	Fergana	"Yukori vodil yahshi niyat"	Abdulhamid ota	9,5	9,5	–	I	SANIIRI flume	Isfayram
11	Kuva	"Tolmozor chashmasi"	Hakimzhon Kurbonov	2,8	2,8	–	III	SANIIRI flume	SFC
	<b>TOTAL</b>			<b>51,3</b>	<b>32,3</b>	<b>19</b>			

Table3.2

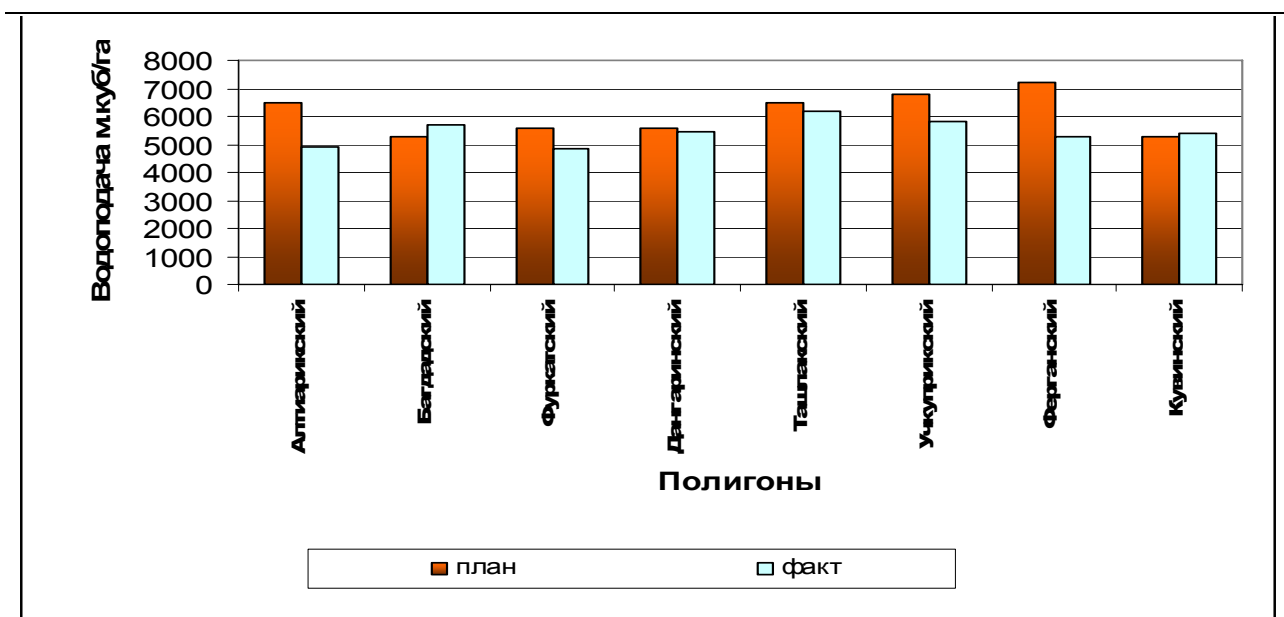
**The summary table on irrigation of cotton on plots of Fergana region**

№	Districts	Polygons	Plot area (Hectares)	Water source	HM D	Recommended irrigation norm			Actual water supply		
						Irrigation rate (m <sup>3</sup> /hectare)	Quantity of irrigations	Average irrigation rate (m <sup>3</sup> /hectare)	Water supply (m <sup>3</sup> /hectare)	Quantity of irrigations	Average irrigation rate (m <sup>3</sup> /hectare)
1	Altirik	Ismoil artikov	4	SFC	II	6500	8	812	5310	5	1062
2	Baghdad	Lazizbek Ergashev	3	Chink	III	5300	6	883	5710	5	1142
3	Furkat	Dilnurabonu	4	BFC	VI	5600	5	1120	4857	5	971
4	Dangara	Nasvali ota	2,6	Soh	VI	5600	5	1120	5470	6	910
5	Tashlak	Ergash ota	1,6	SFC	II	6500	8	812	6183	5	1237
6	Uchkuprik	Kakir zamin kurki	3,8	Soh	IV	6800	8	850	5802	6	967
7	Fergana	Abdulhamid ota	9,5	Isfayram	I	7200	9	800	5250	6	875
8	Kuva	Hakimzhon Kurbonov	2,8	SFC	III	5300	6	883	5490	5	1073

Table3.3

**The summary table on irrigating the winter wheat on plots of Fergana region**

№	Districts	Polygons	Plot area (Hectares)	Water source	HM D	Recommended irrigation norm			Actual water supply		
						Irrigation rate (m <sup>3</sup> /hectare)	Quantity of irrigations	Average irrigation rate (m <sup>3</sup> /hectare)	Water supply (m <sup>3</sup> /hectare)	Quantity of irrigations	Average irrigation rate (m <sup>3</sup> /hectare)
1	Besharik	A. Mazhidov fayzi	6	Isfara	VI	2700	4	675	4192	5	838
2	Yazyavan	Dustlik	7	BFC	VII	2900	4	725	5297	5	1059
3	Ahunbabaev	Ganizhon	6	SFC	VI	2700	4	675	6371	6	1062



Drawing 3.1 Water use on polygons of Fergana region (cotton), 2008

### 3.2 Irrigation mode for winter wheat at demonstration plots

Winter wheat was grown in 2008 at three districts polygons of Fergana region: Besharik, Yazyavan and Ahunbabaev. The area of three polygons is 19 hectares. On soil and hydro-geological conditions these polygons are included in VI and VII – HMD, sources of irrigation of this fields are different canals. Data on water supply are resulted in table 3.4.

The analysis of materials on water use for winter wheat has shown, that recommended irrigation norm was 2700 – 2900  $\text{m}^3/\text{hectare}$ , quantity of recommended irrigations - 4 times. Actual irrigation norm has formed from 4997  $\text{m}^3/\text{hectare}$  to 6606  $\text{m}^3/\text{hectare}$ , and quantity of irrigations 5-6 times. Thus, we have overexpenditure of rate in 2 times, irrigation norm in 1,5 times and 5-6 irrigations instead of recommended 4.

### 3.3 Water use productivity on polygons

Productivity of water is an indicator which characterizes "payment" for water by yield in physical or cost expression. It is visible from the table 3.5 that the greatest crop of cotton in 2008 was collected on polygons of Kuva ("H.Kurbanov" farm) and Dangara («Nasivali ota» farm) districts – 34.2 c/hectare, low productivity was registered at Fergana district («Abdulhamid ota» farm) – 27.4 c/hectare, average productivity on polygons of Fergana region formed 31.6 c/hectare. The greatest quantity of water spent for the vegetation period was registered in Tashlak district (farm «Ergash ota») – 6183  $\text{m}^3/\text{hectare}$ , the least water discharge was in Furkat district ("Dilnurabonu" farm) – 4857  $\text{m}^3/\text{hectare}$ . The average index of water productivity on Fergana region plots at cotton cultivation has formed 0,57  $\text{kg}/\text{m}^3$ , the greatest efficiency is registered in «Nasivali ota» farm - 0,63  $\text{kg}/\text{m}^3$ , and the least in «Abdulhamid ota» farm and "L.Ergashev" farm - 0,52  $\text{kg}/\text{m}^3$ .

Table 3.4

**Productivity and efficiency of water use on polygons of Fergana region**

**Cotton**

№	Districts	Polygons	Water source	HMD	Actual water supply (m <sup>3</sup> /hectare)	Crop, (kg/hectare)	Water productivity, (kg/m <sup>3</sup> )	Water supply per production unit, (m <sup>3</sup> /kg)
1	Altirik	Ismoil artikov	SFC	II	5310	3075	0,58	1,73
2	Baghdad	Lazizbek Ergashev	Chink	I	5710	2960	0,52	1,93
3	Furkat	Dilnurabonu	BFC	IV	4857	3010	0,62	1,61
4	Dangara	Nasvali ota	Soh	IX	5470	3420	0,63	1,60
5	Tashlak	Ergash ota	SFC	II	6183	3250	0,53	1,90
6	Uchkuprik	Kakir zamin kurki	Soh	IV	5802	3390	0,58	1,71
7	Fergana	Abdulhamid ota	Isfayram	II	5250	2740	0,52	1,92
8	Kuva	Hakimzhon Kurbonov	SFC	IV	5490	3420	0,62	1,61

**Wheat**

№	Districts	Polygons	Water source	HMD	Actual water supply (m <sup>3</sup> /hectare)	Crop, (kg/hectare)	Water productivity, (kg/m <sup>3</sup> )	Water supply per production unit, (m <sup>3</sup> /kg)
1	Besharik	A. Mazhidov fayzi	Isfara	VII	4192	3500	0,84	1,20
2	Yazyavan	Dustlik	BFC	VII	5297	4500	0,85	1,18
3	Ahunbabaev	Ganizhon	SFC	V	6371	3630	0,57	1,76

The reason of low water use productivity at farm "L. Ergashev" was rather low yield of cotton (29,6 c/hectare), which is caused by limited involvement of manual labor (17 men-days/hectare) during the vegetation. At farm «Abdulhamid ota» productivity was still below (27,4 c/hectare) that caused by insufficient amount of applied fertilizers (495 kg/hectare against the recommended 800 kg/hectare) and almost absence of manual labor during the vegetation (only 7 men-days/hectare). It is necessary to say, that indicators of water use productivity considerably exceeded similar district indicators (table 3.5) which is explained mainly by higher cotton yield (more on 10 c/hectare), and in some cases applying the recommended irrigation norms (in Fergana district irrigation norm for cotton was 9100  $\text{m}^3/\text{hectare}$  against 5250  $\text{m}^3/\text{hectare}$  at district plot, in Tashlak district the actual irrigation norm was 8500  $\text{m}^3/\text{hectare}$  against 6183  $\text{m}^3/\text{hectare}$  at district plot). Productivity of wheat on polygons fluctuated from 35,0 - 36,3 c/hectare to 45,0 c/hectare at actual water supply equal to 4192 – 6371  $\text{m}^3/\text{hectare}$ . Water productivity on winter wheat has developed quite low on all the plots – from 0,84 – 0,85  $\text{kg}/\text{m}^3$  (farms "M.Mazhidov", "Dustlik") to 0,57  $\text{kg}/\text{m}^3$  (farm "Ganizhon"), that is caused both by incorrect mode of irrigation and rather low productivity. For example, in Besharyk district (farm «A. Mazhidov Fayzi») there were almost no means of crop protection, at polygons of Ahunbabaev and Yazyavan districts irrigation norm was obviously overestimated for winter wheat (6371  $\text{m}^3/\text{hectare}$  and 5297  $\text{m}^3/\text{hectare}$  accordingly), that against low mechanized (7.5 – 9.9 mash-hours/hectare) and manual labor (6.1 – 7.1 men-days/hectare) caused productivity decrease to 45.0 – 35.0 c/hectare.

### 3.4 Water use productivity on farms located around the polygons

The project involved 166 farms around demonstration plots of 11 districts of Fergana region, which were involved into the process of training on effective water and ground resources use. Average productivity of cotton in farms covered by the project, in 2008 has formed 26,0 c/hectare, the greatest productivity was registered at farms of Dangara (30,3 c/hectare) and Ahunbabaev districts (29,6 c/hectare), low productivity was noted in Fergana district (20,3 c/hectare) and Besharyk district (21,2 c/hectare). At average irrigation norm of 6037  $\text{m}^3/\text{hectare}$  (an average on all the pilot farms) the greatest water for vegetation is noted at farms of Ahunbabaev (7215  $\text{m}^3/\text{hectare}$ ) and Dangara (7105  $\text{m}^3/\text{hectare}$ ) districts, the lowest irrigation norm was registered at farms of Besharyk districts – 5033  $\text{m}^3/\text{hectare}$  (table 3.6). It is necessary to say, that actual volumes of water submitted to pilot farms was defined by expert observations (irrigation dates, water discharge in a furrows, time of irrigation were fixed then the irrigation norm was roughly calculated) due to absence of water measuring devices.

Parity between crop and water used for its creation, have caused the level of productivity of polygons (table 3.6). The greatest efficiency of water use at cotton cultivation is noted in Yazyavan and Baghdad districts – 0,48  $\text{kg}/\text{m}^3$ , the least one - in Fergana district – 0,36  $\text{kg}/\text{m}^3$ , at average efficiency on all the pilot farms (polygons) of the Fergana region equal to 0,43  $\text{kg}/\text{m}^3$ . The reason of low efficiency of water in Fergana, Kuva, Furkat and Besharyk districts was low productivity of cotton (20,3 – 23,6 c/hectare) caused by violation of cultivation technology (low norms of the application of fertilizers, the limited volumes of the mechanized and manual works, insufficient measures of struggle against weeds, wreckers and illnesses

Table3.5

## Water productivity on districts, polygons and farms located around the polygons of Fergana region (2008)

№	Districts	District indicators			Polygon indicators			Farm indicators		
		Yield, c/hectare	Irrigation rate (m <sup>3</sup> /hectare)	Water productivity Kg / m <sup>3</sup>	Yield, c/hectare	Irrigation rate (m <sup>3</sup> /hectare)	Water productivity Kg / m <sup>3</sup>	Yield, c/hectare	Irrigation rate (m <sup>3</sup> /hectare)	Water productivity Kg / m <sup>3</sup>
<b>Cotton</b>										
1	Altariq	20,3	4854	0,42	30,7	5310	0,58	27,9	6502	0,43
2	Baghdad	18,2	4076	0,44	29,6	5710	0,52	27,3	5702	0,48
3	Dangara	20,7	4733	0,43	34,2	5470	0,63	30,3	7105	0,43
4	Kuva	20,1	6550	0,31	34,2	5490	0,62	23,6	5728	0,41
5	Uchkuprik	27,6	6121	0,45	33,9	5802	0,58	26,8	5850	0,46
6	Fergana	19,7	9100	0,22	27,4	5250	0,52	20,3	5969	0,36
7	Furkat	22,5	4850	0,46	30,1	4857	0,62	23,6	5728	0,41
8	Tashlak	26,7	8500	0,34	32,5	6183	0,53	28,8	6176	0,47
<b>Winter wheat</b>										
9	Besharik	54,3	8136	0,66	35,0	4193	0,84	42,5	5833	0,73
10	Yazyavan	41,1	10242	0,40	45,0	5297	0,85	48,4	7512	0,64
11	Ahunbabaev	44,6	9596	0,46	36,3	6371	0,57	47,8	6944	0,69



Irrigation norms have been exceeded ( $7105 - 7215 \text{ m}^3/\text{hectare}$ ) only in Dangara and Ahunbabaev districts. It is necessary to notice, that efficiency of water use was lower of those of polygons (table 3.5), but exceeded official statistics on districts that testifies to positive influence of the project on farms surrounding the polygons farmers of which have been involved in activity of the project and were trained at seminars.

On grain crops average productivity has formed  $43,7 \text{ c/hectare}$  (the maximum productivity  $55,6 \text{ c/hectare}$  was received in Uchkuprik district, the minimum productivity  $23,0 \text{ c/hectare}$  was in Fergana district). The average irrigation norm on all the farms has formed  $6751 \text{ m}^3/\text{hectare}$  (the maximum water supply was noted in Yazyavan district –  $7512 \text{ m}^3/\text{hectare}$ , the minimum - in Fergana district –  $5097 \text{ m}^3/\text{hectare}$ ). The greatest efficiency of use of water has formed in Uchkuprik and Dangara districts –  $0,74 \text{ kg/m}^3$ , the lowest efficiency of water –  $0,45 \text{ kg/m}^3$  was registered at farms located in Fergana district. As a whole on all the farms covered in Fergana region, average water productivity at cultivating the wheat has formed  $0,65 \text{ kg/m}^3$  that is a comprehensible result for the current period because exceeds statistical district indicators of efficiency of water use and is reached at the expense of positive influence of the project.

### **3.5 Agroeconomic indicators on district polygons**

Agro economic indicators of district polygons (table 3.7 – 3.8) allow assessing efficiency of production and analyzing distinctions among polygons on separate elements in price expression. First of all, it is necessary to notice, that cost of gross outputs which are directly connected to the received productivity, considerably differ on separate polygons. The greatest gain from the sold crop has been received at farm "H.Kurbonov" -  $1757200 \text{ sum/hectare}$ , (productivity of  $38,2 \text{ c/hectare}$ ), and the least gain - at «Abdulhamid ota» farm-  $1233000 \text{ sum/hectare}$  (productivity of  $27.4 \text{ c/hectare}$ ).

The greatest production expenses are noted at «Ergash ota» farm -  $1069388 \text{ sum/hectare}$ , and the least cost price of received production at farm «Abdulhamid ota» -  $614526 \text{ sum/hectare}$ . Such distinctions on variable expenses have been developed because of actual cost of technological works and physical expenses on production. So for example, amount of the mechanized work at polygons varied from  $16,0 \text{ mashine-hours/hectare}$  (farm «Abdulhamid ota») to  $24,0 \text{ mashine-hours/hectare}$  (farm "H.Kurbanov"), amount of manual labor has formed at farm "Dilnurabonu" only  $14 \text{ men-days/hectare}$  against  $71 \text{ men-days/hectare}$  at farm «Ergash ota», and amount of brought fertilizers fluctuated from  $495 \text{ kg/hectare}$  at farm «Abdulhamid ota» to  $873 \text{ kg/hectare}$  at farm «Nasivali ota». It is necessary to note superfluous physical expenses made on purchase of a seed material at farm «Lazizbek Ergashev» -  $90 \text{ kg/hectare}$  and at farm «Ergash ota» -  $93 \text{ kg/hectare}$  while at farm "I.Artikov" expenses on this position have made twice smaller amount ( $45 \text{ kg/hectare}$ ). Polygons of Dangara, Altiaryk, Fergana, Tashlak and Furkat districts did not apply potash fertilizers completely; farms "Dilnurabonu and «Abdulhamid ota» have brought less than  $500 \text{ kg/hectare}$  of mineral fertilizers in physical weight. First of all, these physical and financial expenses have effected size of the developed variable expenses on polygons.

Table3.6

**Water use productivity at farms located around the polygons of Fergana region (2008)**

№	Districts	Cotton				Wheat			
		area, hectares	Crop, c/hectare	Irrigation rate (m <sup>3</sup> /hectare)	Water productivity Kg / m <sup>3</sup>	area, hectares	Crop, c/hectare	Irrigation rate (m <sup>3</sup> /hectare)	Water productivity Kg / m <sup>3</sup>
1	Kuva	15,4	23,6	5728	0,41	14,5	45,0	7487	0,60
2	Tashlak	17,9	28,8	6176	0,47	15,9	40,6	7380	0,55
3	Fergana	16,3	20,3	5696	0,36	15,3	23,0	5097	0,45
4	Yazyavan	7,5	27,0	5672	0,48	7,6	48,4	7512	0,64
5	Baghdad	9,0	27,3	5702	0,48	8,4	45,2	6864	0,66
6	Uchkuprik	11,9	26,8	5852	0,46	8,4	55,6	7498	0,74
7	Furkat	10,0	23,6	5728	0,41	8,1	43,4	6327	0,69
8	Besharik	18,8	21,2	5033	0,42	14,3	42,5	5833	0,73
9	Dangara	6,4	30,3	7105	0,43	7,5	47,8	6461	0,74
10	Ahunbabaev	13,1	29,6	7215	0,41	12,0	47,8	6944	0,69
11	Altirik	24,6	27,9	6502	0,43	21,5	41,5	6861	0,61
	<i>Average</i>	<i>13,7</i>	<i>26,0</i>	<i>6037</i>	<i>0,43</i>	<i>12,1</i>	<i>43,7</i>	<i>6751</i>	<i>0,65</i>

Fixed charges on paying the taxes and expenses out of an irrigated field considerably fluctuated on plots – from 22632 sum/hectare at farm «Abdulhamid ota» to 55357 sum/hectare at farm "H.Kurbanov", that caused by various yield class of land and corresponding taxes and also by storage costs for means of production and crop.

As a result, the developed production expenses and crop actual productivity presented in price expression formed the actual net profit on polygon. The greatest net profit from cotton was gained at farm «Kakir zamin kurki» - 741537 sum/hectare, and the least - at farm "L.Ergashev" - 338133 sum/hectare.

At cultivation of winter wheat the greatest net profit was received at "A.Mazhidov" polygon - 542997 sum/hectare (at the cost price of production of 631336 sum/hectare), and the least net profit was registered at polygon "Ganizhon" - 288411 sum/hectare (at the developed cost price of production 499786 sum/hectare). The low profit of farm "Ganizhon" is connected with the limited quantity of the brought fertilizers, low application of manual labor and also with excessive amount of water submitted for vegetation ( $6371 \text{ m}^3/\text{hectare}$ ) that promoted washing away of nutrients from a root zone and to development of diseases in crops (rust).

Table3.7

**Gross profit on polygons of Fergana region, 2008 (cotton)**

Indices	Unit	Farms								
		Bagdad - farm <i>"L.Ergashev"</i>	Dangara - farm <i>"Nasivali ota"</i>	Kuva – farm <i>"Hakimzhon Kurbonov"</i>	Oltiarik – Farm <i>"I.Ortikov"</i>	Tashlak- farm <i>"Ergash ota"</i>	Uchkuprik- farm <i>"Kakir zamin kurki"</i>	Fergana- farm <i>"Abdulhamid ota"</i>	Furkat - farm <i>"Dilnu- rabonu"</i>	
Seeds	Kg/hectare	90	69	60	45	93,75	58	50	60	
	Sum/hectare	89000	69231	60000	50000	93750	57895	52000	60000	
Fertilizers	Kg/hectare	800	873	725	800	628	820	495	680	
	Sum/hectare	240800	282096	285000	230000	187000	271000	121621	206401	
Protection means	chemical weed- killers	Litre/hectare	601	308	304	125	-	237	280	1333
		Sum/hectare	43000	46154	47857	23750	-	31579	32105	109354
	biological	Pieces, g/hectare	-	2	2	2	3	3	-	-
		Sum/hectare	-	5769	6857	6000	72813	6579	-	-
Mechanisms	Mash-hours/hectare	22	23	24	18,5	21	18	16	17,5	
	Sum/hectare	211600	228846	248571	185950	210000	166053	139474	157540	
Transport	Sum/hectare	48333	65385	49286	43000	53750	55526	39705	51333	
Labor	men-days/hectare	17	25	36	33,5	71,25	21	7,26	14	
	Sum/hectare	373200	383308	406357	357850	541125	354895	289621	410755	
Water	Thousand m3/hectare	5710	5476	5366	4905	6183	5802	5250	4857	
	Sum/hectare	-	-	-	-	-	-	-	-	
Variable charges	Sum/hectare	999000	980788	995248	881950	1069388	829384	614526	952583	
Crop	Tons/hectare	2,96	3,42	3,82	3,18	3,25	3,39	2,74	3,30	
Gross production	Sum/hectare	1337920	1556100	1757200	1436010	1485250	1552600	1233000	1511600	
Profit	Sum/hectare	413133	634404	939211	616025	493862	770484	686316	618217	
fixed charges	Sum/hectare	25000	40385	55357	31750	51875	28947	22632	49333	
Net profit	Sum/hectare	388133	594019	883854	584275	441987	741537	663684	568884	

Table3.8

## Gross profit on polygons of Fergana region, 2008

## Whinter wheat

Indices		Unit	Farms		
			Ahunbabaev – farm "Ganizhon"	Besharyk- farm "A.Mazhidov fayzi"	Yazyavan – farm "Dustlik"
Seeds		Kg/hectare	240	240	250
		Sum/hectare	105754	110400	106250
Fertilizers		Kg/hectare	638	880	950
		Sum/hectare	146935	260569	189181
Protection means	chemical weed- killers	Kg/hectare	33,35	0,02	42,87
		Sum/hectare	22637	18869	23584
	biological	Pieces, g/hectare	-	-	-
		Sum/hectare	-	-	-
Mechanisms		Mash-hours/hectare	9,3	7,5	9,9
		Sum/hectare	136750	127500	147143
Transport		Sum/hectare	51710	40666	24625
Labor		men-days/hectare	7,16	7,1	6,14
		Sum/hectare	36000	36666	22571
Water		Thousand m3/hectare	6371	4197	5297
		Sum/hectare	-	-	-
Variable charges		Sum/hectare	499786	631336	513354
Crop		Tons/hectare	3,63	3,5	4,5
Gross production		Sum/hectare	809030	1191833	923071
Profit		Sum/hectare	309244	560497	409717
fixed charges		Sum/hectare	20833	17500	14000
Net profit		Sum/hectare	288411	542997	395717

## 4. Water productivity in Osh region

### 4.1 Assessment of water use at demonstration plots of RAS

Demonstration fields of RAS are located in six districts of Osh region (Alay, Aravan, Naukat, Karasu, Kora-kulzha, Uzgen). Quantity of demonstration plots is 31, the total area - 27 hectares. The following crops have been grown on this fields: corn for grain - 3,6 hectares, wheat – 23,4 hectares, cotton - 1,2 hectares (tables 4.1 – 4.4). Consultants covered 644 farms around the demonstration fields. Trainers of Oblvodhoz (3 people) together with trainers of Rural Advisory Service organized work on monitoring of water use.

The size of demonstration fields in Aravan district (table 4.1) formed 200 to 600 m in length, from 10 m to 60 m in width; in Naukat district the length fluctuated from 50 to 1000 m, width from 6 m to 100 m. Such configuration of fields is very inconvenient for the organization of irrigation. Usually farms use the big length of irrigation furrows. Trainers recommend to apply optimum length of furrows  $\approx$  60-80 m and corresponding quantity of irrigation sites. Many farmers do not know or do not consider a correct length of furrow that influences quality and time of irrigation. It is possible to raise a crop, reduce water volume and time of irrigation by creating the optimal length of an irrigation site. Usually many farmers irrigate with length of furrows of 100-250 m and more. At training on the demonstration field farmers have been shown the advantage of optimal size of furrows of 70-80 m. in comparison with usual furrows of 150-250m in length.

The expert assessment of water use has been executed with no respect to water discharge, therefore has approximate view (table 4.3). According to the data from demonstration fields of Naukat district the quantity of irrigations was 3-4 times for wheat, and the irrigation norm changed from 4123  $\text{m}^3/\text{hectare}$  to 4450  $\text{m}^3/\text{hectare}$ . On demonstration fields of Aravan district the quantity of irrigations of wheat was 4-5 times, the irrigation norm fluctuated from 4419  $\text{m}^3/\text{hectare}$  to 6619  $\text{m}^3/\text{hectare}$ . On demonstration fields of Uzgen district the quantity of irrigations was 3-4 times for wheat, the irrigation norm fluctuated from 3590  $\text{m}^3/\text{hectare}$  to 5511  $\text{m}^3/\text{hectare}$ . On demonstration fields of Karasu district the quantity of irrigations was 4-5 times for wheat, irrigation norm fluctuated from 3488  $\text{m}^3/\text{hectare}$  to 6247  $\text{m}^3/\text{hectare}$ . The irrigation norm recommended according to hydro module districts is 3600  $\text{m}^3/\text{hectare}$  for wheat, in many farms the irrigation norm was essentially exceeded. Productivity of wheat in Aravan district was from 40 c/hectare to 56 c/hectare, in Naukat district - from 32 c/hectare to 45 c/hectare.

In Aravan district one field under cotton was demonstrative where the cotton was irrigated 5 times - the first irrigation (water retention) had been done on April, 3rd, last - on August, 3rd. The irrigation rate was from 1275  $\text{m}^3/\text{hectare}$  to 1650  $\text{m}^3/\text{hectare}$ , irrigation norm of 6888  $\text{m}^3/\text{hectare}$ . In Karasu district also one demonstration field was under cotton where the cotton had been irrigated 4 times, instead of recommended 5 times, the first irrigation was on May, 14th, last- on August, 12. The irrigation norm was from 1494  $\text{m}^3/\text{hectare}$  to 1680  $\text{m}^3/\text{hectare}$  instead of recommended on HMD 1100-1300  $\text{m}^3/\text{hectare}$ , i.e. overestimate of irrigation norms formed 1,3 times.

Almost at all farms of Aravan district there were interruptions of water supply during the irrigations. The reason of these faults is non-observance of water rotation by surrounding farms, i.e. autocratic capture of water. For this reason some farms did not receive the water during 2- 10 hours during carrying out the irrigation. The similar situation was in Karasu district where interruptions were 2- 10 hours because of violating the water turn among the farmers

Table 4.1

**Elements of irrigation technology at demonstration fields of Osh region (2008)**

Farms	Crop	Area of demonstration Fields (hectares)	Length of field (m)	Width of field (m)	Length of furrow	Presence of main furrows (exist, not exist)	Number of shoh-aryks	Number of ok-aryks	Quantity of irrigation sites divided by ok and shoh aryks	Width of row-spacings (m)	recommended scheme of irrigation (quantity of irrigation sites)	recommended length of furrows (m)
<b>Aravan district</b>												
Kudayberdiev Nurkamil	wheat	0,4	200	20	200	exist	1	3	2	0,6	3	60-70
	cotton	1,2	200	60	200	exist	1	3	2	0,6		60-70
Tolobekov Abdimanap	wheat	0,5	430	11,6	100-110	exist		2	4	0,6	6	70-80
Tolobekov Abduvahop	wheat	0,35	200	17,5	100-110	exist		2	2	0,6	4	70-80
Toktoraliyev Anvar	wheat	1	550	18,2	150	exist		2	4	0,6	8	70-80
Orunbaev Rahmatilla	wheat	0,6	600	10	150	exist		2	4	0,06	8	70-80
<b>Naukat district</b>												
Ergesh azhy	wheat	1	100	100	50		1	2	2	0,6	2	50-60
Muratbek	wheat	0,6	1000	6	80		1	12	12	0,6	13	70-80
Zhalal	wheat	0,2	50	40	50		1	1	1	0,6	1	50-60
Nichke suu	wheat	0,6	400	15	80		1	5	5	0,6	7	60-70

Table 4.2

## Elements of irrigation technology at demonstration fields of Osh region (2008)

Farms	Crop	Area of demonstration Fields (hectares)	Length of field (m)	Width of field (m)	Length of furrow	Presence of main furrows (exist, not exist)	Number of shoh-aryks	Number of ok-aryks	Quantity of irrigation sites divided by ok and shoh aryks	Width of row-spacings (m)	recommended scheme of irrigation (quantity of irrigation sites)	recommended length of furrows (m)
<b>Karasu district</b>												
"Ergesh uulu" Kyrgyzbaeva Aynisa	wheat	2	250	80	80	3+2	2	3	3	0,6	3	70-80
k/h "Talgat" Adaev Orunbay	wheat	1,5	540	29	77	7+2	2	7	7	0,6	7	70-80
k/h "Omurbek" Kadyrov Gulayim	wheat	1	975	11	81	12+2	2	12	12	0,6	12	70-80
Myrzabaeva Rabykan	wheat	1	810	13	81	10+2	2	10	10	0,6	10	70-80
Myrzabaeva Rabykan	Corn for grain	0,9	630	15	90	2+2	2	7	7	0,6	7	80-90
<b>Uzgen district</b>												
Kazybekov M	wheat	2	400	50	100		2	3	4	0,6	5	70-80
	Lucerne	1	400	25	100		2	3	4	0,6	5	70-80
Chalabaev K.	wheat	0,3	150	20	75		2	2	2	0,6	2	75
Kulmatov M.	wheat	1	200	50	100		2	2	2	0,6	2	80
Zhanzhiev K.	Corn	1,35	350	39	90		3	4	4	0,6	4	80-90
Dosov A.	wheat	0,4	180	22	90		2	2	2	0,6	2	90



Demonstrations of rational water use were carried out at 6 demonstration fields of the Osh region by trainers of RAS and Oblvodhoz. The main attention was given to a choose of the irrigation technological scheme taking into account the recommendations developed by IWRM-Fergana project (choose of optimal length of a furrow, quantity of irrigation sites, discharge of a furrow and other). Methods of water saving also were shown at demonstration sites, such inter-furrow irrigation, use of short furrows, night irrigation, water rotation and organization of irrigation among the small farms.

Trainers identified needs and problems of farms on water use at field level, problems with water supply to their fields during vegetation. Project WPI-PL will work on these problems in the following phase.

#### 4.2 Water productivity at demonstration plots of Osh region (2008)

The least efficiency of water use has been formed in Nookat district at fields under winter wheat at farm "Muratbek" -  $0,85 \text{ kg/m}^3$  where of a principal cause was rather low productivity (36.0 c/hectare) and excessive irrigation norm ( $4235 \text{ m}^3/\text{hectare}$  against the recommended according to the hydro module norm of  $3700 \text{ m}^3/\text{hectare}$ ). The greatest efficiency is noted at farm "Zhalal" -  $1,09 \text{ kg/m}^3$ , at an average regional indicator of  $0,94 \text{ kg/m}^3$ .

In Aravan district the greatest efficiency of water has been formed at farm "Orunbaev" -  $0,97 \text{ kg/m}^3$ , the least - at farm "Kudayberdiev" -  $0,81 \text{ kg/m}^3$ , at an average index on district of  $0,85 \text{ kg/m}^3$ . Of the reason of low water productivity was low productivity and high irrigation norm –  $4941 \text{ m}^3/\text{hectare}$  against  $2800 \text{ m}^3/\text{hectare}$  recommended on HMD.

In Karasu district, at "Talgat" farm efficiency of water was only  $0,60 \text{ kg/m}^3$  where at low crop (37.5 c/hectare) the actual irrigation norm was  $6247 \text{ m}^3/\text{hectare}$  against  $3600 \text{ m}^3/\text{hectare}$  recommended on HMD. The greatest indicator of water efficiency is registered at farm «Ergash uuli» -  $1,01 \text{ kg/m}^3$ , at an average index on district –  $0,91 \text{ kg/m}^3$ .

In Uzgen district the greatest efficiency of water is registered at farm "Kazibaev" -  $0,80 \text{ kg/m}^3$ , the least efficiency – at farm "Kultaev" -  $0,74 \text{ kg/m}^3$ , at an average index on district –  $0,78 \text{ kg/m}^3$ . The reason of low efficiency of water is high water charges during the vegetation ( $5511 \text{ m}^3/\text{hectare}$  against the recommended  $3700 \text{ m}^3/\text{hectare}$ ).

The summarized indicators of water use efficiency on separate districts of Osh region allow to range them by water use efficiency:

Nookat district –  $0,94 \text{ kg/m}^3$ ; Karasu district –  $0,91 \text{ kg/m}^3$ ;  
Aravan district –  $0,85 \text{ kg/m}^3$ ; Uzgen district –  $0,78 \text{ kg/m}^3$ ;

Table 4.3

## Water productivity at demonstration plots of Osh region (2008)

№	Districts	Farms	Recommended irrigation norm, m <sup>3</sup> /hectare	Crop	Actual irrigation norm, m <sup>3</sup> /hectare	Yield, c/hectare	Water productivity, kg/m <sup>3</sup>
1	<b>Nookat</b>	Ergesh azhy ф\ч	2800	wheat	4450	42,0	0,94
		Muratbekд\ч	2800	wheat	4235	36,0	0,85
		Zhalal ж\ч	2800	wheat	4123	45,0	1,09
		Nichke suu д\ч	2800	wheat	4279	38,0	0,89
2	<b>Karasu-2</b>	Bekishov S.	5000	Corn	8856	72,0	0,81
		Abzhalov D.	5000	Corn	8122	68,9	0,85
		Tashpolotov S.	6180	cotton	6312	23,0	0,36
3	<b>Uzgen</b>	Kazybaev M.	3700	wheat	4250	34,0	0,80
		Kultaev M.	3700	wheat	5511	41,0	0,74
		Chalabaev K.	3700	wheat	4102	32,0	0,78
		Жанжиев К.	5000	Corn	6016	64,0	1,06
		Dosov A.	3700	wheat	3590	28,0	0,78
4	<b>Aravan</b>	Kudayberdiev Nurkamil	3700	wheat	4941	40,0	0,81
			5800	cotton	6888	24,0	0,35
		Tolobekov Aduvahop	3700	wheat	6619	56,0	0,85
		Tolobekov Abdimanap	3600	wheat	6174	51,0	0,83
		Toktoraliyev Anvar	3700	wheat	5062	41,0	0,81
		Orunbaev Rahmatilla	3600	wheat	4419	43,0	0,97
5	<b>Karasu-1</b>	"Ergash uuli" Kyrgyzbaeva Aynisa	3600	wheat	4463	45,0	1,01
		"Talgat" Adaev Orunbay	3600	wheat	3377	40,0	1,18
		"Omurbek" Kadyrov Gulayim	3600	wheat	6247	37,5	0,60
		"Mirbek" Myrzabaeva Rabykan	3600	wheat	3488	30,0	0,86
			5000	Corn	5156	69,2	1,34

## 5. Water productivity in Sogd region

### 5.1 Assessment of water use at irrigating the cotton at pilot farms of Sogd region (according to data of Region Water Authority (Oblvodhoz) trainers)

Data on water use at irrigating the cotton at farms of D. Rasulov, Kanibadam, Spitamen, Zafarabad, Matchi and Sogd districts are shown in table 5.1. Materials of this table show, that the cotton was sowed on fields of I<sup>a</sup> - HMD, I - HMD and II - HMD which means, that soils of this fields are strongly water-permeable, and ground water level is located low. It is recommended to carry out 10-12 irrigations per vegetation with irrigation norm from 535 <sup>m<sup>3</sup>/hectare</sup> to 900 <sup>m<sup>3</sup>/hectare</sup> and with irrigation norm from 7860 <sup>m<sup>3</sup>/hectare</sup> to 10700 <sup>m<sup>3</sup>/hectare</sup>. The analysis of the water supply for 2008 on fields of D.Rasulov district has shown, that the actual quantity was 4-9 times, the irrigation rate varied from 581 <sup>m<sup>3</sup>/hectare</sup> to 884 <sup>m<sup>3</sup>/hectare</sup>, and irrigation norm from 2640 <sup>m<sup>3</sup>/hectare</sup> to 7929 <sup>m<sup>3</sup>/hectare</sup>.

On fields of Kanibadam district the actual quantity of irrigations of cotton was from 6 to 11 times, irrigation rate from 510 <sup>m<sup>3</sup>/hectare</sup> to 898 <sup>m<sup>3</sup>/hectare</sup>, and irrigation norm from 2868 <sup>m<sup>3</sup>/hectare</sup> to 7700 <sup>m<sup>3</sup>/hectare</sup>. On fields of Spitamen district the actual quantity of irrigations fluctuated from 3 to 8 times, irrigation rate from 332 <sup>m<sup>3</sup>/hectare</sup> to 850 <sup>m<sup>3</sup>/hectare</sup>, and irrigation norm from 1122 <sup>m<sup>3</sup>/hectare</sup> to 6800 <sup>m<sup>3</sup>/hectare</sup>. On fields of Zafarabad district the actual quantity of irrigations was from 4 to 16 times, irrigation rate from 420 <sup>m<sup>3</sup>/hectare</sup> to 806 <sup>m<sup>3</sup>/hectare</sup>, and irrigation norm from 1680 <sup>m<sup>3</sup>/hectare</sup> to 8000 <sup>m<sup>3</sup>/hectare</sup>. On fields of Matchi district the actual quantity of irrigations was from 6 to 10 times, irrigation rate from 460 <sup>m<sup>3</sup>/hectare</sup> to 655 <sup>m<sup>3</sup>/hectare</sup>, and irrigation norm from 3000 <sup>m<sup>3</sup>/hectare</sup> to 6550 <sup>m<sup>3</sup>/hectare</sup>.

The resulted analysis has shown, that 2008 was sharply shallow on water security (concerning the recommended irrigation mode of cotton) for pilot fields of Sogd region of Tajikistan. Despite this, it was noticed according to table 5.1 non-uniform water share the farms that means presence of a problem with water distribution in all the districts of Sogd region. Other important factor is providing the farms with water from water sources by means of pumps. These objects could not provide crops with water in due time and in necessary amount, because of constant faults, shortage of the electric power and spare parts.

### 5.2 Assessment of water use at irrigating the winter wheat at pilot farms of Sogd region (according to data of Region Water Authority (Oblvodhoz) trainers)

Data on water use at irrigating the winter wheat at farms of Sogd district in 2008 allow drawing the following conclusions:

At fields of D.Rasulov district quantity of irrigations for winter wheat fluctuated during the vegetation period from 1 to 3 times, the irrigation rate changed from 432 <sup>m<sup>3</sup>/hectare</sup> to 864 <sup>m<sup>3</sup>/hectare</sup>, and irrigation norm from 1728 <sup>m<sup>3</sup>/hectare</sup> to 2374 <sup>m<sup>3</sup>/hectare</sup>.

At fields of Kanibadam district quantity of irrigations fluctuated from 2 to 3 times, the irrigation rate changed from 423 <sup>m<sup>3</sup>/hectare</sup> to 762 <sup>m<sup>3</sup>/hectare</sup>, and irrigation norm from 907 <sup>m<sup>3</sup>/hectare</sup> to 1651 <sup>m<sup>3</sup>/hectare</sup>.

At fields of Zafarabad district quantity of irrigations fluctuated from 2 to 3 times, the irrigation rate changed from 360 <sup>m<sup>3</sup>/hectare</sup> to 734 <sup>m<sup>3</sup>/hectare</sup>, and irrigation norm from 991 <sup>m<sup>3</sup>/hectare</sup> to 1645 <sup>m<sup>3</sup>/hectare</sup>.

Table5.1

**The summary table on irrigating the cotton at farms of Sogd region for 2008 (according to trainers of Oblvodhoz)**

Districts	Farms	Area hectares	HMD	*Recommended norm of irrigation			Actual water supply		
				Irrigation rate m <sup>3</sup> /hectare	Quantity of irrigations	Irrigation norm m <sup>3</sup> /hectares	Irrigation rate m <sup>3</sup> /hectare	Quantity of irrigations	Irrigation norm m <sup>3</sup> /hectares
Dzhabbor Rasulov	Baht	23	II	850	9	7650	660	4	2640
	Somon	15	I	675	12	8100	691	7	4837
	Usto Haydar	1,5	I	675	12	8100	822	6	4932
	Guliston	23	I	675	12	8100	716	6	4296
	Ohuni Kabir	8	I	675	12	8100	884	8	7072
	Devashtich	2	I	675	12	8100	881	9	7929
	Mahmadomon	1	I	675	12	8100	789	8	6312
	A.Ikromov	9	I	675	12	8100	808	8	6464
	Saidabrор	12	I	675	12	8100	849	7	5943
	Nilufar	7	I	675	12	8100	865	7	6055
	Ok-arik	28	I	675	12	8100	711	7	4977
	Kata-dam	22	II	873	9	7860	581	7	4067
	Azimobobo	9	II	873	9	7860	624	7	4368
Tozhikobod	18	I	675	12	8100	766	9	6894	
Konibodom	K.Mahkamov	51	1	670	16	10700	737	6	4422
	T.Tozhiev	58	1	670	16	10700	693	6	4158
	Pahtakor	92	1	670	16	10700	510	6	3060
	Dovud Sarkor	37	2	900	11	10200	717	4	2868
	Mahram	40	2	900	11	10200	898	5	4490
	Nozim Sarkor	51	2	900	11	10200	750	7	5250
	A.Kodirov	45	2	900	11	10200	750	7	5250
	Navbahor	27	1	700	16	10700	600	10	6000
	Durahshon	46	1	700	16	10700	600	9	5400
	Nurmuhammad	10	1	700	16	10700	700	11	7700
Spitamen	Galaba	30	1a	570	15	8550	365	3	1095
	Farovon	23	1a	570	15	8550	450	3	1350
	Tadbirkor	47	1	675	12	8100	830	8	6640
	Shark	6,9	1	675	12	8100	850	8	6800

	Namuna	31	1	675	12	8100	586	7	4102
	Navruz	30	1	675	12	8100	374	3	1122
	Yakka tut	31	1	675	12	8100	504	3	1512
	Otaeva	46	1	675	12	8100	500	4	2000
	Nur	47	1	675	12	8100	468	4	1872
	Pahtakor	50	1	675	12	8100	354	4	1416
	Barakat	46	1	675	12	8100	332	4	1328
Zafarobod	Rahsh	30	1	675	12	8100	506	6	3036
	Buron	1,3	2	775	10	7750	780	4	3120
	Zhonikulbobo	1	2	775	10	7750	725	4	2900
	Buron -2	1	2	775	10	7750	772	4	3088
	Buron-4	1	2	775	10	7750	806	4	3224
	Utogar	2,75	1	675	12	8100	500	16	8000
	Mahbuba	10,5	1a	535	16	8550	623	12	7476
	Oykul	23	1a	535	16	8550	630	12	7560
	Zahmatobod	8	1	675	12	8100	761	9	6849
	Isfandiyor	3,5	1	675	12	8100	687	7	4809
	Safarrahmon	8	1	675	12	8100	650	9	5850
	Murod-2	2,9	1	675	12	8100	560	9	5040
	Tursunzoda	6,5	1	675	12	8100	420	4	1680
	Shukurbobo	12	1	675	12	8100	371	7	2597
Matchi	Navbahor	50	1	675	12	8100	550	8	4400
	Aminzhon	15	1	675	12	8100	460	7	3220
	Amakzhon	55	1	675	12	8100	655	10	6550
	Payrav	4	1	675	12	8100	576	6	3456
	Turon-4	25	1	675	12	8100	520	6	3120
	Fayzi Diyor	35	1	675	12	8100	500	6	3000

\*Irrigation norm from «Recommendations on irrigation modes for crops of Republic Tajikistan». Volume-1.  
 Author Domullozhanov, approved by Ministry of Water Resources of Republic Tajikistan on April, 20th, 1988

At farms of Spitamen district the quantity of irrigations for winter wheat fluctuated from 2 to 3 times, the irrigation rate changed from 432  $\text{m}^3/\text{hectare}$  to 691  $\text{m}^3/\text{hectare}$ , and irrigation norm from 1100  $\text{m}^3/\text{hectare}$  to 1800  $\text{m}^3/\text{hectare}$ .

### 5.3 Water productivity at farms of Sogd region (2008 r.)

The summarized indicators of water use efficiency on separate districts of Sogd region allow to range them as follows:

Cotton  
 Spitamen district – 0,42  $\text{Kg}/\text{m}^3$ ;  
 Zafarabad district – 0,44  $\text{kg}/\text{m}^3$ ;  
 J. Rasulov district – 0,44  $\text{kg}/\text{m}^3$ ;  
 Kanibadam district – 0,50  $\text{kg}/\text{m}^3$ ;  
 Matchi district – 0,56  $\text{kg}/\text{m}^3$ ;

Winter wheat  
 J. Rasulov district – 1,01  $\text{kg}/\text{m}^3$ ;  
 Zafarabad district – 1,22  $\text{kg}/\text{m}^3$ ;  
 Kanibadam district – 1,45  $\text{kg}/\text{m}^3$ ;  
 Spitamen district – 1,69  $\text{kg}/\text{m}^3$ .

Table 5.3

Water productivity at farms of Sogd region of Tajikistan (2008)

Districts	Farms	Winter wheat			Cotton		
		Irrigation rate ( $\text{m}^3$ )	Yield (c/hectare)	water productivity ( $\text{kg}/\text{m}^3$ )	Total amount of given water ( $\text{m}^3$ )	Yield (c/hectare)	water productivity ( $\text{kg}/\text{m}^3$ )
<b>Dzhabbor Rasulov</b>	Baht	1728	5	0,29	2640	19,6	0,74
	Somon	648	4	0,62	4837	23,0	0,47
	Usto Haydar	1728	16	0,93	4932	21,9	0,44
	Guliston	518	7	1,35	4296	18,3	0,42
	Ohuni Kabir	648	3,8	0,59	7072	28,0	0,39
	Mahmadomon	1208	10,5	0,87	6312	22,7	0,36
	A.Ikromov	480	5	1,04	6464	23,8	0,37
	Saidabrор	450	5	1,11	5943	22,5	0,38
	Nilufar	400	5	1,25	6055	24,1	0,40
	Ok-arik	1000	16	1,60	4977	22,7	0,46
	Tozhikobod	1080	16	1,48	6894	24,3	0,35
	<b>Average</b>	<b>899</b>	<b>8,5</b>	<b>1,01</b>	<b>5485</b>	<b>23,1</b>	<b>0,44</b>
<b>Konibodom</b>	K.Mahkamov	1433	15	1,05	4422	22	0,50
	T.Tozhiev	907	5	0,55	4158	20	0,48
	Pahtakor	1597	15	0,94	3060	22,3	0,73
	Dovud Sarkor	1339	28	2,09	2868	18,9	0,66
	Mahram	1080	28	2,59	4490	26,2	0,58
	Nozim Sark	1651	28	1,70	5250	26,1	0,50
	A.Kodirov	1597	25	1,57	5250	22,7	0,43
	Navbahor	1597	20	1,25	6000	28,6	0,47
	Durahshon	1339	18	1,34	5400	21,6	0,40
	Continuation of Table 5.3						
	<b>Average</b>	<b>1393</b>	<b>20,2</b>	<b>1,45</b>	<b>4860</b>	<b>22,7</b>	<b>0,50</b>

<b>Spitamen</b>	Tadbirkor	1785	30	1,68	3640	7	0,20
	Shark	1800	30	1,67	2800	4	0,14
	Namuna	1796	24	1,34	4102	4	0,10
	Galaba	1200	28	2,33	2095	15	0,71
	Farovon	1100	16	1,45	5280	21	0,41
	<b>Average</b>	<b>1536</b>	<b>26</b>	<b>1,69</b>	<b>2470</b>	<b>9</b>	<b>0,42</b>
<b>Zafarobod</b>	Zahmatobod	1425	10,0	0,70	6849	19,0	0,28
	Isfandiyor	1141	16,0	1,40	4809	18,0	0,37
	Buron	991	16,0	1,61	3120	23,3	0,75
	Safarraimon	991	15,0	1,51	5850	25,0	0,43
	Murod-2	1645	14,0	0,85	5040	26,0	0,52
	Zhonikulbobo	1152	14,0	1,22	2900	12,5	0,43
	Buron-2	1593	14,0	0,88	3088	8,7	0,28
	Buron-4	1554	7,6	0,49	3224	16,0	0,50
	Utogar	507	12,0	2,37	8000	22,5	0,28
	Mahbuba	1080	13,0	1,20	7476	6,1	0,08
<b>Average</b>	<b>1208</b>	<b>13,2</b>	<b>1,22</b>	<b>4659</b>	<b>17,4</b>	<b>0,44</b>	
<b>Mastchoh</b>	Navbahor	No Seeding of Wheat			4400	22	0,50
	Aminzhon				3220	18	0,56
	Amakzhon				6550	35	0,53
	Payrav				3456	17,2	0,50
	Turon-4				3120	18	0,58
	Fayzi Diyor				3000	21	0,70
	<b>Average</b>						

#### 5.4 Assessment of irrigating the cotton in Sogd region (according to data from research fields of CECI) for 2008

Research fields of CECI are located on territory of Spitamen, D. Rasulov, Matchi and Kanibadam districts of Sogd region of Tajikistan. The quantity of covered dehqan farms (DF) is 55, with total area under cotton (of Turkish grade) of 234,3 hectares. The first irrigation was started since May, 12th, the last irrigation was on August, 24<sup>th</sup>;

at DF of J. Rasulov district the first irrigation - on May, 13th, the last irrigation - on August, 16<sup>th</sup>;

at DF of Matchi district the first irrigation - on April, 24th, the last - on August, 25<sup>th</sup>;

at DF of Kanibadam district the first irrigation - on March, 17th (water retention), the last - on August, 26th.

It is known, that the water account at DF of Sogd region is not conducted, including the research fields of CECI. There are only data presented on irrigation dates, quantity of irrigations for a season and time spent for irrigation. Based on this material experts of CECI gave an expert evaluation of the irrigation.

The total quantity of irrigations essentially differed on various DF. According to the table below, there were farms which irrigated only once (DF "Somoniyon" of Spitamen district, DF "Isomiddin" of Matchi district) and in the subsequent crops were written-off. Only 2 irrigations were at DF "Diyor" of Matchi district. But there are some farms which spent 9 irrigations for vegetation: DF "Tadbirkor" of Spitamen district, DF "Navbahor", DF «Nozim Sattor», DF "Pahtakor" of Kanibadam district.

From total of 55 pieces DH, 17 DH (31,5 %) having watered spent to 4 times, 26 DH (48,1 %) having watered spent 5-6 times, 11 DH (20,4 %) having watered spent 7-9 times. According to the irrigation mode, recommended for territory of Sogdijsky area, for poliva srednevoloknistogo clap grades it is necessary (depending on hydromodular area) to spend from 6 to 16 polivov with irrigating norm gross from 6600 m<sup>3</sup>/hectares to 8550 m<sup>3</sup>/hectares.

The received actual materials testify, that between DH there is very big difference on the received volumes of irrigating water, quantity actual polivov much more below recommended norm. This situation speaks first of all influence malovodija 2008, on the other hand problems of non-uniform distribution of irrigating water between DH.

### 5.5 Water productivity at demonstration fields of CECI (2008)

The least efficiency of water use on fields of CECI was registered in Spetamen district at DF "Abullaev" - 0,16 kg/m<sup>3</sup>, the greatest efficiency - at DF "Setora" - 0,66 kg/m<sup>3</sup>, at an average district indicator of 0,48 kg/m<sup>3</sup>.

Table5.6

#### Water productivity at demonstration fields of CECI (2008)

District	Hashar	Farm	Area, hectares	Yield (c/hectare)	Quantity of irrigations	Irrigation rate, m <sup>3</sup> /hectare	water productivity, kg/m <sup>3</sup>	
Spitamen	Sitora	Sitora	5	29	5	4410	0,66	
	Sitora	Lochin	5	26	5	4435	0,58	
	Sitora	Mehvar	5	25	5	4415	0,56	
	Shark	Shark	2	21	6	5280	0,40	
	Tadbirkor	Tadbirkor	5	28	9	5735	0,49	
	Tadbirkor	Somonien	5	29	7	5800	0,50	
	Average						5013	0,53
Д.Рацулов	Tochikobod	Ohuni Kabir	3	41	6	5145	0,79	
	Tochikobod	Zarkor	5	8	5	4485	0,18	
	Baht	Baht(Omad)	7,7	11	5	4400	0,25	
	Baht	Ustohaydar	1	20	5	4500	0,44	
	Baht	Somon	4,6	12	4	3920	0,31	
	Average						4490	0,39
Мастьях	Dier	Dier	5	13	2	1880	0,69	
	Dier	Ruhshiv	5	13	5	4420	0,30	
	Dier	Hochi Amirien	5	21	6	5350	0,39	
	Malikien	Mulloibrohim	4	18	3	2810	0,64	
	Vositobod	Obshor	5	11	6	5190	0,21	
	Table 5.6 continuation							
	Vositobod	Vositobod	5	25	6	5230	0,48	
	Vositobod	Hochimahmad	5	23	6	5335	0,43	
	Vositobod	Islommiddin	5	25	6	5630	0,44	
	Fayzi-Dier	Aminchon	2	7	4	4450	0,16	



	Fayzi-Dier	Navbahor	5	27	4	3520	0,76
	Chanok	Amakchon	5	37	5	4440	0,83
	Average					4387	0,49
Канибодом	Sodirov	Sohil	5	27,20	7	5850	0,46
	Sodirov	Ganchina	4	19,80	7	5710	0,35
	Navbahor	Navbahor	7	32,26	9	6330	0,51
	Navbahor	Navruz	5	23,86	8	5590	0,43
	Navbahor	Durahshon	5	37,37	8	5540	0,67
	Navbahor	Nurmuhammad	3	18,87	8	5440	0,35
	Navbahor	A Kodirov	5	21,73	8	5260	0,41
	ADH Tochikiston	P Kosimov	4	20,86	5	4960	0,42
	Zafar	Omad	4	16,10	5	4210	0,38
	Zafar	Sada-1	5	35,52	6	4185	0,85
	Zafar	Sada -2	5	32,61	6	5090	0,64
	Himoyatbonu	Galaba-60	5	44,36	5	4230	1,05
	Zafar	Istikloliyat	4	10,86	4	3385	0,32
	ADH Nazarov	A Kodirov	4,5	11,64	5	4095	0,28
	ADH Karoboev	Zarbdor	4	25,00	5	4170	0,60
	ADH Karoboev	Navbahor	4	6,75	3	2810	0,24
	ADH Karoboev	Bahor	4	20,25	5	4410	0,46
	ADH Dusti	Mahram	4	33,10	8	4970	0,67
	ADH Dusti	Nozim Sarkor	4	25,90	9	5785	0,45
	ADH Dusti	Pahtakor	4	27,25	9	5785	0,47
	Isoev	Isoev	5	42,88	6	4720	0,91
	ADH Patar	Mukarramov	4	31,90	5	4130	0,77
	ADH Patar	Sohibkor	4	28,93	6	4930	0,59
	Sidikov	Farovon	5	23,30	4	3400	0,69
	Sidikov	III Boirov	5	17,80	4	3580	0,50
	Sidikov	A Sidikov	4	25,50	3	3450	0,74
	Sidikov	Temurmalik	4	25,70	3	2760	0,93
	Sidikov	K Churaev	4	18,20	4	3530	0,52
	Sidikov	K.Madaliev	4	4,50	3	2730	0,16
	Sidikov	shahid mazor	4	25,97	3	2730	0,95
	Average					4459	0,56

In J. Rasulov district the greatest water efficiency is registered at DF "Ohuni-Kabir" - 0,79 kg/m<sup>3</sup>, the least - at DF "Zarkor" - 0,18 kg/m<sup>3</sup>, at an average index on district of 0,39 kg/m<sup>3</sup>. In Maschi district, at DF "Amakchon" efficiency of water has formed 0,83 kg/m<sup>3</sup>, the least - at DF "Malikien" - 0,11 kg/m<sup>3</sup>, at an average index on district – 0,43 kg/m<sup>3</sup>. In Kanibadam district the greatest water productivity was registered at DF «Galaba-60» - 1,05 kg/m<sup>3</sup>, the least - at DF "K.Madaliev" - 0,16 kg/m<sup>3</sup>, at an average index on district– 0,56 kg/m<sup>3</sup>.

The summarized indicators of water use efficiency on separate districts of Sogd region allow to range them as follows:

Kanibadam district – 0,56 kg/m<sup>3</sup>; Spitamen district – 0,48 kg/m<sup>3</sup>;  
 Matchi district – 0,43 kg/m<sup>3</sup>; J. Rasulov district – 0,39 kg/m<sup>3</sup>;

## 5. Conclusion

The data on Fergana and Andizhan regions of Uzbekistan for 2008 allow making a conclusion that the developed mode of irrigation on demonstration plots differs from republican recommendations of hydro module zoning (table 6.1). The actual quantity of irrigation of cotton was underestimated in the Fergana region on 22 %, and in Andizhan region on 30 % that led to increase in irrigation norms. As a result, developed irrigation norm in the Fergana area ( $5509 \text{ m}^3/\text{hectare}$ ) was on  $691 \text{ m}^3/\text{hectare}$  below the recommended on HMZ ( $6100 \text{ m}^3/\text{hectare}$ ), and in Andizhan region ( $5688 \text{ m}^3/\text{hectare}$ ) on  $362 \text{ m}^3/\text{hectare}$  below the recommended ( $6050 \text{ m}^3/\text{hectare}$ ), that at essential reduction of number of irrigations led to violation of irrigation terms.

table6.1

**The summary table on water use at irrigations at polygons of Andizhan and Fergana regions (2008)**

Region	Crop	Recommended irrigation mode			Actual irrigation mode		
		Irrigation rate ( $\text{m}^3/\text{hectare}$ )	Quantity of irrigations	Irrigation norm ( $\text{m}^3/\text{hectare}$ )	Irrigation rate ( $\text{m}^3/\text{hectare}$ )	Quantity of irrigations	Irrigation norm ( $\text{m}^3/\text{hectare}$ )
Andizhan	Cotton	852	7,1	6050	1138	5	5688
Fergana	Cotton	885	6,9	6100	1020	5,4	5509
Andizhan	Wheat	745	4,2	3130	1065	4,8	5110
Fergana	Wheat	700	4	2800	941	5,5	5175

The opposite situation has developed at irrigation of grain crops – in Fergana region on fields under winter wheat it was on 1,5 irrigations more than recommended, that has led to increase of irrigation norm on  $241 \text{ m}^3/\text{hectare}$  and finally promoted excess of irrigation norm on  $2375 \text{ m}^3/\text{hectare}$  ( $5175 \text{ m}^3/\text{hectare}$  against recommended  $2800 \text{ m}^3/\text{hectare}$ ). In Andizhan region it was on 0,6 irrigations more, the irrigation rate exceeded recommended on  $320 \text{ m}^3/\text{hectare}$ , and irrigation norm on  $1980 \text{ m}^3/\text{hectare}$  ( $5110 \text{ m}^3/\text{hectare}$  against recommended  $3130 \text{ m}^3/\text{hectare}$ ).

Materials stated in table 6.2 allow to conclude, that productivity of water use (an average on polygons) at cotton cultivation changes slightly on areas – from  $0,57$  to  $0,58 \text{ kg/m}^3$ .

Table6.2

**The summary table on water productivity at polygons of Andizhan and Fergana regions.**

Region	Wheat			Cotton		
	Irrigation norm ( $\text{m}^3/\text{hectare}$ )	Yield (c/hectare)	Productivity ( $\text{Kg/m}^3$ )	Irrigation norm ( $\text{m}^3/\text{hectare}$ )	Yield (c/hectare)	Productivity ( $\text{Kg/m}^3$ )
Andizhan	5110	50	0,98	5688	33,2	0,58
Fergana	5175	38,8	0,75	5509	31,6	0,57

At plots under winter wheat efficiency of water reached in Andizhan region ( $0,98 \text{ kg/m}^3$ ) considerably exceeds an indicator of Fergana region ( $0,75 \text{ kg/m}^3$ ) because of difference in the received crop ( $50,0 \text{ c/hectare}$  in Andizhan against  $38,8 \text{ c/hectare}$  in Fergana), at practically equal water discharges ( $5110 - 5175 \text{ m}^3/\text{hectare}$ ).

Water productivity at cultivation of cotton at farms located around the demonstration plots (table 6.3) in Andizhan region ( $0,51 \text{ kg/m}^3$ ) is considerable above the similar size in Fergana ( $0,43 \text{ kg/m}^3$ ) because of distinction in crops ( $27,2 \text{ c/hectare}$  against  $26,0 \text{ c/hectare}$ ) and in irrigation norms ( $5378 \text{ m}^3/\text{hectare}$  in Andizhan,  $6037 \text{ m}^3/\text{hectare}$  in Fergana). The similar tendency is traced on plots under

wheat – efficiency of water in Andizhan has formed 0,76 kg/m<sup>3</sup> against 0,65 kg/m<sup>3</sup> in Fergana, at corresponding crops 27,2 – 26,0 c/hectare and irrigation norms 5378 – 6037 m<sup>3</sup>/hectare.

Table 6.3

**Water productivity at farms located near the project plots (2008)**

Region	Wheat			Cotton		
	Yield (c/hectare)	Irrigation norm (m <sup>3</sup> /hectare)	Productivity (Kg/m <sup>3</sup> )	Yield (c/hectare)	Irrigation norm (m <sup>3</sup> /hectare)	Productivity (Kg/m <sup>3</sup> )
Andizhan	27,2	5378	0,51	44,9	5895	0,76
Fergana	26,0	6037	0,43	43,7	6751	0,65

Data on water use at demonstration fields of Osh region for vegetation of 2008 are presented in table 6.4, according to which for irrigating the winter wheat 4715 m<sup>3</sup>/hectare of water was used and quantity of irrigations was 3,7 times at average irrigation norm of 1288 m<sup>3</sup>/hectare. Comparison of the received data with a mode of irrigation recommended for these zones allows to conclude, that farmers overestimated both the irrigation rate and norm on 1,3-1,4 times. The similar situation is marked at irrigation of cotton – the average irrigation norm was 6600 m<sup>3</sup>/hectare, irrigation rate of 1466 m<sup>3</sup>/hectare, and quantity of irrigations 4,5 times that exceeds recommended norms.

Table 6.4

**Water use at demonstration fields of Osh region for vegetation of 2008**

Districts	Wheat			Cotton		
	Actual water supply			Actual water supply		
	Average irrigation rate (m <sup>3</sup> /hectare)	Quantity of irrigations	Irrigation norm (m <sup>3</sup> /hectare)	Average irrigation rate (m <sup>3</sup> /hectare)	Quantity of irrigations	Irrigation norm (m <sup>3</sup> /hectare)
Aravan	1174	4,2	4931	1378	5	6888
Naukat	1220	3,5	4270	-	-	-
Karasu	1512	3,5	5292	1578	4	6312
Uzgen	1245	3,5	4365	-	-	-
<b>Average on region</b>	<b>1288</b>	<b>3,7</b>	<b>4715</b>	<b>1466</b>	<b>4,5</b>	<b>6600</b>

The analysis of use of irrigating water on demonstration fields of the Osh area has shown, that in many farms there are faults in water giving at polivah and the reason of these faults is sequence non-observance poliva from next FH because of autocratic capture of water. From trainers needs FH and problems on water use at field level have been defined, problems with supply by water of their fields in a vegetation current are revealed. Over these problems the project will work in the basic phase.

The greatest efficiency of use of water on crops zernokolosovyh in the Osh area is noted in Naukatsky area (0,94 kg/m<sup>3</sup>) and Karasujsky area (0,91 kg/m<sup>3</sup>), the least in Uzgensky area (0,77 kg/m<sup>3</sup>) at an average index on area equal 0,84 kg/m<sup>3</sup> (table 6.5). At cultivation of a cotton the indicator of efficiency of water on areas fluctuated slightly (0,35-0,36 kg/m<sup>3</sup>), at an average index on the Osh area of 0,35 kg/m<sup>3</sup>.

Table 6.5

**The summary table on water productivity at demonstration fields of Osh region for the vegetation of 2008**

Districts	Wheat			Cotton		
	Irrigation norm (m <sup>3</sup> /hectare)	Yield (c/hectare)	Productivity (Kg/m <sup>3</sup> )	Irrigation norm (m <sup>3</sup> /hectare)	Yield (c/hectare)	Productivity (Kg/m <sup>3</sup> )
Aravan	4931	42,0	0,85	6888	24	0,35
Naukat	4270	40,2	0,94	-	-	-
Karasu	4194	38,1	0,91	6312	23	0,36
Uzgen	4365	33,8	0,77	-	-	-
<b>Average on region</b>	<b>4715</b>	<b>39,6</b>	<b>0,84</b>	<b>6600</b>	<b>23,5</b>	<b>0,35</b>

Data on water use at irrigations on demonstration fields of Sogd region are resulted in table 6.6. The quantity of irrigations for winter wheat fluctuated on districts from 2 to 3 times. The irrigation norm varied from 1020 m<sup>3</sup>/hectare to 1460 m<sup>3</sup>/hectare and has formed on the average 1225 m<sup>3</sup>/hectare for vegetation. The average irrigation norm on cotton fields was 4333 m<sup>3</sup>/hectare, irrigation norm – 647 m<sup>3</sup>/hectare, quantity of irrigations -6,7 time. A little bit other situation developed on demonstration fields of CECI where grown cotton was of Turkish grade. On this fields the irrigation norm was 4563 m<sup>3</sup>/hectare, quantity of irrigations 5,4 times, irrigation norm of 845 m<sup>3</sup>/hectare.

Table 6.6

**The summary table on water use at demonstration fields of Sogd region for the vegetation of 2008**

Districts	Wheat			Cotton			Turkish cotton (CECI)		
	Average irrigation rate (m <sup>3</sup> /hectare)	Quantity of irrigations	Irrigation norm (m <sup>3</sup> /hectare)	Average irrigation rate (m <sup>3</sup> /hectare)	Quantity of irrigations	Irrigation norm (m <sup>3</sup> /hectare)	Average irrigation rate (m <sup>3</sup> /hectare)	Quantity of irrigations	Irrigation norm (m <sup>3</sup> /hectare)
D.Rasulov	510	2	1020	772	7,1	5485	900	5	4490
Kanibadam	466	3	1400	684	7,1	4860	782	5,7	4459
Spitamen	486	3	1460	578	4,6	2660	824	6,1	5029
Zafarabad	510	2	1020	613	7,6	4660	-	-	-
Matchi	-	-	-	563	7,1	4000	929	4,6	4275
<b>Average on region</b>	<b>490</b>	<b>2,5</b>	<b>1225</b>	<b>647</b>	<b>6,7</b>	<b>4333</b>	<b>845</b>	<b>5,4</b>	<b>4563</b>

The resulted materials say that there is a difference between districts on the received volumes of water and quantity of irrigations, which much more below the recommended norms. This situation is caused first by water shortage in 2008 and also problems of non-uniform distribution of water between DF and its use at field level (incorrectly chosen irrigation schemes, overestimate of irrigation norms at the reduction of irrigations, etc.)

Efficiency of water use in Sogd region on demonstration fields under wheat fluctuated from 1.01 kg/m<sup>3</sup> (J. Rasulov district) to 1,69 kg/m<sup>3</sup> (Spitamen district) at an average index on district equal to 1,34 kg/m<sup>3</sup>. This indicator varied from 0,42 kg/m<sup>3</sup> (Spitamen district) to 0,56

kg/m<sup>3</sup> (Matchi district) on demonstration fields under cotton at average efficiency of water on district -0,47 kg/m<sup>3</sup> (table 6,7). A little smaller indicator of water efficiency was registered on demonstration fields of CECI (0,46 kg/m<sup>3</sup>) where Turkish grade of cotton was sowed and fluctuation of this indicator on districts (0,39-0,56 kg/m<sup>3</sup>) was connected mainly with the received crop.

Table6.7

**The summary table on water productivity at demonstration fields of Sogd region for the vegetation of 2008**

Districts	Wheat			Cotton			Turkish cotton (CECI)		
	Irrigation norm (m <sup>3</sup> /hectare)	Yield (c/hectare)	Productivity (Kg/m <sup>3</sup> )	Irrigation norm (m <sup>3</sup> /hectare)	Yield (c/hectare)	Productivity (Kg/m <sup>3</sup> )	Irrigation norm (m <sup>3</sup> /hectare)	Yield (c/hectare)	Productivity (Kg/m <sup>3</sup> )
D.Rasulov	1020	10,3	1,01	5485	24,1	0,44	4490	17,5	0,39
Kanibadam	1400	20,3	1,45	4860	24,3	0,50	4459	25	0,56
Spitamen	1460	24,7	1,69	2660	11,2	0,42	5029	24,1	0,48
Zafarabad	1020	12,4	1,22	4660	20,5	0,44	-	-	-
Matchi	-	-	-	4000	22,4	0,56	4275	18,4	0,43
<b>Average on region</b>	<b>1225</b>	<b>16,4</b>	<b>1,34</b>	<b>4333</b>	<b>20,4</b>	<b>0,47</b>	<b>4563</b>	<b>21,3</b>	<b>0,46</b>

Material on separate regions of Uzbekistan, Kyrgyzstan and Tajikistan (table 6.8) allows to conclude that the greatest water productivity on cotton in 2008 has been formed on demonstration plots of Andizhan and Fergana areas (0,57 – 0,58 kg/m<sup>3</sup>) at enough equal indicators on crops (33,2 – 31,6 c/hectare) and amount of water (5688 – 5509 m<sup>3</sup>/hectare).

Table6.8

**Water productivity at polygons of project «WPI-PL»**

Region	Cotton			Winter wheat		
	Yield c/hectare	Irrigation norm m <sup>3</sup> /hectare	Productivity Kg/m <sup>3</sup>	Yield c/hectare	Irrigation norm m <sup>3</sup> /hectare	Productivity Kg/m <sup>3</sup>
Andizhan	33,2	5688	0,58	50,0	5110	0,98
Fergana	31,6	5509	0,57	38,8	5175	0,75
Osh	23,5	6600	0,35	39,6	4715	0,84
Sogd	20,4	4333	0,47	16,4	1225	1,34

In Sogd region the indicator of water efficiency has formed 0,47 kg/m<sup>3</sup>, at low productivity (20,4 c/hectare) and not high water discharge (4333 m<sup>3</sup>/hectare). The lowest water productivity is noticed in Osh region– 0,35 kg/m<sup>3</sup> that is caused by rather low productivity of cotton (23,5 c/hectare) and high discharges of water – 6600 m<sup>3</sup>/hectare.

The greatest indicator of water productivity no winter wheat was registered in Sogd region – 1,34 kg/m<sup>3</sup>. It is necessary to say that though this indicator is high it was reached at very low productivity (16,4 c/hectare) and low water discharges (1225 m<sup>3</sup>/hectare). In Andizhan region water productivity formed 0,98 kg/m<sup>3</sup> at productivity of 50,0 c/hectare and irrigation norm of 5110 m<sup>3</sup>/hectare. In Fergana and Osh regions productivity of winter wheat differed slightly (38,8 – 39,6 c/hectare) as well as the developed irrigation norms (in Osh region – 4715 m<sup>3</sup>/hectare, in Fergana region – 5175 m<sup>3</sup>/hectare), that has accordingly affected developed efficiency which formed 0,84 kg/m<sup>3</sup> in Osh region and 0,75 kg/m<sup>3</sup> in Fergana region.