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Swiss Agency for Development and Cooperation (SDC)

Interstate Commission for Water Coordination (ICWC)

PROJECT COMPLETION REPORT

WATER PRODUCTIVITY IMPROVEMENT AT PLOT-LEVEL PROJECT

Inception phase

(April 1, 2008 – February 28, 2009)

Implemented by:

Scientific Information Center of the ICWC (SIC)

International Water Management Institute (IWMI)

Tashkent, 2009

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Abbreviations

ADB	Asian Development Bank
AKIS	Agricultural Knowledge and Information System
ATC	Advisory Training and Information Center (new name: ZOKI)
BISA	Basin Irrigation System Authority
BWO	Basin Water Organization
CA	Central Asia
CACLIM	Central Asia and Caucasus Land Improvement and Management Project
CAREWIB	Central Asia Regional Environment and Water Information Base
CECI	Centre Canadien d'Etude et de Coopération Internationale
CGIAR	the Consultative Group on International Agricultural Research
CHF	Swiss Francs
CIDA	Canadian International Development Agency
CPM	Country Project Manager
FFS	Farmer Field School
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICWC	Interstate Commission for Water Coordination
IWMI	International Water Management Institute
IWRM	Integrated Water Resource Management
IWRM-Ferghana	The Integrated Water Resources Management in Ferghana Valley project
MAWR	Ministries of Agriculture and Water Resources
MTP	Machinery and Tractor Center
NCSGs	National Coordination and Support Groups
NPCC	National Project Coordination Committee
PSC	Project Steering Committee
RAS	Rural Advisory Services
RESPII	Second Rural Enterprise Support Project (WB)
SANIIRI	Central Asian Research Institute for Irrigation
SDC	Swiss Agency for Development and Cooperation
SIC	Scientific Information Centre
TOT	Training of Trainers
WP	Water Productivity
WPI	Water Productivity Improvement Project
WUA	Water User Association
WUG	Water User Group
YPO	Yearly Plan of Operations
ZEF	Zentrum für Entwicklungsforschung

1. Preface

Following reform in the agricultural sector post-Soviet Central Asia, SDC initiated the IWRM-Ferghana valley project to improve institutional and organizational requirements for transparent, reliable and crop demand based water allocation and delivery to farmers. This project focused predominantly on the institutional, organizational and management aspects related to reliable, timely and adequate water supply to the farm gate. Activities at the plot level were subsequently initiated to assess the impact of reliable water availability on water use and the crop yields. To take full advantage of the water savings potential created by the IWRM project, a specific focus on plot level water efficiency and productivity was initiated.

This project was thus a logical continuation of the plot-level work within the IWRM project. Improved water application methods and techniques generated by IWRM or available from other counties/projects have to be evaluated on farm; to be adapted to local prevailing socio-economic contexts; and disseminated to farmers through existing extension agents and channels. This next step was also strongly recommended by the IWRM external review of October 2007.

In CA countries, poor management practices have resulted in unreliable, inadequate and inequitable water distribution, excessive water use, significant water losses and consequently water logging with the generation of high drainage volumes which all contribute to potential conflicts between water users. In many cases, irrigation methods applied at farm level are extremely wasteful, resulting in fields being over irrigated, waterlogged, and the development of secondary salinization. The major reason for excessive water use and low crop yields at the plot level is the lack of knowledge and resources for farmers. This clearly indicates that the issue is not of water scarcity but that of management.

Currently, water saving and water productivity at the plot level are inadequately addressed. Major deficiencies that have been identified are: insufficiently levelled land; excessive plot size and furrow length with corresponding over-watering and seepage at the head and under watering at the tail end; and insufficient attention to correct crop water requirements as well as soil water retention capacity.

Furthermore, in Central Asian countries, the available information associated with crop water requirements has very little relevance with current day challenges of water scarcity and environmentally sound water use. There is a critical need to update this information on the basis of soil, crop and climatic conditions for different agro-ecological zones. Levelling of farmer fields is generally poor and plot layouts are not adapted to soil conditions and water flow at the farm gate. Changing and adapting plot and furrow layouts and levelling fields are therefore considered to be important elements to minimize water losses and improve water productivity.

The number of women involved in water management and participating in the decision making has increased significantly over the last decade. It is interesting to note that in the central departments, women participation is more visible than men. However at district level their participation does not exceed 25% of the total number of employees. Women generally work in the field and get about 15-20$ per month or they are paid in kind such as share from agricultural production. The payments are only made during the cotton picking season. Mostly women work in the field performing the labor-consuming manual work. Men basically do more qualified work – carrying out the irrigation, application of fertilizers, plowing and cultivation.

The inception phase of this project was designed to review the existing knowledge on water use, crop yields, water productivities and existing extension services in the three target countries with a special focus on areas where IWRM project activities were being implemented. SIC, IWMI and local partners worked together to collect data from monitoring fields, agricultural departments and other on-going projects in the region and to carry out the review. Current extension services and practices and materials available for dissemination to farmers to improve productivity of water at the plot level were also reviewed during the inception phase. This information was reviewed to obtain a broader picture of the issues of water productivity at the plot level. In addition, the project contracted local consultants to review current situation on water productivity and extension services in all three countries.

In this report, we are presenting the progress made during the inception phase on all three components of the project. The summarized results of analysis on the current WP situation, major issues, limitations and suggestions for possible future research are included. Comprehensive discussion and analysis on these topics are contained in detailed reports which have been produced by IWMI and SIC with the assistance of local institutions and consultants and already submitted to SDC in September 2008 during the planning workshop, and which were the basis for this report.

Major achievements of the inception phase:

- Database on water productivity at plot level strengthened with field data gathered by partners in project regions. This database allows evaluation of basic trends of irrigated agricultural development in the region and provides an estimation of the impact of individual factors on efficiency of water use and crop production. This database is available to all research, water management and farmer organizations.

- Dissemination of information and training was provided through existing advisory services in Kyrgyzstan and Tajikistan and through Basin Authorities of the Irrigation Systems in Uzbekistan. This included trainings for extension workers, and production and distribution of various information bulletins and leaflets.

- Training of free lance consultants available within WUA as informal extension workers to support farmers with their operational and planning questions to sustain higher yields while applying lesser water to their fields;

- Situation analysis clearly revealed that farmers use excessive water, do not follow recommended practices, and that water productivity is generally low, the common problem is the lack of knowledge about actual crop water requirements, unstable water supply to farms during the irrigation inadequate access to finances;

- The analysis of the current extension strategies in Central Asian revealed that the agricultural extension systems are fragmented due to changes that these countries are experiencing with regard to different agricultural policies but can be mainstreamed through combination of state and donor efforts on policy and framework development to support extension.

2. Project Goal and Objectives

The project overall goal is stated as same as in the IWRM-Ferghana Project, which is "to contribute to more secure livelihoods, increased environmental stability, reducing water related conflicts and thus to greater social harmony, through improved effectiveness of water resources management".

The role of the project is the farmer field testing and subsequent dissemination through local partners of context adapted state of the art technologies and methods for irrigation water use to improve land and water productivity at the farm and plot level and to provide capacity building, training and material to extension. The project's long term objective is:

Enhancing water productivity, crop yields and yield stability at plot level through improved on farm water management thereby avoiding negative impacts on the environment such as water logging and salinization.

This requires:

- The definition of the appropriate crop water requirements for various crops that is contingent on the agro climatic conditions;
- The calculation of the irrigation intervals and timing based on soil physical characteristics (water retention capacity);
- The optimization of the applied irrigation techniques depending on different soil types (infiltration rate), canal flows at the field gate, availability of equipments and economic conditions of the farmers.

However, the context in which the aforementioned apply in the three countries varies substantially. The privatization of agriculture and the liberalization of agricultural markets have been fully achieved in Kyrgyzstan. In Tajikistan this process has only partly been achieved and agriculture continues to struggle with a quasi-command system and a high level of cotton-related farm debt. In Uzbekistan, progress is equally limited, with wheat and cotton still being command crops to be compulsorily grown and sold to the state. Accordingly, the scope for improving water productivity at plot level will vary substantially between countries, size of landholdings, and cropping pattern to name a few.

The phase objective was: *Development of a solid project document inter alia on the basis of and in conjunction with activities below WUA/WUG previously carried out within the IWRM project.*

In pursuing the objective, particular attention was paid to:

- the data base on current water use and productivity at plot level according to crops and farm sizes initiated by SIC/IWMI under the IWRM project while concurrently promoting selected good practices of water management through linking persons to extension.
- existing research and extension materials concerning plot level water productivity and productivity improvement in Central Asia.
- gaps to be addressed in the main phase in the areas of 1) adequate knowledge; 2) technical adaptation requirements; and 3) socio-economic context (gender segregated work load and load trends; labour availability and qualification in the light of a feminization of agriculture; cost-benefit, incentives etc.).
- the suitability of existing extension strategies and approaches and on suitable partners for results dissemination/extension in each country.
- the strategy and an institutional setup together with the potential partners for the main phase (phase 2).

Expected outputs

The expected outputs of the inception phase were divided into four components:

1. Data base on water productivity at plot level strengthened and dissemination of current good practices of water management through extension, initiated under the IWRM project.

2. Situation /gap analysis completed that included:

   2.1 Data on current situation and practices (including existing research and extension recommendations and international norms) collected, systematized and collated
   2.2. Limitations and bottlenecks (technical, labour, socio-economic) and particularly the role of and likely impact on women analyzed and collated.

3. Extension strategies, approaches and material with respect to water productivity improvement at plot level reviewed and prospective partners assessed.

4. ProDoc for Phase II (Implementation Phase) elaborated and agreed by stakeholders.

3. Results/achievements of Inception Phase

Component 1: Strengthening database on WP and dissemination through extension

During the inception phase of the project, the dissemination and training work started in the third phase of the IWRM-Fergana has continued. During this period, processing of data collected from IWRM pilot site and non IWRM fields has progressed. This data included water use and agro-economic indicators at pilot level (quantity of irrigations, date of irrigation, starting and finishing of irrigation, water supply at polygons, specific water used per hectare). Besides, data on irrigation technology (length of a furrow, distance between ok-aryks, etc.) was also obtained. This data was processed to quantify water application to fields and the corresponding runoff from polygons.

In Sogd region the project cooperated with the Canadian Center on the International Studies and Cooperation (CECI) that has a network of demonstration plots throughout the region. Each demonstration plot has a trainer from CECI who monitors the demonstration plots and provides advisory services to farmers located in the area. The project trainers are provided with methodical help concerning rational use of irrigation water through provincial executors.

In Kyrgyzstan activities were organized in Osh SKS (RAS) sites in 6 regions through 7 trainers-advisers where 645 farms are involved. In Uzbekistan, project work was undertaken with the Basin Irrigation System Authorities of (BISA). With the help of BISAs in Fergana and Andijan regions, monitoring of existing water use conditions, introduction of improved technologies for efficient water use and water productivity improvement were undertaken in each district. Each plot had a trainer-hydro technician assigned who monitor irrigation water use at the field level and extended advisory service to farmers.

Activities with the above mentioned organizations were initiated in April 2008. All information on irrigated agriculture at the farm level gathered during monitoring was systematized in the form of a database. This database allows the evaluation of basic trends of irrigated agricultural development in the region and provides an estimation of the impact of individual factors on efficiency of water use and crop production.

Dissemination of best water management practices

Based on materials of field monitoring on water use and agro-technical measures following problems were identified to develop, plan and implement the dissemination strategy which were based on needs of farmers:

- top-heavy irrigation rates are used everywhere;
- grate losses on runoff and filtration because of low level of knowledge and non-observance of technology of irrigation;
- absence of water account at taps of farms
- instable water supply at farm border
- incorrectly chosen technological schemes and parameters of furrow irrigation
- discrepancy between planned irrigation modes and required ones
- low quality of lands leveling

- relatively low quality of separate agro-technical arrangements
- absence of plan-schedule of water use

The dissemination of information and training was provided through existing advisory services in Kyrgyzstan and Tajikistan and through Basin Authorities of the Irrigation Systems in Uzbekistan. In Tajikistan, CECI conducted trainings in 5 areas in which 17 extension workers were trained. Five bulletins were prepared in Tajik and Uzbek languages which were distributed among 202 farms. In Kyrgyzstan, 7 advisors belonging to SKS (RAS) were trained in 6 areas of Osh region covering 645 farms. Regional advisors of the project prepared 6 bulletins in Kyrgyz language for distribution among farmers.

In Uzbekistan, due to the absence of an advisory service platform, the project cooperates and works with the Basin Irrigational Systems Authorities (BISAs). In the Fergana and Andijan regions, advisory services impacted 171 farms with a total area of 3921.4 ha out of which 2197.1 ha were under cotton, 1715.5 ha under winter wheat and 103.8 ha under other crops. In the Andijan region, there are 14 regions with a total area of 213 ha, out of which 93.3 ha are under cotton and 119.7 ha under wheat. The Polygon advisory services covered 236 farms with a total area of 6978 ha, out of which 4031 ha are under cotton, 2740 ha under winter wheat and 207 ha under other crops. Regional advisors provided 9 bulletins for farmers on different aspects of land and water management and also noted problems faced by farmers.

Four leaflets in Kyrgyz, Tajik and Uzbek languages were prepared covering the following topics:

1. Water rates for cotton and winter wheat;
2. Technological scheme of watering in view of various soil conditions and field biases;
3. Inter-irrigation actions on saving the soil humidity;
4. Necessary inter-irrigation actions for increase of water and land efficiency.

The leaflets were disseminated by trainers among farms located near IWRM plots and also among farmers participating in meetings organized by local authorities (Table 1). Trainers also visited farmer fields to answer their questions and gave practical recommendations to solve their respective problems. After every 10-15 days, regional executors of the project conducted meetings with trainers for discussion on field work, quality checks for monitoring and records in field notebooks.

Table 1: Quantity of leaflets distributed to farmers in different regions

Regions and advisory services	Quantity of farms	Quantity of leaflets disseminated to farmers
RAS, Osh region	180	360
CECI, Sogd region	76	304
Fergana BISA	220	880
Andijan BISA	325	3200
Total	801	4744[1]

[1] Mentioned leaflets were produced by local partners using equipment provided from the IWRM FV project during Phase 3

For the purpose of data collection, three WUGs in Kyrgyzstan, three WUGs in Tajikistan and six WUGs in Uzbekistan were selected. The data consisted of on farm water application and crop yield for major crops. Details of selected WUGs in the three countries are presented in Table 2. These leaders of WUGs have been instructed to collect data for further analysis of WP and other parameters.

Table 2: Details of selected WUGs to collect WP data

	Provinces	WUA	WUG	Irrig. area (ha)	Type of water users
1	Sogd	Rahbar kosimov	H. Vohidov	122	1 dehkan farm and 75 small landholders
2	Sogd	Rahbar Kosimov	O. Boboev	76	1 dehkan farm and 30 small land holders
3	Sogd	Rahbar Kosimov	Iskandarov	64	1 dehkan farm and 120 small land holders
4	Osh	Sharq Uvam	Dyuker	18	48 farms
5	Osh	Sharq Uvam	Sattor	16	36 farms
6	Osh	Sharq Uvam	Sharkratma	24	28 farms
7	Andijan	Hujaobkash	masjid boglari	30	2 farms and 2 mahallas
8	Andijan	Hujaobkash	Hujaobod	14	6 farms
9	Andijan	Tomchi kuli	K-4 leviy-1	35	4 farms
10	Andijan	Tomchi kuli	Perviy may-1	17	3 farms
11	Ferghana	K.Umarov	Dashman	91	4 farms and 1 mahalla
12	Ferghana	K.Umarov	Toglik	76	3 farms and 3 mahalla

Training of consultants

As a vehicle to disseminate project results local freelance consultants were nominated by WUAs in each country, and trained through this project. The reasoning behind this was to make local knowledge accessible and usable locally. In total, 36 independent local retired consultants (for training details see Appendix 3) have been selected for developing informal extension services in Fergana valley. They were trained on subjects related to on-farm water management with the expectation that they will provide freelance consultancy services to farmers in their respective districts and to WUAs.

The steps in this training included:

- Identifying the locally recognized, experienced (or even retired) leaders of former kolkhoz, water managers of *rayvodkhoz*es, *kolkhoz* hydrotechnicians, ditch riders, former brigadiers, agronomists, irrigators available within WUA or nearby with the consent of WUA;
- Train and equip the these local consultants on water management concepts that are promoted under IWRM principles (hydrographic, demand oriented, participatory, user oriented, simple rotational mechanisms, bottom up WUA concept; role of water users in the governance, WUG concept);
- Linking them as local consultants with existing WUAs in the project area and making a “consultants resource pool” available for needs based extension for WUA specialists, farmers, water users, WUG leaders and water managers on request. He or she will be available to the WUA members on a fee base individual (private farms) or group consultations;

- Facilitation of informal and nominal payment mechanisms at an affordable level for water users such as in-kind contributions that included harvested products, the collection of fees, or through labour/help etc.;
- WUA/WUGs will organize and coordinate the service and payment - a nominal payment mentioned above and collected from the beneficiaries on a case by case basis (not a full time and salary based employment);
- Periodic process monitoring, constant follow up and methodological back up from the project side provided by the members of SMID team;
- Facilitation and promotion of these local "freelance" consultants within and outside WUAs through WUA informal networks;
- Facilitation of knowledge transfer from local research and academic institutions to local consultants through links established between local academic and research institutes with the freelance consultants;

The subjects covered under these trainings included: crop water requirements (plant development stages and its water demand, critical phases of development, irrigation timing, field measurements to assess the need for water); water use planning (data requirements, role and participation of farmers in forming demand, simple spreadsheet, water agreements, adjusting water use in terms of seasonal changes); distribution of water amongst farmers (rotational, role of water user groups, role of collective action, water conservation and methods of effective use); measuring water flow and recording (measurement equipments, water accounting and recording for farmers, where and how to install different water measuring devices, water recording protocols) and performance assessment (indicators: equity, reliability, timeliness and sensitivity, how to conduct performance assessment, roles and responsibilities, data requirements and protocols, interpretation of performance results into decision making).

Component 2: Situation /gap analysis undertaken

Diagnostic analysis of current situation and practices

The data collected from IWRM monitoring fields and non-IWRM fields was analyzed to assess the current status of water productivity in the area. For this purpose, reports and published material from different ministries and research organizations of three countries were also used for comparison. A brief description of our findings is given below.

2.1 Results from IWRM monitoring fields

The data collected from different experimental farms and government departments indicate current farmer irrigation practices in CA are aimed at applying maximum water to the plot in order to maximize crop production. Data collected from polygons under IWRM project have shown that average irrigation water applied to wheat in Andijan province is 7650 m^3/ha, 9220 m^3/ha in the central part of the valley (Fergana zone) and 9620 m^3/ha in the south-west (Kokand zone). In the case of cotton, irrigation applications of 8650 m^3/ha for the Kokand, 9110 m^3/ha for central part of Fergana Valley and 7520 m^3/ha in the Andijan zone are common.

The productivity of water (crop yield per unit of water applied at the plot level expressed in Kg/m^3) at individual farms of the Ferghana region ranges between 0.3 to 0.4 kg/m^3 for cotton and 0.4 to 0.7 kg/m^3 for winter wheat. The small differences in water productivity demonstrate that there are not large differences in water use and crop yields within the Ferghana region. The highest water productivity for cotton is observed in Andijan and Ferghana regions of Uzbekistan, which remained between 0.31 to 0.32 kg/m^3. For winter wheat, WP ranged between 0.68 to 0.85 kg/m^3 for Andijan and Ferghana regions (Figure 1).

In Kyrgyzstan, average WP values in the Osh province were 0.22 and 0.70 kg/m^3 for cotton and wheat, respectively. However, in Sogd province of Tajikistan, water productivity of wheat and cotton was far below than Uzbekistan and Kyrgyzstan. WP for cotton decline to a low of 0.15 kg/m^3 whereas WP for winter wheat reaches a maximum of 0.30 kg/m^3.

The results obtained from experimental fields under IWRM project suggest that the recommended irrigation norms (280-580 mm for cotton and 320-520 mm for wheat) based on hydro-module system are not adhered to by farmers.

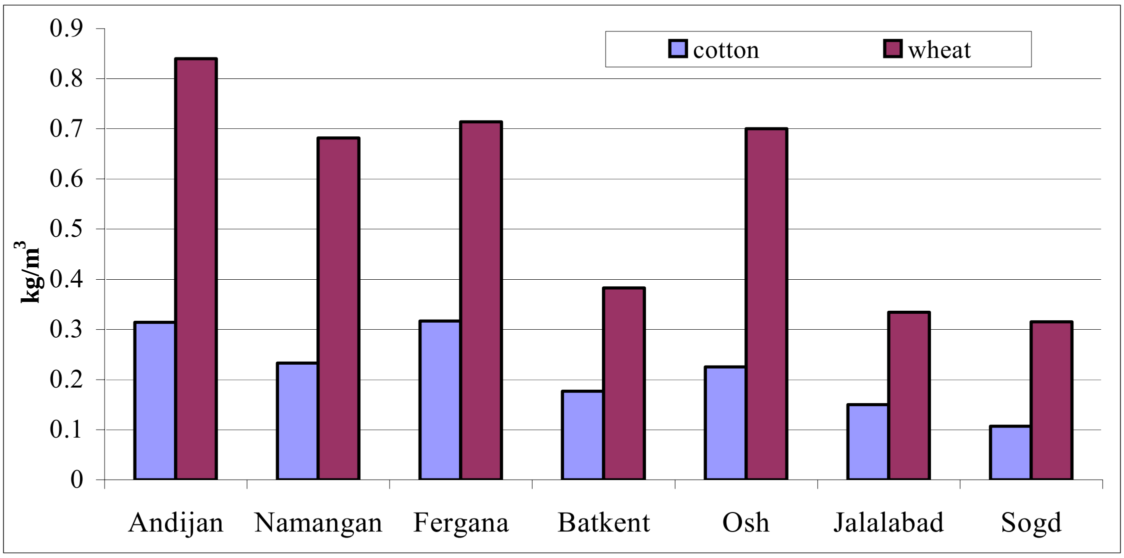


Figure 1: Comparison of water productivities of cotton and wheat at individual farms in different regions of Ferghana

Table 3 demonstrates that actual water applied through irrigations is much higher than recommended under hydro-module system. This may in part be due to the fact that farmers are not fully aware of these recommendations. During the field surveys under this project, farmers also reported that the recommended irrigation norms were prepared 25-30 years ago when soil, groundwater and crop conditions were different from today. Therefore it becomes imperative to revisit these recommendations and adjust them according to current soil, climate and crop conditions. After reconfirmation of this data, new guidelines should be prepared for each agro-ecological zone as crop requirements differ due to amelioration conditions and agro-geological conditions. These recommendations should be disseminated to farmers through extensive extension services and demonstration plots.

Table 3: Comparison of recommended and actual water use for cotton at demonstration fields

Farm ID	Amount per irrigation event*		Total amount of irrigation water for vegetation season		Outflow[2] losses		Deep percolation		Field application efficiency
	Norm	Actual	Norm	Actual	Norm	Actual	Norm	Actual	Actual
	m^3/ha	m^3/ha	m^3/ha	m^3/ha	%	%	%	%	%
Samatov (Tajikistan)	1220	751	6642	8264	12,5	10,3	11,7	19,7	70
Sajed (Tajikistan)	960	524	7296	7342	16,9	20,8	20,2	20.2	59
Bahoriston (Tajikistan)	960	1621	7587	12968	16,9	19,5	20,2	35,5	45
Hozhalhon (Uzbekistan)	1090	1866	8038	18804	12,9	18,2	17,4	40,6	41
Nozima (Uzbekistan)	900	2239	4074	6718	1,9	0	30,9	58,1	42
Turdiali (Uzbekistan)	965	429	2090[3]	4020	10,3	5,1	11,5	10.7	84
Tolibzhon (Uzbekistan)	960	1902	6871	9399	16,9	12,9	20,2	28.5	58
Tolojkon (Kyrgyzstan)	1011	2902	2982	5803	1,3	32	45,8	40.2	28
Noursultan-Ali (Kyrg)	800	2560	3530	5120	4,9	18,4	26,9	31.2	50
Sandyk (Kyrgyzstan)	1150	1206	7072	6030	1,3	25,8	45,8	10.7	64

** Irrigation amounts recommended by SIC based on hydro-module system.*

[2] Inflow and outflow are measured using standard water flume meters (hydroposts)
[3] Here groundwater level is less than 0.5 m from the soil surface during peak irrigation periods, that is why very low irrigation norm which takes account shallow groundwater level

For calculation of filtration losses (deep percolation) the following approach was used – the full saturation is equal to the field capacity (FC). Prior to each irrigation event we have soil moisture equal to FC – ET (where ET is actual evapotranspiration). To fill the deficiency of depleted water till ET we determine the value of moisture scarcity to FC rate based on calculations and recommended by Sh.Mukhamedjanov (Sh.Mukhamedjanov, 2004). The acquired amount is the irrigation norm that needs to be applied to field. By knowing how much water was applied to field, the difference between it and moisture deficiency till field capacity is the value of deep percolation (filtration) losses.

$$F = M - (L*100* V*(FC - SM)) - R$$

где:

F – deep percolation losses due to filtration, m3/ha;
M – irrigation norm, brutto, m3/ha;
L – soil layer, m;
V – soil volumetric weight, g/cm3;
FC – field capacity, in % from soil weight;
SM – soil moisture before irrigation, in % from soil weight;
R – outflow losses from field, m3/ha.

Field application efficiency is ET actual divided by the amount of actually delivered water to the field.

From the data of monitoring fields, it appears that there are large discrepancies in the amount of irrigation water actually applied and the amount of water recommended through irrigation norms. To solve this problem, under IWRM project, crop water requirements were calculated for individual demonstration fields and farmers were advised to irrigate their cotton fields according to the recommended rates. Comparison of recommended and hydro-module based irrigation requirements is presented in Figure 2. The figure shows that project recommend only four irrigations instead of continues flow per decade based on previous hydromodules. In June only two irrigations are required as compared to three irrigations applied by farmers. Similarly in July, only one irrigation is needed as compared to three irrigations applied by farmers. In August, farmers do not need to apply irrigation water. This shows that by adopting recommended irrigation schedules, farmers can save considerable amount of water..

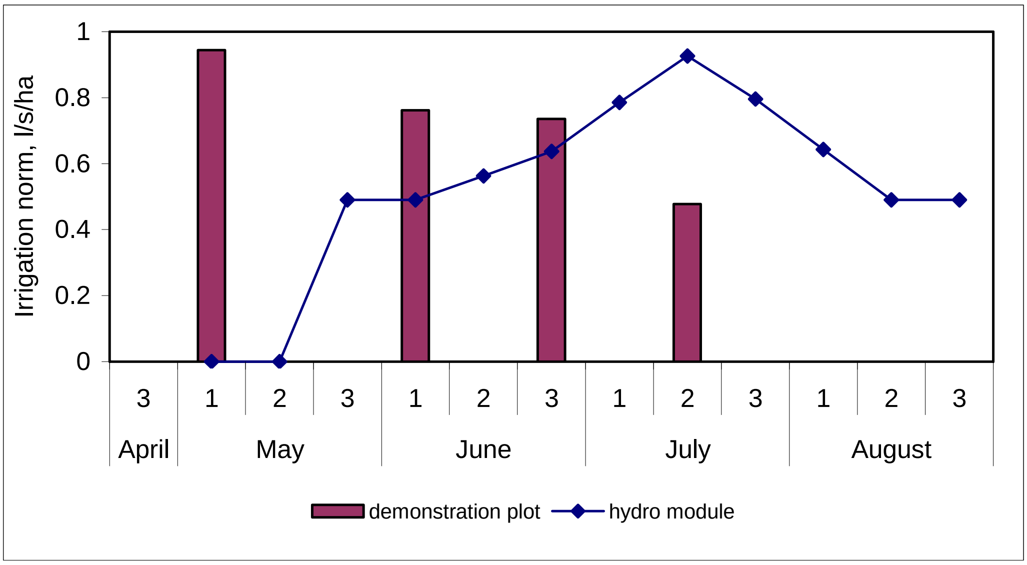


Figure 2: Comparison of recommended (demand based irrigation events) and hydro-module (continuous and constant flow - discharge - of irrigation water per decade) based irrigation for cotton

2.2 IWRM project interventions to enhance water productivity

Based on the analysis of the available data of 2002, the project developed a set of recommendations for farmers to carry out field operations and irrigation practices. These include timing and quantity irrigation, methodology of field work monitoring, field-specific layouts for irrigation and agro-technical aspects. These recommendations were aimed at improving irrigation and production processes and to achieve higher efficiency of water use at pilot sites. The findings of the study suggest that during 2004 water saving was better as compared to previous years i.e. 2002-03. Table 4 compares the water use for years 2002, 2003, and 2004.

Table 4: Comparison of irrigation water use in different areas during 2002 to 2004

Farms	Irrigation norm required for whole vegetation season*			Outflow losses						Deep percolation losses						Field application efficiency		
	2002	2003	2004	2002		2003		2004		2002		2003		2004		2002	2003	2004
	m^3/ha			m^3/ha	%	m^3/ha	%	m^3/ha	%	m^3/ha	%	m^3/ha	%	m^3/ha	%			
Bahoriston (Cotton)	8264	5012	8032	853	10	468	9	339	4	1628	20	674	13	2364	29	0,70	0,77	0,66
Sajed (Cotton)	7342	5940	6658	1536	21	1071	18	895	13	1483	20	142	2	575	10	0,59	0,80	0,78
Samatova (Cotton)*	12968	7643	8815	2483	19	1557	20	1361	15	4604	36	622	8	1588	18	0,45	0,71	0,67
Hozhalhon (Cotton)	18804	12525	10305	3173	17	1980	16	2342	23	7635	41	3917	31	3683	36	0,43	0,53	0,42
Nozima (Cotton)	6718	3468	4523	0	0	0	0	0	0	3903	58	1281	37	647	14	0,42	0,63	0,86
Turdiali (Cotton)	4020	3429	3290	255	6	453	13	164	5	430	11	133	4	292	9	0,83	0,83	0,86
Tolibzhon (Cotton)	9399	5925	5761	1208	13	1685	28	1485	26	2679	29	631	11	634	11	0,59	0,61	0,63
Tolojkon (Wheat)	5803	4569	5494	1855	32	606	13	1666	30	2333	40	2040	45	1938	35	0,28	0,42	0,34
Noursultan (Wheat)	5120	2130	4393	942	18	418	20	1200	27	1597	31	418	20	1404	32	0,50	0,61	0,41
Sandyk (Cotton)	6030	5540	6236	1554	26	1170	21	1139	18	645	11	593	11	686	11	0,64	0,68	0,71

** - Irrigation amounts recommended by SIC based on hydro-module system.*

The adoption of cultural and irrigation practices proposed by the IWRM project also helped in enhancing crop yields and water productivity in the pilot sites. These interventions actually helped in improved management and performance of agro-technical operations which resulted in lower water use and higher water productivity. Similar results were obtained for pilot sites in Tajikistan and Kyrgyzstan. Table 4 shows that at different individual farms water productivity vary heavily. However, statistical analysis suggests that improvements in water productivity at the regional level are not significant at 5% confidence level.

Changes in water productivity in different pilot sites during 2002 to 2004 are shown in Table 5. The reason for this is the high degree of variability between farms.

Table 5: Water productivity in pilot sites during 2002 and 2004

Farm	Crop yields (kg/ha)			Water use (m^3/kg)			Water productivity, (kg/m^3)		
Years	**2002**	**2003**	**2004**	**2002**	**2003**	**2004**	**2002**	**2003**	**2004**
Bahoriston (Cotton)	2450	2722	3104	5,29	2,81	2,84	0,19	0,36	0,35
Sajed (Cotton)	2750	2925	2992	2,67	2,03	2,23	0,37	0,49	0,45
Samatova (Cotton)*	3220	3253	2340	2,57	1,54	3,43	0,39	0,65	0,29
Hozhalhon (Cotton)	2640	2691	3070	7,12	4,65	3,36	0,14	0,21	0,30
Nozima (Cotton)	2420	2000	2783	2,78	1,73	1,63	0,36	0,58	0,62
Turdiali (Cotton)	3520	3920	4600	1,14	0,87	0,72	0,88	1,14	1,40
Tolibzhon (Cotton)	3790	3620	4100	2,48	1,64	1,41	0,40	0,61	0,71
Tolojkon (Wheat)	3000	4430	4580	1,93	1,03	1,2	0,52	0,97	0,83
Noursultan (Wheat)	2440	4300	4300	2,10	0,50	1,02	0,48	2,02	0,98
Sandyk (Cotton)	2860	3060	3585	2,11	1,8	1,7	0,47	0,55	0,57

** A long-staple low-yield cotton variety was grown in Samatova farm in 2004.*

Table 6: Changes in water supply, crop yields and water productivity during 2002 and 2004

Improvement indicators	Tajikistan	Uzbekistan	Kyrgyzstan	
	cotton	cotton	cotton	Wheat
Decrease in water supply	33 %	34 %	17 %	40 %
Increase in crop yield	18 %	21 %	25 %	64 %
Increase in water productivity	62 %	69 %	52 %	96 %

2.3 Results from non-IWRM fields

Irrigation requirements were calculated for wheat and cotton using FAO Penman-Montheit method. For this meteorological data for 2004 was used from Kokand, Fergana and Andijan weather stations. Groundwater data was collected under the GW Fergana Valley project funded by OPEC. Actual crop irrigation water supply obtained from the Basin Irrigation System Administration Syrdarya-Sokh water use planning unit.

Irrigation water applied to cotton and wheat crops in three districts of Ferghana against the recommended values for 2004 is presented in Figure 3 for and Figure 4 for wheat. Irrigation crop water requirements were calculated using FAO Penman-Monteith method (FAO, 1977). Actual irrigation rates district wise are taken from Basin Irrigation System Administration (BISA) Syrdarya-Sokh. The irrigation rates given at the district level include losses at field and irrigation canal levels also. Losses at the irrigation system level amounts to 0.355 of total irrigation water delivered at the district level.

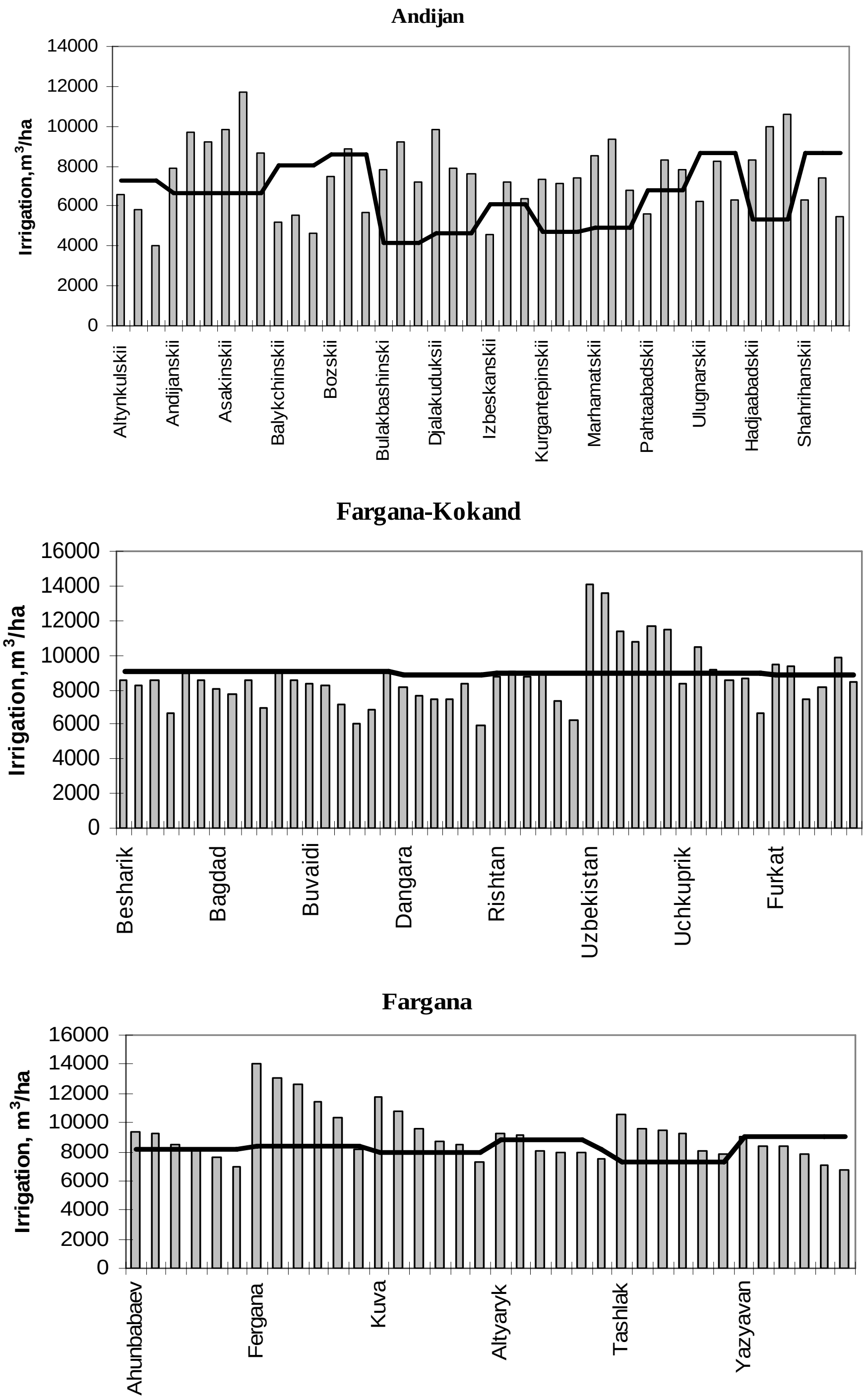


Figure 3: Irrigations to cotton in three districts of Ferghana (the line indicates the recommended irrigation requirement).

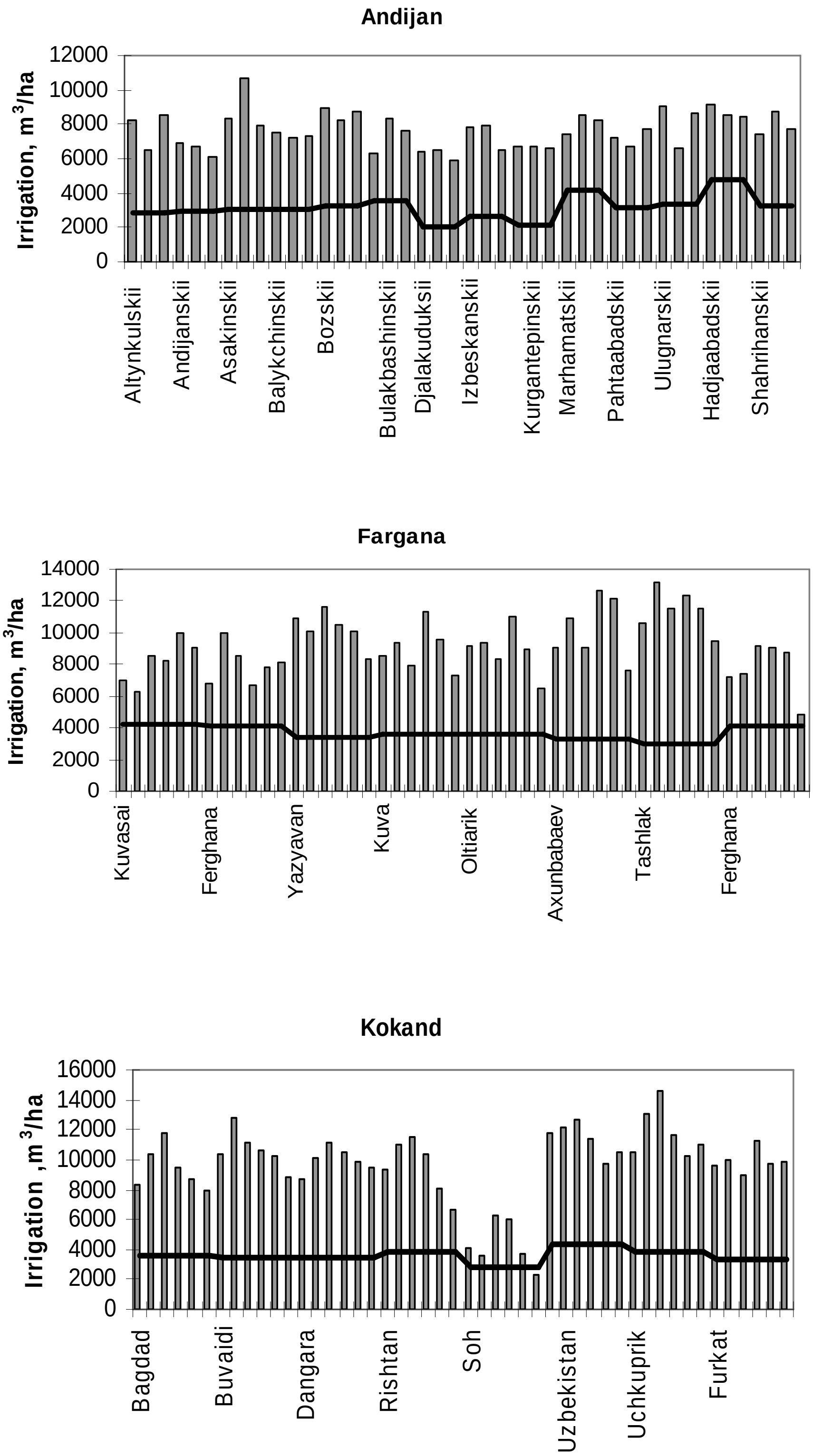


Figure 4: Irrigations to wheat in three districts of Ferghana (line indicates recommended irrigation requirement).

Figure 3 and 4 would suggest that irrigation water application to cotton and wheat varies from one district to another. Large variations are found in the Andijan province where actual applied water is 57% to 198% higher than recommended values. This clearly indicates poor planning in water distribution and highlights the need for educating farmers on actual crop water requirements. It is of note that excessive water applications are more prevalent in the upper part of the system where water availability is relatively higher. This shows that farmers having less access to water are more careful in using it. As seen as from Figure 3 and 4, wheat is over-irrigated as compared to cotton. This is because farmers in order to get high yield of grain apply more irrigation. They believe that high irrigation water rates ensure high yield of wheat. Since supply is unreliable farmers use available water as much as possible. They sale excess as compared to state quota grain production by the market prices while for cotton the picture is different. That is why in order to gain extra grain for their own needs and for cash they try and succeed to get high yields however this is high water consumptive option.

Farmers succeeding in wheat production failing in cotton production and in many cases yield of cotton is lower as compared to obtained earlier during the collective farm time. This is indication that farmers are not interested (due to lack of free marketing) or are not able to produce high yields which relates to agronomy and farming practices. Low irrigation water supply for cotton shows lack of incentives for farmers from cotton production.

In Ferghana province, variations in water supply are less pronounced and the excessive applications remain within the range of 74 to 168%. On the other hand, in the Kokand zone, irrigation water supply was less than the irrigation requirements except for Uzbekistan district. These areas have a shortage of irrigation water and consequently soil salinity problems, which contributes to lower crop yields and low water productivities.

Current irrigation practices of farmers in the Ferghana include a tendency to over-irrigate and hence there is a need to reduce the amount of water applied. Irrigation practices observed in the field are based on the maximum amount of water a farmer can acquire. Lower crop yields in the Ferghana zone are also due to lower application rates of fertilizers. High water losses during irrigation application in Ferghana are related to its lighter soil types. Therefore in this area, irrigation technologies other than furrow irrigation should be considered.

A review of studies conducted in Tajikistan (FAO, 2005; Toderich et al., 2006; KasWag, 2008) has shown that after independence yields of cotton declined significantly. Prior to independence average cotton yields were 2.8 t/ha compared to current yields of 1.9 t/ha. Similarly, current average wheat yields are in the range of 2.0 t/ha, down from above 2.5 t/ha before independence. Reasons for these declines in the yields are lack of input resources that include certified seeds, fertilizer and farm machinery. Currently agricultural machinery available in the country is sufficient to fulfill 20% of total needs. Only 10-15% of the entire cereal crop is sown by mechanical drills whereas the rest is sown manually or by other traditional methods. This results in non-uniform crop germination and significant yield losses. In addition, quality seeds are not available. Quality seed provided by different donor agencies and NGOs are too low to meet actual demand. Lower than recommended applications of fertilizer is a further key factor in low crop yields. Low usage of fertilizer is mainly attributed to higher costs.

In Tajikistan, irrigation water is usually not measured and irrigation scheduling is still based on conventional approaches and there is no culture of applying irrigation water according to actual crop water requirements. The problem is further aggravated due to the fact that no guidelines on irrigation scheduling for different crops is available in the country. The concepts of water requirement of different crops, impact of water deficit at different growth stages of crop, improving water application and water use efficiency are not known to most of the farmers. Lack of knowledge on water holding capacities of different textured soils is the major reason for wide scale in field percolation losses. As a result, waterlogging and soil salinization problems are emerging in many irrigated areas. Therefore there is a need to provide relevant extension services to farming community so as to enhance their capacity to use irrigation water more productively.

The results obtained during the inception phase shows that amount of water applied for individual irrigation bears no relationship to actual crop water requirements. In most cases, farmers open the field inlet from one end and allow the water to completely fill the field and over flow into the next field. Furrow lengths are usually over 200 m long. Farmers' perception of what is a good irrigation is the amount of water impounded in the field when irrigation is completed. This method does not include infiltration rate during irrigation, soil moisture deficiency, the roughness of the soil profile (fallow or cropped), and the slope or level of the field. Due to neglect of these important factors, the applied amount of irrigation is usually two to three times higher than the required amount for a particular crop.

Despite increasing demand for water, Kyrgyzstan is one of the highest water using countries in the region. The average annual use of irrigation per ha exceeds 11,000 m^3, which is far above international standards (UNECE, 2000). The irrigation water use in Kyrgyzstan is even higher than Egypt and Pakistan (these two countries are also not well known for efficient irrigation water use), which are using 9,000-10,000 m^3 per ha per year. The high rates of application are mainly due to high water losses both at farm and system level. Poor irrigation and drainage infrastructure is mainly responsible for system losses, which are about 25% of Kyrgyz water use (FES/IISS, 2003). At the plot level, water is lost due to over irrigation as farmers are not aware of actual irrigation requirements of crops. This results in lower productivity of water at the plot level.

2.4 Results from the review of different projects carried out in CA

Data collected on projects such as Best practices, Bright spots, Soil and Water, water productivity was analyzed to get information regarding current water use patterns, volumes of water applied to different crops under field conditions, irrigation technologies applied, crop yields, inputs used, farm incomes etc. Consultants were hired to collect essential secondary data and synthesize on-farm water management practices, socio-economic limitations for the adoption of improved irrigation technologies and other limitations faced by farmers to adapt these technologies.

During the month of August, the project conducted a preliminary survey of farmers from selected WUGs to obtain first hand information on the perception of farmers regarding on-farm water management issues. The survey was completed in the second week of August. Analyses of the data collected was undertaken to meet the September workshop deadline.

Preliminary results suggest that water productivity is less than 0.3 kg of raw cotton or wheat grain per m^3 of irrigation water under excessive water conditions in some parts of the region while others are stressed by water shortage. Over 30000 ha of agricultural land of Mirzachul steppe are abandoned due to a lack of irrigation water and consequent salinization (Kushiev et al., 2005).

Farmers on over 900000 ha of land of middle stream of Syrdarya river receive water for 1-2 irrigations of cotton which causes low yields not exceeding 2 t/ha. In conditions when upstream regions have issues related to excessive water use causing water logging and salinity, farmers of lower reaches do not have access to water that result in thousands of ha being taken out of cultivation.

Water productivity improvement can be achieved through yield increase or a reduction in unnecessary soil evaporation or applied irrigation water. The results of selected water conservation technologies tested in the CA region that have shown improvements in water productivity through reductions of non-productive soil evaporation or applied irrigation water are discussed below.

Improved alternate furrow irrigation: Alternate furrow irrigation (AFI) has been adopted by many innovative farmers in different parts of the region. Alternate furrow irrigation technology has proved successful on moderate and heavy loam soils. The yield of raw cotton was increased using cutback and discrete methods of irrigation by 10% and 8%, respectively, compared to the control. On average, surface runoff was reduced by 34% and deep percolation by 14% using cutback and discrete AFI. AFI increased WP by 8-57%. Reduction of physical evaporation from the soil surface contributed to increase of WP. Although average WP under AFI was increased by 32%, the WP values remained below 0.5 kg/m^3 which suggest the need for integrated water/soil/crop management.

Drip irrigation: Drip irrigation was tested in various regions of Uzbekistan under different soil conditions on sloping areas and lowlands. Conventional furrow irrigation along the slope prevalent in foothill areas of Central Asia causes significant surface runoff and soil erosion. On these areas surface runoff amounts to 50% of applied irrigation water, soil erosion exceeds 10 t/ha. There are some documented cases from sloping areas when soil erosion was more than 50 t/ha due to poor irrigation practices. Under these conditions micro-irrigation is an alternative method to sustain soil productivity and to avoid soil erosion. Self-pressurized drip irrigation technology tested under similar conditions at Boikozon farm, Tashkent province for grapevines and inter-row vegetables showed high efficiency and water saving (Karajeh et. al., 2004, Novikova et. al., 2003).

Cost of the installation of drip system was 2246 USD/ha. Net profit from vegetables in first year was 1683 USD/ha. The study showed that the capital cost of drip irrigation systems was recovered in the first two years. On lowlands efficiency of drip irrigation technology becomes especially evident under water shortage conditions and on light textured soils when conventional irrigation practices result in high water losses.

Soil mulching for water conservation: Water loss due to non-beneficial soil evaporation is one of the contributors to low water productivity by ET. By controlling excessive evaporation through bare soil can significantly improve water productivity (ET based). Under the Bright Spots project funded by ADB (Bright Spots, 2008), the effect of mulching on cotton yield was investigated at the Akaltyn site, Uzbekistan. The study found that wheat straw can effectively be used as mulch in reducing bare soil evaporation from the fields (Bezborodov, 2007).

This material could created an adequate soil cover and reduce physical evaporation. Mulching improved the water productivity by 10%. Soil moisture content under mulching was 15% higher compared to the none mulched treatment, which reduces irrigation requirements especially for low and moderately saline water conditions. Application of mulch reduces non-productive evaporation and that way decreases salinity increase in the topsoil, which means less water is required to maintain proper soil salinity level.

Application of Bentonite to improve soil permeability: Bentonite is usually applied to improve physical and chemical properties of light textured soils to increase water holding capacity. Since bentonite contains the clay mineral montmorilonite it has a high cation exchange capacity exceeding in some cases 100 cmolc/kg. Application of bentonite significantly improves cation exchange capacity of soil. Application of bentonite in Khorezm on sandy-loam soil increased cotton yields by 10-33% compared to no bentonite treatments.

Furrow Irrigation on sloping areas: Traditional irrigation on sloping areas which is mainly applied along the maximum slope causes high surface runoff and soil erosion. It is estimated that almost 800,000 ha of irrigated land in Uzbekistan, including 268,000ha in high altitudes are affected by water erosion. Poor irrigation practices along with heavy rainfall events contribute to soil erosion and fertility reduction. Existing irrigation system promotes erosion loss, which range from 22 to 50 kg/ha with each irrigation, which results in rapid reduction of highly productive surface layer. Different technologies were tested recently for sloping areas of Tashkent province under ICARDA On-farm S&W project funded by ADB (F.Karajeh et al., 2004, Kambarov et. al., 2003). One of them is contour and 'joyak' (zigzag furrow) irrigation. Water productivity of wheat under contour or joyak irrigation was in the range of 0.87-0.90 kg/m^3 while under conventional furrow irrigation it was 0.70 kg/m^3. Moreover, contour irrigation arrested soil erosion and improved soil productivity.

Supplemental irrigation: Supplemental irrigation is another way of enhancing yields and WP on sloping areas by conjunctive use of rainfall and irrigation water. The productivity of both irrigation water and rainwater is improved when they are used conjunctively. The average rainwater productivity of wheat grains in the dry areas is about 0.35 kg /m^3. However, it may increase to as much as 1.0 kg/m^3 with improved management. It was found that 1 m^3 of water applied as supplemental irrigation at the proper time produce more than 2.0 kg of wheat grain over that using only rainfall (Oweis, 1997; Oweis and Hachum, 2003; Akramov et al., 2004).

Improving water distribution at field level: One of the deficiencies of current irrigation practices at field level is manual water distribution which takes time and there are additional water losses in irrigation ditches called "ok-aryk". SANIIRI in collaboration with ICARDA introduced portable plastic chutes at Kushman ota farm, Syrdarya province on lowlands. The chutes were designed for uniform water distribution at field level. After application of the chute irrigation rates were reduced by 30% on lowlands. Water productivity was increased for wheat on the sloping areas from 1.27 to 2.11 kg/m^3 when chutes were used compared to conventional furrow irrigation.

Using sprinkler irrigation the farmers achieved water productivity levels of 3.84 kg/m^3 for wheat (ICARDA, 2007). Even more tangible results were obtained when chutes were applied on sloping areas of Boikozon farm, Tashkent province in combination with contour irrigation. After application of the chutes, irrigation rates were reduced by 17-23% and water productivity for wheat was increased from 4.4 to 6.5 kg/m^3 compared to conventional furrow irrigation. Plastic chutes tested at Kushman ota farm showed the same effect for cotton water productivity. Irrigation rates using plastic chutes are reduced from 4000-4500 m^3/ha to 2400-3500 m^3/ha and

WP increased to 1.15 kg/m^3. A limitation in the adoption of this technology is its high cost (Karajeh et al., 2004).

Raised bed planting: Raised bed planting is well known in the region (Ryjov et. al., 1980). Yields of cotton under raised bed planting were found to be 3.7-4.8 t/ha versus 3.4–3.8 t/ha under conventional practices. In southern Kazakhstan, the studies have proved that WP under raised bed planting of wheat were 25% higher compared to traditional sowing method. When cutback-furrow irrigation was applied on raised beds, water productivity reached 32% (Kalashnikov, 2005).

Effect of land leveling on crop yields: Effect of preparation of fields for cotton production was studied during 1986-1989 by SANIIRI (Khegai and Tatur, 2003). The studies were carried out at Gafur Gulam farm, Syrdarya province of Uzbekistan. Data indicated higher yields and high water productivity for cotton after fields were laser leveled. Irrigation efficiency gains were in the order of 0.75 to 0.93 after precise leveling. The data collected by IWRM project from Tajikistan also advocates gains in water saving, crop yields and water productivity when fields were laser leveled. In 2005-06, an experiment was conducted on 5 ha in the Sogd area of Tajikistan to evaluate the effect of laser leveling on water saving and crop yields.

A further study was carried out by IWRM project on loam soil of Gafurov district of Tajikistan with a deep water table. The experimental data indicates that laser leveling reduces irrigation rate by 10% and ET by 3% and increases yield of raw cotton by 36%. Irrigation water productivity for 2004-2006 was 48% higher compared to the yield of raw cotton on the control field. Water productivity calculated for ET was 38% higher compared to the control. The average annual net income from the laser leveled fields was 22% higher than that from the control field. In spite of considerable increase in water productivity obtained in the two studied cases, precise leveling is to be proposed selectively to avoid soil fertility losses.

2.5 Technical, labour and socio-economic constraints

2.5.1 Water related constraints

By far the most important factor which is common in three countries is the lack of knowledge about actual crop water requirements, which results in excessive water applications. In Uzbekistan, this information exists in the form of hydro-module systems; however, this approach is out dated and does not match with present day field situations. This is the reason why farmers are reluctant to use it as a management tool. These recommendations were prepared 30 years ago but since then in many areas soil and groundwater conditions have changed which necessitates revisiting of these recommendations. In Tajikistan, these guidelines do not exist and need to be prepared and disseminated to farmers.

We have also identified that irrigation applications in most of the fields has no relevance with the soil conditions of the area. For example, in Ferghana, a major reason of water losses associated with the heavy pre-sowing irrigation and light textured soils. As farmers are irrigating their fields using the furrow method, it requires large applications of water to cover the entire field especially particularly when these fields are not properly leveled. This causes huge field losses and results in low productivity of water. In Ferghana and Tajikistan, field losses are also subjected to long furrow lengths which create patches of low and high infiltration and consequently un-even crop stands. There is definitely a need to guide farmers to level their fields, adopt appropriate irrigation application methods suited to their soil type and to choose furrow lengths that best reduce field losses.

Unstable water supply to farms during the irrigation is another major reason of low water use efficiency. In all three provinces of Ferghana, the majority of farmers suffers from this and thus uses excessive quantities of water when available. In Tajikistan and Kyrgyzstan the largest losses of water are the result of the selection of inappropriate irrigation application methods. In Tajikistan, unavailability of water in pump irrigated areas is due to power shortages that significantly constraint then timely application of irrigations to crops. Details of water management constraints in improving on-farm water productivity are briefly discussed below.

Non-regular water supply from canals: In Ferghana, canal water is usually supplied in small intervals. After every 2-3 hours, water supply is stopped for the outlet pipe to which the farmer is linked. After the restoration of water supply, farmer is compelled to start irrigation again and consequently apply more than required. In Tajikistan and Kyrgyzstan, water losses mainly occurred due to the wrong selection of irrigation methodologies. Irrigation is undertaken through furrows having lengths up to 200 m, which creates patches of low and high infiltration within the same field. As a result, irrigation applications are usually higher than the recommended norms.

Absence of irrigation schedules according to soil, crop and climatic conditions of the area: In most of Uzbekistan, pre-sowing irrigation is being practiced regardless of soil type and climatic conditions in order to create favourable moisture conditions in the crop root zone. This results in large water losses in the case of light loamy soils and serves no purpose except wastage of water. Moreover, irrigation amounts recommended by the hydro-module system are not suited to present day soil and groundwater conditions and result in excessive irrigation applications. In Kyrgyzstan and Tajikistan, these recommendations are non-existing therefore farmers' irrigation practices are based on their conventional wisdom and have no relevance with the crop water requirements. This is not only wasting precious irrigation water but also causing soil erosion, water logging and salinity problems.

High field infiltration losses: Due to non-uniform furrow lengths and poor levelling of farmer fields, field percolation losses are high.

Higher runoff from fields: Due to excessive irrigation, over applications of water to fields is common causing high runoff from farmer fields.

Lower crop yields: In Fergana average wheat yields are 18% lower than in the Andijan area. For cotton, average yields are 11% lower in Ferghana as compared to Andijan. These lower yields are mainly due to lower application of phosphorous and potassium fertilizers. Another reason for these low yields is poor management of weeds and other crop diseases especially for cotton. In Tajikistan, crop yields are also far lower than Andijan province and Kyrgyzstan. These lower yields are also related to poor quality seed, low application of fertilizer and mismanagement of water resources. In pump irrigated areas, power shortages makes it difficult for farmers to get irrigation water as and when needed, which also affect crop yields.

Inefficient water distribution at the farms: Planning and distribution of water at the farm level is done only up to the canal border. As water measuring and control devices are not provided on all outlets, water is being used without any organization, discipline and sequence. Small farmers (< 1 ha) are scattered and they use water at their own discretion which makes it impossible to supervise their time and volume of application. Irregular electricity supply is another reason of delayed irrigation supplies to farmers. Moreover, most of the WUAs are also not providing enough guidance to farmers regarding water use as they lack experienced experts and because they do not have any control on water distribution as it is the responsibility of regional management of irrigation systems.

The aforementioned discussion indicates that farmers are wasting large amounts of irrigation water due to poor water management practices. On the other hand, many farmers are not able to irrigate their lands due to shortage of water. This clearly demonstrates the need to educate farmers regarding improved water management practices and water saving strategies.

In addition to these water related constraints, there are other limitations which are equally responsible for low water efficiencies in the target countries. These include:

- Chronic lack of extension services and inadequate access to finances
- Unreliable and expensive supply of seeds, fertilizers and pesticides etc. The situation is more serious in Tajikistan than in Uzbekistan and Kyrgyzstan.
- Lack of knowledge about agronomic and other cultural practices. Farmers do not have knowledge of advanced agronomic, cultural and soil management practices. Same the case with the access to latest seed varieties. The old varieties are now exhausted and can not give high yields. Therefore farmers are looking for new high yielding and low water consuming crop varieties.
- Irrigation and drainage infrastructure is in poor shape which causes huge conveyance losses. Farmers do not have the means to do the necessary repair work to attain adequate control of their water resources. Similarly there are no devices installed on major outlets for the measurement of water from major canals and the water which is delivered to farmer fields.
- Farmers in all three countries have machinery constraints. Farming implements for sowing, harvesting, leveling fields and to perform other field operations are either not available or are very old to be effective. Performing field operations manually takes considerable time and resources. Farmers are reluctant to level their fields or make smaller furrows or improve the layout of their field as it costs them lots of labor which they usually do not have. If they have labor they prefer to engage it in some off-farm income generation activity rather than using it on the farm.
- Due to imposition of quotas by the Hukumats, farmers are disowned and disinterested in improving their crop yields. As farmers are devoid of any incentives, there is no interest in saving water to improve productivity. Moreover, in Tajikistan, taxes per ha and cost of production of cotton is higher than in Uzbekistan and Kyrgyzstan, which makes it less attractive for farmers.

2.5.2 Social -economic limitations and role of women in water management

Under the IWRM, social surveys were conducted in the project area to get first hand information about the socio-economic constraints and role of women in water management. The results show that equal access of men and women in the decision making of water resources management is the need of today as the number of women manufacturers of agricultural production and number of women workers in agricultural fields has increased significantly over the last decade and they are now playing very crucial role in the development of irrigated agriculture in the region. However, in the main departments and operational services of water, men still dominate. It is interesting to note that in the central departments, women participation is more visible than men. However at district level their participation does not exceed 25% of the total number of

employees. Generally, women participation is about 18% with the remaining 82% dominated by men.
Women generally work in the field and get about 15-20$ per month or they are paid in kind such as share from agricultural production. The payments are only made during the cotton picking season. Mostly women work in the field performing the t labor-consuming manual work. Men basically do more qualified work – carrying out the irrigation, application of fertilizers, plowing and cultivation.
Almost in all regions of Fergana valley, women are taking over men in all spheres of life although their contributions are not fully recognized. With time, women are playing key roles in family and farm affairs. This is mainly due to the fact that most of the men have left their homes in search of employment in other cities and countries and women have no choice but to play this role.

In Tajikistan members of dehqan farm are basically women, and the head of dehqan farm is a man. Women have no rights in such dehqan farms. They have no idea about incomes, expenses on the land and production. Women are reluctant to take control of land or share of the land in dehqan farm because they might not be able to get any profits due to uncertainty of irrigation water supply. As they are women, they cannot agree with management of the canal or district water management on the amount of water and most likely they will not get any water.

In Uzbekistan the situation a different as women are now the heads of farms. The basic problem in agriculture and in housekeeping is water. Frequently the lands of women-farmers are located in dry zones. There is no water on their lands and even when they are allocated water it is in small volumes and for short periods. However, due to collective actions it has become possible for them to receive water and to gain knowledge in the discipline of water use. Women-farmers indicated that they have significant difficulties with administration due to lack of economic and legal knowledge. As water is the crucial factor in their work, farmers should have good knowledge of water planning, on water distribution, rates and duration of irrigation.
During meetings held in the Osh region of Kyrgyzstan, in the Fergana and Andizhan regions of Uzbekistan and in Sogd region of Tajikistan, the problems encountered were common to all these states. The basic problem is related to low profitability of agricultural production and absence of alternative job opportunities for both men and for women. The men have no possibilities to earn enough for the family and therefore leave the lands to women and go to other regions and states in search of jobs.

2.5.3 Labor and economic constraints

Monitoring of demonstration sites in all three countries indicated major factors reducing efficiency of water use on farms. This includes incorrectly chosen schemes and technology parameters of irrigation, and overestimated irrigation norms. With the introduction of irrigation norms, economic indicators of polygons/demonstration sites have increased by 20 % when compared to ordinary farms. The results achieved within this project show the usefulness and efficiency of work on distribution of water economic, agricultural knowledge and skills among farmers. Undoubtedly, it is possible to achieve higher productivity and water resources saving. However, it is important to solve social, organizational and financial problems. Economic questions concerning farming communities include liberalization of the prices, increase of procurement prices of agricultural products, privileges under taxation, reception of credits, streamlining of contractual relations, etc. According to district data, efficiency of water on vineyards is considerably higher than other widely practiced crops.

Component 3: Extension strategies and approaches

To review the existing situation of the extension services, three local consultants were hired under this project. These consultants work in close collaboration with IWMI and SIC project team to review the existing information. In addition, available international literature on extension services in CA was also reviewed.

3.1 Current situation with Agricultural Extension

Kyrgyzstan

In Kyrgyzstan, Ministry of Agriculture, Water Resources and Processing Industry (MAWRPI) is responsible for extension services. Its role includes policy making and extend technical and financial support to farmers to increase agricultural production. They are usually involved in delivering research results, preparing professional staff through education and development of new technologies and introducing new seed varieties. However, in reality, opposing evidences exist about fragmented functions of different departments and projects. The Ministry has three wings – agriculture, water and processing industry. The Water Resources Department (WRD) has strong organizational and a hierarchical structure (Basin Water Management Organizations and Rayon WMOs serving WUAs) and its key and specific task is to organize water use in national economy on the research, equity and rational base. It has 7 (Oblasts) BWMOs, 40 RWMOs.

Agriculture Department (AD) has oblast and rayon structures but has a larger role in regional and local governance. It deals with a wide range of agricultural issues compare to water department – such as livestock, crop production, fertilizers, machinery, pest management etc. For example, the deputy governor of oblast and deputy hakim of rayon is the head of ADs. This wing has also Research and Agricultural Development Department, which includes 3 research institutes: irrigation, land management and livestock. It has indirect links with RAS system and provides occasional trainings for ATC staff through associated research institutes. Kyrgyz Agrarian University and the Osh Agricultural Institute are responsible for education and preparation of professionals to serve water and agricultural sectors (engineers, researchers etc.) (Figure 5).

WUA Support Units under the MAWRPI

In the Kyrgyz Republic, with World Bank support, the WRD established WUAs to take over on-farm irrigation operation and maintenance (O&M). To date 451 WUAs have been legally registered under this law. As farmers had no experience with participatory associations, an intensive capacity development program was critical for success. Within the WRD of the Ministry of AWRPI the WUA Support Units (SUs) at the central (1), provincial (7) and district (40) level were formed. The team of WUA Support Units include experts in WUA Development, training and promotion, water and WUA legislation, financial management, and monitoring and evaluation.

ASSP-RAS

RAS is NGO initiated by IFAD/WB/SDC to deliver advisory and development services to farmers with the objectives of (a) prepare and implement technical programs in advisory services; (b) carry out on-farm demonstrations and field trials on farmers' fields at farmers' request; (c) commission local adaptive research contracts; (d) manage oblast and rayon level staff and maintain accounts; (e) liaise with local governments; and (g) disseminate information. RAS is decentralized organization with branches in Oblast and rayons. RAS managers are responsible for the development of annual work plans for their respective oblasts under the overall guidance of local Oblast Steering Councils (OSCs). The OSCs comprised of representatives of farmers, NGOs, and government agencies from the oblast and plays the same role as national RAS.

ATC of KSAP

The Advisory Training Centre (ATC) was initiated under the KSAP due to non-satisfactory development of internal potential within the RAS system. The ATC's overall objective was to build capacity of the extension staff (ATC report, 2007). In order to strengthen RAS (extension) with knowledge management and capacity building, an autonomous ATC unit was established in the RAS system like any Regional RAS. The ATC specialists and contract trainers are working on farm development, business planning, proper use of plant and livestock production technologies, home scale processing, marketing by improving the publication quality devoted to farmers and advisors.

TES Center

TES is a Kyrgyz NGO specialized in rural advisory services. GTZ and the Osh State University founded TES in 1997. Their goal is to increase people's income from farming with the help of qualitative training and advisory work. It is based on private consultation with freelance field advisors and trainers served by the TES Centre.

The focus of TES is on small farms with little to average resource endowment. TES assist farmers in forming interest groups. At the same time, these groups represent a starting point for self-help organization with different ends such as common marketing and qualification for seasonal loans. TES supports and gives contracts to freelance trainers and field advisors to train and advise farmer groups throughout the year. Training in extension methods and agricultural technologies mostly takes place in the off-season. This way every year TES supports more than 50 agricultural advisors, more than 100 farmer groups and between 1000 and 1500 farmers. In return, trainers and advisors pay an annual service fee to TES. Farmers pay for every training.

Recent developments to consolidate extension

Policy Support Project (PSP) funded by the SDC was set up in 2007 with the aim of strengthening capacity of the Ministry of Agriculture, Water Resources and Processing Industry (MAWRPI). PSP has 2 key objectives: i) Development of rural extension policy jointly with the Rural Advisory Services (RAS) and Kyrgyz Swiss Agricultural Program (KSAP) and ii) assist the MAWRPI in co-ordination of agricultural projects. There are 61 donor driven activities related to agriculture in Kyrgyzstan: 46 projects, 11 programs, 3 funds and 1 centre. The donors are Asian Development Bank, World Bank, USAID, GTZ, European Commission, United Nations Development Program, Swiss Government, Turkish International Co-operation Administration, Sweden International Development Agency, and Japan International Co-operation Agency.

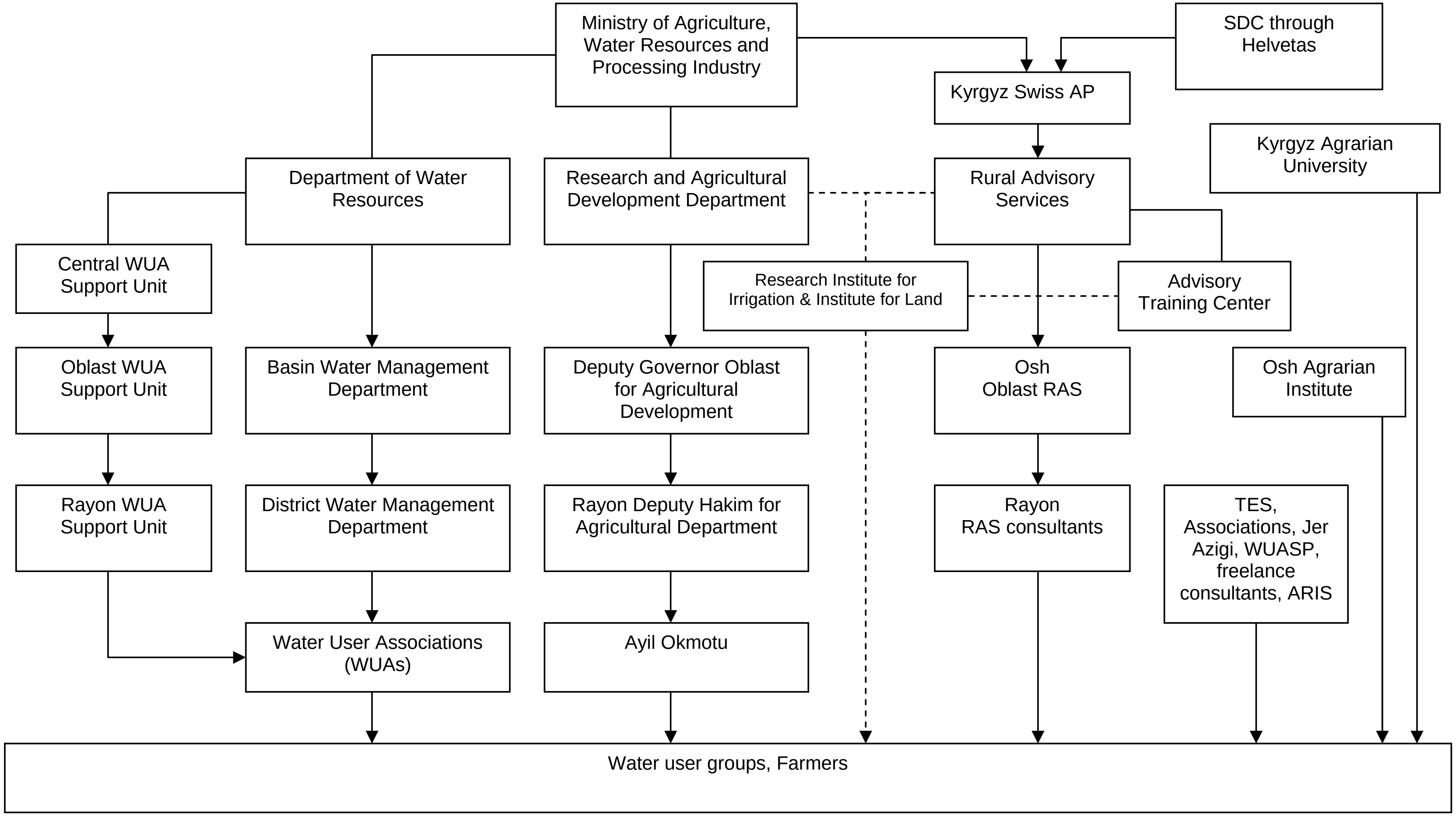


Figure 5: Existing agricultural extension in Kyrgyzstan

Uzbekistan

During the past several years, government is trying to establish ways for sustainable development of agricultural sector. The Ministry of Agriculture and Water Resources (MAWR) has been made responsible for the coordination of all agricultural activities including extension services to farmers in Uzbekistan (Figure 6).

As a part of this, MAWR initiated several reforms in the agricultural sector including (i) creation of private farms in the territory of old shirkats; (ii) establishment of Association of Private Farmers (APF) with offices in each oblast and rayon; (iii) introduction of Basin Irrigation System Authorities (BISAs) within inter-farm systems and Water Users Associations for on-farm systems (WUA); (iv) creation of Alternative Machine Tractor Pools (AMTP); (v) formation of agrofirms to assist the dehkhan and private farmers involved in fruit and vegetable production.

There are several organizations that provide agricultural extension services in Uzbekistan. Some of these organizations are government funded, some NGOs, universities, farmers' associations, research institutes, and others. These organizations are:

1. Association of Private Farmers (APF)
2. Rural Business Advisory Services (RBAS)
3. Agricultural Service Center
4. Agrofirms
5. Basin Irrigation System Authorities (BISA)
6. Rayon Agriculture and Water Resources Authorities (Rayselvodkhoz)
7. District Polygons initiated by MAWR
8. Water Users Association (WUA)
9. Alternative Machine Tractor Pools (AMTP)
10. Academic and Research Institutes: Uzbeks Agriculture and Production Center, SANIIRI, TIIM, Tashkent State Agrarian University.

Despite all these efforts, current structural frameworks do not completely meet the needs of farmers. Un-defined structural and organizational parameters of different organizations, lack of stimulation and remuneration for labour and lack of integration of interests of producers and service providers are part of the problems. In addition to above, dominating administrative methods of work are not letting the world experienced technologies and progress in agricultural research to make its ways to the farmers' fields.

Development of agricultural extension service in Uzbekistan is becoming a matter of national importance. However, there is no national policy framework on extension service development, which could ensure political and financial commitment of the government and other stakeholders. Therefore there is a need of effective extension service national policy framework. This framework should indicate national agricultural development priorities; outline the organizational structures necessary to implement these priorities and the corresponding institutional linkages, and the extent and nature of the commitment to encourage farmers. There is also a need to provide incentives to farmers involved in the production of state ordered crops such as cotton and wheat. The situation is different among the farmers involved in fruits and vegetables production, where the use of informal extension services is in practice and in high demand.

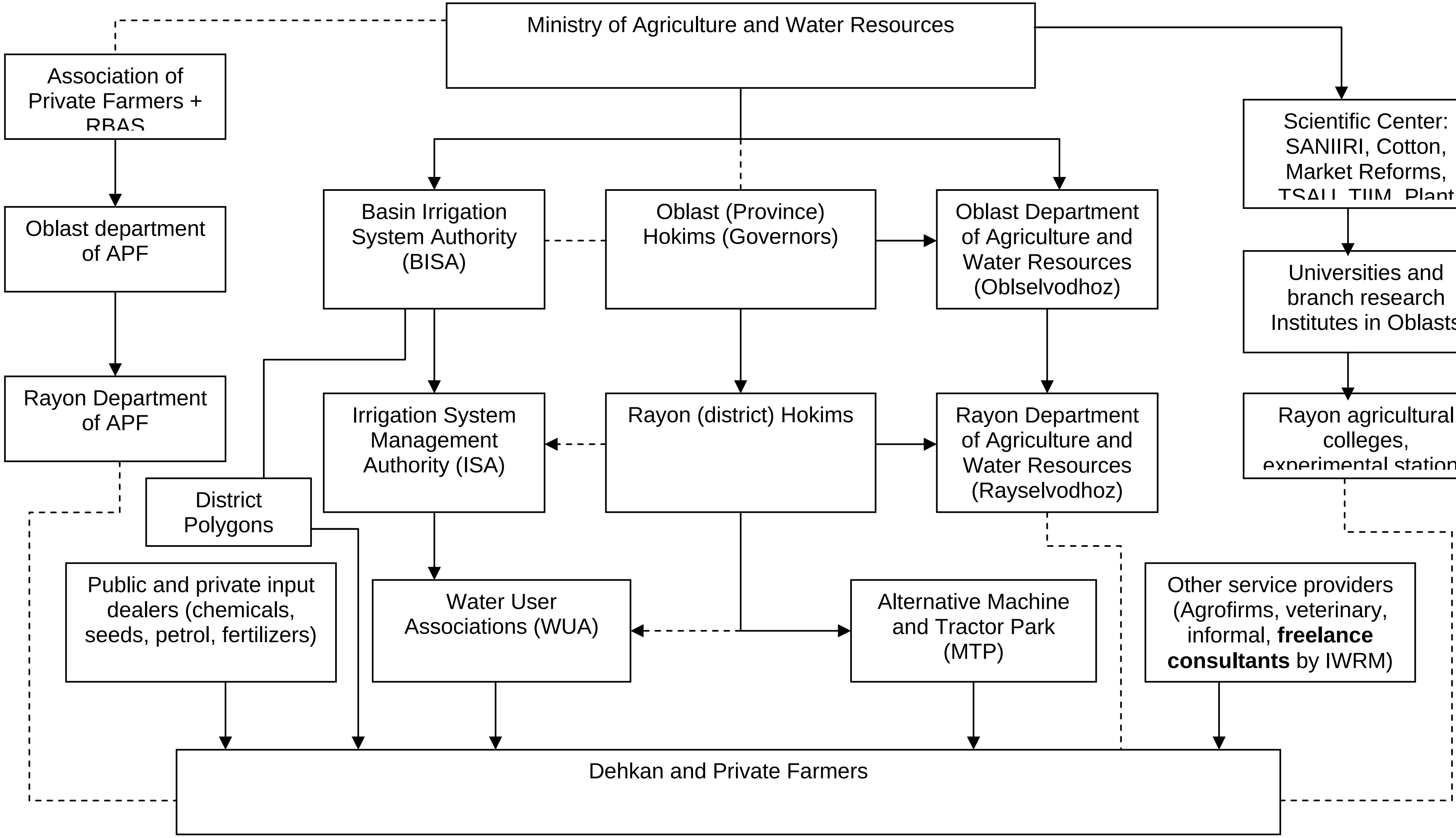


Figure 6: Existing agricultural extension in Uzbekistan

Tajikistan

In Tajikistan, Ministry of Agriculture (MoA), and Ministry of Melioration and Water Resources (MoMWR) are the major public sector organizations involved in agricultural extension. MoA's Agroprom has officers in all oblasts and rayons but their functions are mostly supervisory (reporting to Hukumats) and collecting data for statistical purposes (including yield forecasting based on highly unreliable methodology). Agroproms can become more sustainable by strengthening their ties with research institutions (Tajik Agrarian Academy, Irrigation Institute and universities – Tajik Agrarian University). Agroproms can be complemented by water knowledge and information through Oblvodkhoz and rayvodkhoz wings of MoMWR (Figure 7).

The Union of Dekhan Farms and Rural Businessmen were established in 1996 as a non-governmental, independent and self-governed social association. Global aims of the UDFB are to support dehkan farms and businesspersons in improving market infrastructure and strengthening farms and entrepreneurs, protect dehkan farms and businessmen interests and to help them in establishing links with foreign partners.

Presently, there are about 90 agricultural extension activities going on in Tajikistan and most of them are separate initiatives by different donors and projects, often small and duplicating each other. There is no unified national level initiative to consolidate all extension activities.

ACTED has established Advisory Information Network: 1 in Dushanbe with 2 sub-offices in Kurgan Tepa and Khodjent. They support 16 Rural Advisory Information Centers (AIC).
JOVID supported by the German AgroAction (GAA) and German Development Service and based in Chkalovsk – the focus is foothill, mountainous;

Association of Professional Agrobusiness Consultants – ZarZamin (Golden Earth) initiated by Mennonite Economic Development Associates (MEDA) supported by the CIDA, they have Oblast office in Khodjent, in some districts – Agro Business Innovation Centers (AgBIC); SENAS, a recent initiative supported by EC, TACIS started in October 2007 have taken over to support the establishment of the national advisory service in Tajikistan. Specifically their objectives include: strengthen Agricultural Training and Advisory Center (ATAC) in Kulyab Province, re-initiate Agricultural Information and Coordination Center within MoA (AICC), based on Sogd Aproprom + NGOs try to convince MoA establish National Agricultural Advisory Service (NAAS) and support Union of Dehkan Farmers and Rural Business of Tajikistan.

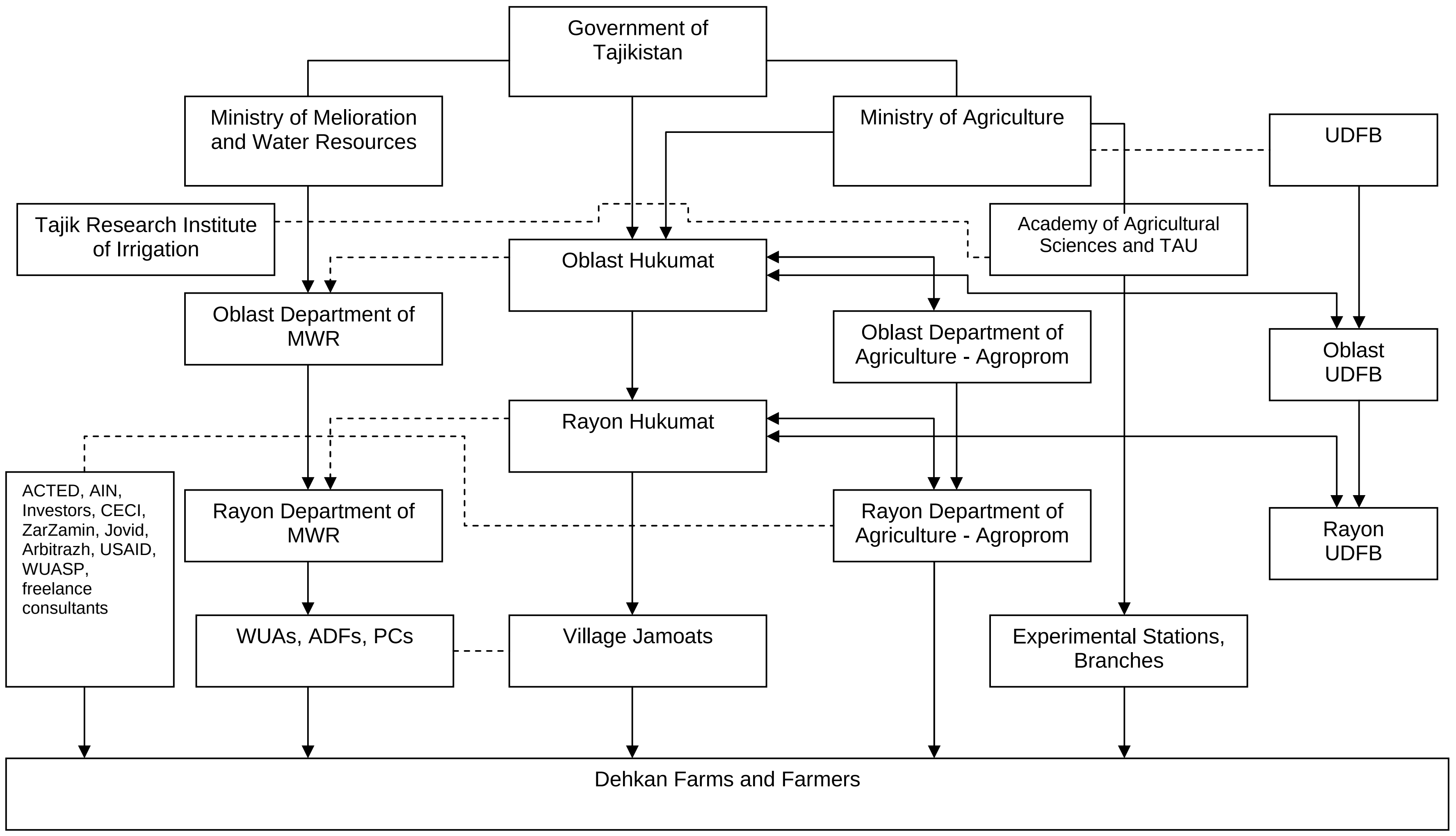


Figure 7: Existing agricultural extension in Tajikistan

3.2 Gaps in Agricultural Extension systems

Tajikistan

The following gaps were identified during the review by regional project staff suggests (Rakhmatullaev, 2008):

- The concept of public extension, provision of continuouss advice to farmers is not widely understood. There is no institutional extension exist in Tajikistan. The state organizations practice top down and order approaches when working with farmers.
- Research, education and agricultural policies are isolated from each other. State funding is decreasing. The management of all three aspects are highly centralized and strictly controlled.
- The bulk of current extension is provided by a number of projects, NGOs. They are geographically, subject-wise focused and have limited reach. There are some signs of cooperation but occurring to a limited extent. Many overlapping and duplications exist.

There are contrasting agricultural extension service providers – two extremes exist: from one side strong administrative state organizational structure but with weakened capacities and mislead staff with overlapping tasks and from other side good skilled and active numerous NGOs supported by donor specific projects, very scattered and duplicated with less communication with each other and questioned sustainability.

KasWag AgriConsulting (KasWag AgriConsulting, 2008) identified the following needs at the Dekhan farm level:

Governance:

- Farm financial management (book keeping, accountability, finance procurement, reporting)
- Farm business management (budgeting, cropping activities, input procurement, share holder participation)
- Extension services

Agronomy:

- Crop management (irrigation, pest control, weed control, nutrition)
- Water management (cropping practices, irrigation scheduling/allocation, crop requirements, water holding capacity of soil)
- Soil fertility (crop rotations, organic matter, green manure, mineral fertilizers)
- Genetic characteristics of cotton (varieties, seed quality, seed increase) Extension services

Resources: (Infrastructure/equipment/finance):

- Input supply (fertilizers, fuel, pest control agents, etc.)
- Water supply and distribution (Water user associations, maintenance, rehabilitation, gates, regulators, irrigation scheduling)
- Machinery and equipment (improvements, efficiency, new technology)
- Finance (access to cropping and capital investment finance)

Kyrgyzstan

Kyrgyz-Swiss Agricultural Program (KSAP, 2007) indicates following issues with existing rural extension services in Kyrgyzstan:

- Insufficient financing of agricultural extension services by the Government of the Kyrgyz Republic. At present extension services are mainly funded by donor organizations. This cannot last for ever and by 2011 the funding could be terminated;
- Weak co-ordination of agricultural extension services' activities by the MAWRPI. Actually no one subdivision of the MAWRPI works in this area;
- Inadequate level of knowledge in application of new agricultural technologies, economic issues and marketing;
- Weak interrelation between extension services themselves and with scientific-research and educational institutions, and also with production and processing organizations;
- Insufficient number of trained extension staff.
- The MAWRPI vision of further development of rural extension services does not coincide with that of the Rural Advisory Services (initiated by the IFAD and World Bank project Agricultural Services Support Project).
- The MAWRPI attitude towards state allocation of funds for financing rural extension services is not clear.
- National authorities do not consider extension services as a priority of the agrarian policy.

Rural Advisory Service of Kyrgyz Republic (RAS, 2007) has indicated challenges and difficulties in implementing the extension tasks. These include low salaries of staff; outdated office equipment; ever changing concepts of the RAS with each new phase, indifferent attitude of some RAS staff to their work; increased fuel price, office rent fee; outdated devices and vehicle entailed additional expenditures; many obstacles are to realize its mandate (wrong selection of farmers on some advisory topics, sharp decrease of budget; uncertainty about the ways of RAS future activity; political situation with weak support; unchanged level of staff salaries, whereas the living costs and inflation are increasing from year to year, which effects in loosing of well qualified advisors).

The survey conducted by regional project staff (Jooshev and Mitiakova, 2008) indicates the following needs in knowledge by farmers:

- Agrotechnical measures (tillage, planting time, crop cultivation, inter-row cultivation, lay-out and crop rotation);
- Irrigation techniques (irrigation terms and irrigation depths, how to receive water, where, when and how to apply, farmer rights and relations with WUA, how much to pay for water, how received water volume may be determined, measurement of water flow in aryk, measuring devices, water losses, how to determine water flow in a furrow and how to identify furrow length, determination of dependence between water penetration of soil, slope, and types of crops);
- Marketing service (what crop is profitable for planting in the current year, what seeds are fruitful, where and how much seeds may be bought);
- Application of fertilizers and chemical protection of plants;
- Introduction of new irrigation technology (sprinkling irrigation, drop irrigation, etc.);

- Basic economic knowledge on drawing up of business-plans, marketing, estimation of capital investments efficiency, estimation of actual first cost of output, its price, estimation of efficiency and choice of the optimal development directions of agricultural production;
- Legal regulations of land and water use, organization of farms, acquaintance of farmers with their rights and obligations to the state, taxation rules and payments of taxes;
- Opportunities and rules of attraction of investors, drawing up of credits and mortgages, establishment of the credit unions.

Uzbekistan

Regional project staff study suggests that in Uzbekistan there is no organization that could fulfill the functions of agricultural extension system, but there are organizations providing elements of extension services (Nazarov, 2008). The major gaps in the extension services are lack of appropriate infrastructure, poor institutional arrangement and non-availability of extension materials. A brief explanation of these gaps is as follows:

Infrastructure

- Lack of financial resources
- Lack of physical facilities (transportation, office equipment, communication facilities, audio-visual aids)
- Lack of technical specialists
- Inappropriate management structure
- Influence of local authorities
- Lack of farmers' knowledge and incentive for extension service

Institutional arrangements

- Lack of government commitment
- Lack of correspondence between Statue functions and routine activities
- Lack of coordination among extension organizations that causing service duplications
- Low capacity

Availability of extension materials

- Too technical
- Not farmer friendly
- Inappropriate languages
- Not location specific

3.3 Recommendations for improving Agricultural Extension services

The Central Asia case is unique and has contrasting changes since its independence from the Soviets. Each country has adopted different strategies in the process of transforming their economies. Therefore there is no single solution to the problem of all countries. In this section, an attempt is made to generalize and recommend some concepts based on our review of existing extension systems.

With regard to agricultural research and its link to extension, the recommendations are as follows: extension messages should be based on research conducted in the agroclimatic zone for which they are intended. This obviously implies location of research stations in all agroclimatic zones. Even recommendations emerging from such research stations and meant for the specific agroclimatic zone will require further adaptation to suit varying local field conditions. This is particularly true for recommendations aimed at improved soil management, watershed management and fertilizer application.

Farming systems research is even more difficult to make operational and calls for a high degree of expertise at local research stations. Above all, an effective extension system is needed that is capable of diagnosing field problems and transmitting them to the research establishment. World Bank (Cernea et al., 1985) recommend the following:

1. Agricultural extension requires effective organization and management tailored to suit specific circumstances;
2. Agricultural extension requires site-specific methodologies and suitable technologies;
3. Agricultural extension must be relevant and responsive; and
4. Farmer participation is fundamental to sustainable extension.

It is easy to define the broad recommendations for institutional change needed to reform agricultural extension to meet the changing demands. From this review it is obvious that current prescriptions include: decentralization, pluralism, privatization, cost recovery and involvement of farmers as key player. The historical and recent developments around the world illustrates that it must be driven by learning about what works and what doesn't and by the nature of local circumstances and context. An analogous approach proposed by CGIAR is known as the institutional learning and change initiative which is trying to do adaptive agricultural research to address recent challenges (CGIAR, 2008). If such an extension policy is to be pursued in Central Asia, following steps might help:

A first step would be to undertake an in depth institutional analysis of historical and current experiences of implementing different extension approaches. This should focus on successes and failures and should be undertaken in a constructive manner to devise ways by which these approaches could be modified, bottlenecks removed and institutional arrangements amended. It was obvious during this study that there are very limited studies and analysis of the extension sector, and these are usually not used in extension policy development and planning. This approach, of course, will require capacity development of local expertise for analyzing complex systems.

The next step is to set up pilot projects in agricultural extension (which have already started in Tajikistan and Kyrgyzstan, to some extent in Uzbekistan with donor assistance). While this is not new, these experiments should be done together with local institutions (research, state, education, farmers' organizations and local NGOs) so that they can be involved from the beginning to draw upon lessons promoting innovation in rural areas. The initiative can be replicated with some location specific modifications.

Realizing the fact that government technical and financial support is a key for the sustainability of agricultural extension services, it is recommended that associated provincial (oblast) and district (rayon) departments of Ministry of Agriculture or other relevant state agencies should be the main partner of the project to play the role of agricultural extension service provider in the project zone, e.g. the Ferghana Valley.

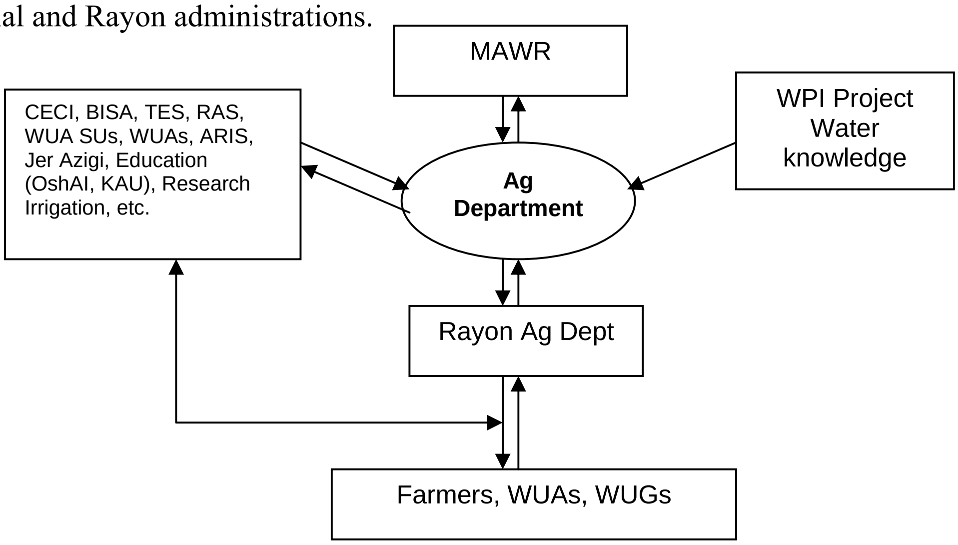
Extension projects should strengthen its institutional capacity by assisting in developing working relations with all the relevant state organizations (state water departments, in our case they are oblvodkhozes, BISAs, BWMOs with its coupled district level sub-ordination units), development projects (funded through EC, WB, ADB, SDC, UNDP), NGOs that are supported by the agricultural projects and have relevant advisory experience (UDFB, Zar-Zamin, CECI and ACTED in Tajikistan; RAS, ATC, Jer-Azigi in Kyrgyzstan and Association of Private Farms in Uzbekistan), producers and private companies that are involved in the agricultural extension. The projects should facilitate the cooperation between the organizations through consensus building, bridging and dialogue roundtables to develop a single strategy on agricultural extension while the major, leading and coordinating role should be given to the Oblast and Rayon Agroproms.

The project should develop recommendation on better ways, approaches and methodology (specifics) of provision of extension services to farmers with respect to on-farm water management through adult training, PRA methods, and needs assessment and how to monitor and evaluate extension activities. The project should transfer its water related materials (on-farm water management, WUA and canal distribution) from previous phases of IWRM project and in-phase materials (water conservation, water saving and increased productivity technologies) of current project to the Provincial Agricultural Department and should improve its training and methodological capacity.

The project should facilitate and assist AgDeps to establish working and effective linkages with local National Research and Education Systems for long term and sustainable cooperation. The project should facilitate good working relations and policy uptake of results at a higher level – MAWR through the AgDeps for wider dissemination of positive experiences of comprehensive and sustainable systems of agricultural extension in Sogd province.

The project should participate in other larger initiatives to establish national level umbrella institution or systems (SENAS in Tajikistan and Policy Support Project by KSAP in Kyrgyzstan) with appropriate policy framework, sustainability issues (cost recovery) and the possible (new) roles of state Agroprom systems (coordination) should be discussed with the appropriate Ministries (or relevant departments) and initiating parties based on project experience.

It is recommended that WPI project should support Agricultural Departments within the Provincial and Rayon administrations.



Overall recommendations for the main phase:

- Should select pluralistic approach (state + others)
- Use current extension as partners (but taking into account their sustainability)
- Establish knowledge base
- Transfer water knowledge to extension (translation is required)
- Have AgDep and WatDep on-board
- Use WUAs as carriers (entry point)
- Facilitate the links of extension with research and education
- Share experience with larger initiatives

5. Conclusions

An inception phase was mainly based and built on the data and experiences that are achieved during the 3rd Phase of the IWRM-FV. The inception phase was successful in meetings its objectives and completing all the outputs. Specifically, the project was able to establish a data base on current water use and productivity at plot level while promoting selected good practices of plot level water management through identified extension services that existed in the region. The data base forms a comprehensive set of data that will be used to benchmark and assess the impact of the project as it progress through its various stages. This database is hosted by SIC with access to IWMI and other partners of the project.

The project analyzed the existing research and extension materials concerning plot level water productivity and productivity improvement in Central Asia and identified gaps and bottlenecks to be addressed in the main phase in the fields of 1) Adequate knowledge, 2) Technical adaptation requirements and 3) Socio-economic context (gender segregated work load and load trends; labour availability and qualification in the light of a feminization of agriculture, cost-benefit, incentives etc.). The project was able to address the suitability of existing extension strategies and approaches and identify suitable partners for results dissemination/extension in each country. Based on recommendations of the two planning workshops to design main phase of the project, these initiatives were critical in; the development of a strategy; the formulation of the institutional framework; and the identification of potential partners for the implementation of the main phase (Phase 2). The planning of the main phase was built on the background of previous work, achieved results of both SIC and IWMI teams and used existing institutional ties. It is anticipated that these institutional linkages will be strengthened and sustained through promotion of the innovation cycles and adopted through the evaluation/feedback system from the farmers.

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Appendix 3. Information regarding training the trainers program and list of freelance consultants within WUA participated in tranings

Title	Crop water requirement and water Accounting for independent Consultants in Ferghana Valley
Short Description	This training organized under WPI project in order to prepare freelance and independent consultants (experienced, well known and knowledgeable agronomists and hydrotechnicians) available within WUAs in Ferghana Valley to improve water productivity through informal dissemination of knowledge
Trainer	Kahramon Jumaboev, Research Officer, IWMI-CA
Organization	IWMI
Target Group	Independent agronomist from Sogd province in Tajikistan, Osh province, Kyrgyzstan and Andijan, Ferghana province Uzbekistan
Objectives	The participants have enhanced their capacity ▪ To judge the importance of water management, improving planning and crop water productivity on-farm level ▪ To introduce volumetric water management on farm level, types of water measurement devices
Contents	The course is part of the strategy of developing extension services in Ferghana Valley
Method	Adult training techniques were used during training period
Duration/Date	1 day in each location 21/09/08 Khudjand, 22/09/08 Ferghana. 23/09/08 Osh
Place/Country	Sogd province in Tajikistan, Ferghana province in Uzbekistan and Osh province in Kyrgyzstan
Number of participants (m/f)	36 male
Evaluation	Training materials should be local languages
Follow up activities	Post training survey will be conducted
Budget/Expenditures	$304.7 in Tajikistan $518.3 in Kyrgyzstan $603.9 in Uzbekistan Total $1427 = $39.6 per capita

	Name	Background	Province
1	Pirimkulov Dustmuhammad	Hydro-technician	Sogd
2	Holov Bahriddin	Hydro - technician	Sogd
3	Islomov Abdullajon	Hydro - technician	Sogd
4	Azamov Bahrom	Hydro-technician	Sogd
5	Mahmadov Mergan	economist	Sogd
6	Samatov Abdumalik	Hydro-technician	Sogd

	Name	Background	Province
7	Majiev Tadjibay	Mechanical engineering	Osh
8	Atahanov Mamir	agronomy	Osh
9	Tursunov Halidjan	Agronomy	Osh
10	Karabaev Tashlanbay	Agronomy	Osh
11	Pattahunov Hasanbay	Mechanical engineering	Osh
12	Tajibaev Rustam	Engineer Technology	Osh
13	Turdibaev Shavkatbek	Veterinary	Osh
14	Hurbaev Nizom	Agronomy	Osh
15	Kayiberdiev Begali	Worked as brigadir	Osh
16	Abduraimova Laylohan	Agronomy	Osh
17	Kyrgyzboev Bahodir	Agronomy	Andijan
18	Norboev Kamoliddin	Agronomy	Andijan
19	Boymirzaev Golibjon	Agronomy	Andijan
20	Holiqov Abdusalom	Agronomy	Andijan
21	Valiev Toyir	Hydro-technician	Ferghana
22	Kuchkarov Hasanbay	Agronomy	Ferghana
23	Madaliev Urinbay	Agronomy	Ferghana
24	Mahammatov Ahmadjan	Agronomy	Ferghana
25	Madaliev Askarali	Agronomy	Ferghana
26	Movlanov Muydin	Agronomy	Ferghana
27	Tillaev Akram	Agronomy	Ferghana
28	Maksudov Nasriddin	Agronomy	Ferghana
29	Isaev Hamroqul	Former chairman of collective farm	Ferghana
30	Ahmedov Rahmat	Agronomy	Ferghana
31	Usmonov Karim	Agronomy	Ferghana
32	Nizamov Muhammadjan	Hydro-technician	Ferghana
33	Gulmirzaev Saydullo	Agronomy	Ferghana
34	Shokirov Ermat	Agronomy	Ferghana
35	Mahmudov Mukum	Agronomy	Ferghana
36	Tuychiev Bahodir	Agronomy	Ferghana