CGIAR Regional Program for Sustainable Agricultural Development in Central Asia and the Caucasus

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Program Facilitation Unit

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Executive Summary

The CGIAR has been promoting sustainable agricultural development in Central Asia and the Caucasus (CAC) through its Regional Program formed by International Agricultural Research Centers and National Agricultural Research Systems. Starting in 1998, the Program has supported the CAC Region in achieving the strategic goals of increased productivity, food and nutritional security through development and transfer of modern agricultural production technologies, while ensuring protection and sustainable use of natural resources.

Initially comprised of nine CGIAR Centers – Bioversity International, CIMMYT, CIP, ICARDA, ICRISAT, IFPRI, ILRI, IRRI, and IWMI – and the National Agricultural Research Systems (NARS) of Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, the Program has expanded during the last years to include three additional Advanced Research Institutions: AVRDC – The World Vegetable Center, the International Center for Biosaline Agriculture (ICBA) and Michigan State University (MSU). ICARDA is the convening Center of the Program. The Program Facilitation Unit (PFU), located in Tashkent, Uzbekistan, provides technical, policy and administrative support to the implementation of the Program.

Central Asia and the Caucasus is a very diverse Region in agro-ecologies and production systems. In spite of the different general development strategies and policies, fundamental principles of sustainable agricultural development remain common for all countries of this Region, making essential the multi-lateral approach combined with country-specific action plans for implementation at national levels.

The Program has achieved considerable progress in major areas of collaborative agricultural research for development, including conservation of genetic resources, germplasm enhancement and crop diversification, and sustainable soil and water management. Building the research capacities of the NARS has also been one of the key dimensions of the Program. During the period covered by this Annual Report (from mid-2010 to mid-2011), the work in these areas has continued and was significantly strengthened owing to the contributions made by all the partners involved.

This Report provides an overview of major activities and achievements in the Program during the past year of work.

Based on available scientific data, it is widely believed that temperatures in Central Asia will be increasing significantly above global average. This and other implications of the climate change will lead to an increase of dry areas. Regions currently depending on irrigated agriculture fed by melting glaciers might be forced to change to rain-fed agriculture and new value chains within one generation, as a recent case study (2010) in mountain villages in Zerafshan (Tajikistan) showed. Worldwide glacier loss drives thousands of mountain villages from plenty to scarcity of water within time period as short as one generation. Village communities in remote mountainous regions have little capacity to cope with the consequences of climate change, particularly the glacier melt off. In order to explore cost-effective ways of building the adaptive capacity of these communities, realistic local adaptation strategies were developed in a participatory way with the villagers. They showed readiness to become key agents of the climate-induced transformation of their livelihoods. This case study marks the Program's engagement in socio-economic research related to climate change.

However, the Program builds upon its long history and significant capacity available in the CGIAR Centers on adaptation strategies to climate change through breeding more efficient crop varieties, promoting water-use efficient technologies and developing sustainable soil and crop management practices. Each Center has its own mandate and expertise. Working together in these three key research directions as part of the Regional Program offers a great, unique opportunity to add value over and beyond the efforts of individual Centers.

In the framework of a broader international project on "Adaptation to Climate Change in Central Asia and People's Republic of China", calibration of CropSyst model has been competed for all selected sites in Kazakhstan, Kyrgyzstan, Uzbekistan and Tajikistan. Calibration of CropSyst model has been carried out for 14 wheat varieties registered by the respective State Variety Testing Commissions, and model calibration

results are being used for climate change simulations.

ICARDA, CIMMYT and IWWIP in partnership with national wheat improvement programs in the CAC introduce and test improved germplasm of winter and spring wheat to address the production constraints. Each year, more than 1000 advanced breeding lines and improved germplasm of wheat received as international nurseries are tested to select for high yield potential, improved quality traits and tolerant to the prevalent abiotic and biotic stresses. Similarly, more than 1000 advanced breeding lines of barley, chickpea, lentil, faba bean and grasspea are introduced and tested in the Region every year to identify high yielding varieties with tolerance to drought, heat, diseases and pests. ICARDA and CIMMYT released 4 new winter and 1 spring wheat varieties, and 2 barley varieties as a result of cooperation with NARS during the past year. Several high yielding, high quality, yellow rust resistant facultative and winter wheat lines were identified in Uzbekistan and are being tested in other countries. Results from field trials suggest promising lines of winter wheat with tolerance to medium level soil salinity.

CIP has worked with national partners to test germplasm materials distributed to the CAC countries, to develop potato varieties resistant to biotic and abiotic stress, improve farmer-based seed production systems, develop effective management practices, and influence policies that promote more durable management of natural resources. Collaboration with NARS of Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan resulted in releasing 3 candidate varieties, while 9 candidate varieties are under testing by the respective State Variety Testing Commissions in Kazakhstan, Tajikistan and Uzbekistan. A protocol for laboratory screening of potato germplasm under different salinity levels was developed, which allows for comparison of laboratory data with field experiments. CIP tested techniques of using true potato seeds, which are particularly adapted to strengthen farmer-based seed potato production systems for resource-poor smallholders in the highlands of Central Asia. The “Participatory Market Chain Approach” identified a number of constraints in the existing potato chain, such as the existence of barter trade and poor quality of seed planting materials.

AVRDC – The World Vegetable Center – in collaboration with NARS partners from Armenia, Kazakhstan and Uzbekistan successfully released twelve new vegetable varieties of hot and sweet pepper, mung bean, soybean, long yard bean, leafy cabbage, and tomato. The released varieties have a very good potential to increase the area of cultivation and production, diversify diets, increase the export potential of fresh and processed products, thereby increasing farmers’ incomes. Evaluation of germplasm materials continued in the AVRDC Regional varietal trial in 2011. Promotion aimed at increasing the production, utilization and consumption of nutrient-rich vegetables included elaboration of recipes, school gardens and lecturing in medical centers and workshops on healthy diet in Uzbekistan.

Building on the strong foundation and the regional network established during past years, the Integrated Pest Management (IPM) project, funded by USAID through Michigan State University, is implementing a five-year collaborative strategy to develop and deliver ecologically-based IPM packages for key food security crops – wheat, tomato and potato. The IPM packages for these three crops are aimed at addressing key pest management problems in Tajikistan, Kyrgyzstan and Uzbekistan.

Diversity, conservation status and economically valuable traits in priority fruit species were assessed in the framework of a project implemented by Bioversity International with funding from the Global Environmental Facility through UN Environment Program. Five Central Asian countries have worked together to identify options for conserving horticultural crops and their wild relatives since 2006. Databases, demonstration plots and nurseries were set up within this project. The nurseries now produce 800,000 saplings for distribution to farmers each year. Demonstration plots help to strengthen on farm and in situ conservation. Supported by public awareness campaigns, recommendations for enabling legislation on conservation and farmers’ rights were incorporated into the legal frameworks in Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. During the past year, 13 scientific manuals and guidelines on characterization of fruit crops local varieties and promising forms of wild fruit species, technologies of their cultivation and management were produced for use by farmers and researchers.

Innovative approaches to reclamation of marginal, low-quality land and water

resources in Central Asia were taken by ICBA and its partners, through studying alley-cropping systems, direct sowing of mixed crops using zero-tillage techniques and crop rotations alternated with indigenous halophytes. These approaches combine profitable agricultural production with environmental concerns and diversification of agro-ecosystems, leading to development of new income sources for the rural poor. Rehabilitation of bare saline biotopes contributes to carbon sequestration by large-scale biomass production. Incentives for farmers to invest in increasing productivity of marginal lands and to establish small cooperatives and market outlets are necessary for the implementation of the research results.

During the reporting period, IWMI in close collaboration with SIC-ICWC successfully completed the IWRM-Fergana Project Phase IV. A one-year interim Phase is currently on-going. The capacity of IWRM institutions and people was considerably strengthened with a number of new organs facilitated and established at Small Transboundary Tributaries to ensure adequate representation and involvement of water users in joint governance at sub-basin and basin levels. Key IWRM tools were developed, improved and packaged for further dissemination. Within IWMI's second large project, WPI-PL, the effectiveness of an "innovation cycle" was devised and tested. The results will lead to improving water productivity at plot level and to evaluate new interventions suggested or already practiced by farmers for wide-scale adaption by area farmers using the innovation cycle. The proposed innovation cycle was found to be very successful in dissemination of information to farmers, as evidenced by increased water productivity at field level at all 25 demo plots in the Fergana Valley, and its subsequent up-scaling in five provinces of the three countries (Kyrgyzstan, Tajikistan and Uzbekistan). In close collaboration with GIZ, IWMI also contributed to building capacities in the use of advanced remote sensing technologies in transboundary water management. At the same time, it brought expertise on governance aspects, such as strengthening Water Users Associations in the three countries. Furthermore, two methods of groundwater recharge tested by IWMI in the Fergana Valley demonstrated their suitability for wide scale application. In particular, shallow bore wells are found to be very effective technology of groundwater recovery for small scale farmers in Central Asia. Farmers of the Fergana Valley growing orchards and vegetables are widely adapting this technology in water scarce areas.

Research on soil and crop management has resulted in the development of more efficient technologies. As a result of collaborative research, zero-till and other conservation agriculture practices are being increasingly adopted by Central Asian farmers. In Kazakhstan, CIMMYT in cooperation with NARS initiated large-scale conservation agriculture activities in the rainfed North and Central Kazakhstan. Due to these efforts, the area under conservation agriculture practices has been increasing from virtually none to an estimated area of 1,500,000 ha in 2009. Presently, CIMMYT supports activities focusing on weed control, crop rotation and diversification in these areas. The expected long-term impact of a new project launched in 2011 by ICARDA with support from and in technical collaboration with Food and Agriculture Organization (FAO) is to improve rural livelihoods and food security through increased productivity of irrigated farming systems in Kazakhstan, Turkmenistan, Uzbekistan and Azerbaijan, using the practices of conservation agriculture.

The Program has also worked on improving livelihoods of smallholders and rural women through value-added processing and export of cashmere, wool and mohair. During the past year, the project worked on developing all components of mohair and cashmere value chains in Tajikistan, including angora and cashmere goat breeding; fiber collection and processing; and production and export of luxury yarn and products. In Kyrgyzstan, the project continued training women groups in producing exportable felt handicrafts and strengthening connections between wool producers and felting groups.

Throughout the year, substantial efforts were dedicated to capacity building and dissemination of research outputs. The various training courses, fellowships and other capacity building activities are described in detail in the individual project sections of this Report.

A new momentum has emerged in the collaboration between the Program and the Tashkent State Agrarian University, a key higher education partner. This collaboration was formalized and lectures, research projects, training and fellowships facilitated.

Farmers' Field Days were conducted in all the countries of the Region during the past year in order to demonstrate promising and released varieties of various crops and to immediately strengthen collaboration with farmers. They facilitate the introduction into smallholder production of achievements of collaborative breeding research. More than 1000 people participated in these field days. Among the participants were, besides farmers and researchers, often representatives from state parliaments, ministers, processing firms' representatives and businessmen. These events usually have a wide coverage by governmental channels on radio and TV, journals and magazines.

Information and knowledge generated by collaborative research has been published in a number of scientific and technical publications, which are listed at the end of this Report. Information has also been more widely disseminated through exhibitions, presentations, interviews, CAC-News, posters and leaflets. The publications produced are available from the Program's website www.icarda.cgiar.org/cac. The website serves as a repository of documents for the Program.

Finally, the Program gives high attention to widening its linkages with partner research and development organizations active in the Region or supporting the Region. Examples of key processes and events where the Program was represented during the past year include:

- Central Asian Countries Initiative for Land Management (CACILM) discussion fora (mechanism for implementation of UN Convention to Combat Deserification);
- International Scientific Symposium "Water in Central Asia", November 2010, Tashkent, Uzbekistan;
- Towards the 6th World Water Forum – Cooperative actions for water security, International Conference, May 2011, Tashkent, Uzbekistan;
- International Exhibition and Scientific Conference «Science, technique and innovation technologies in the Great Revival epoch», in Turkmenistan, in June 2011;
- The World Overview of Conservation Approaches and Technologies (WOCAT) Share Fair and 15th Annual WOCAT Workshop and Steering Committee Meeting, June 2011, Bishkek, Kyrgyzstan.

The Program maintains close linkages with the Central Asia and the Caucasus Association of Agricultural Research Institutions (CACAARI).

As of January 2012, The CGIAR Research Programs (CRPs) will be the main mechanism by which the CGIAR will achieve the greater alignment with the strategic goals. In Central Asia and the Caucasus, future research will focus on "Integrated Agricultural Production Systems in Dry Areas", the CRP led by ICARDA. It will focus on integrated dryland farming systems, with multi-disciplinary research teams working at several action sites throughout CAC. The aim will be to develop and test new farming technologies to improve livelihoods. A global planning workshop was held in Nairobi, in July 2011, at which the participants from CAC identified benchmark areas and action sites for future research.

It is expected that working together on the implementation of CRPs in Central Asia and the Caucasus, the CGIAR Centers will further strengthen linkages and enhance complementarities among them and with their partners in the Region.

Germplasm Conservation and Enhancement in Wheat, Barley and Food Legumes

Aims and scope of work

ICARDA, CIMMYT and IWWIP in partnership with national wheat improvement programs in the CAC introduce and test improved germplasm of winter and spring wheat to address the production constraints. Each year, more than 1000 advanced breeding lines and improved germplasm of wheat received as international nurseries are tested to select for high yield potential, improved quality traits and tolerant to the prevalent abiotic and biotic stresses. Similarly, ICARDA in collaboration with national partners introduces and tests more than 1000 advanced breeding lines of barley, chickpea, lentil, faba bean and grasspea in the CAC region every year to identify high yielding varieties with tolerance to drought, heat, diseases and pests. Besides, basic genetic and breeding studies are conducted, primarily by involving postgraduate students and young researchers to complement capacity building efforts in germplasm characterization and crop improvement. In order to make improved varieties of cereals and food legumes available to the rural farmers to improve their livelihood, varietal promotion is made through seed multiplication and farmers' field demonstrations. ICARDA and CIMMYT put high priority on capacity building through short- and long-term training of young researchers, specialized research projects and opportunities for participation in international meetings and conferences.

Severe weather conditions during the winter crop season

The winter crop season 2010-2011 was drier than average in most parts of the CAC Region. The autumn months in 2010 were very dry resulting in delayed planting of winter crops. The winter temperatures were somewhat milder than normal, followed by warm spring. Due to dry and early warm spring conditions, incidence of diseases and pests were below normal. However, cereals and legumes production in 2011 is expected to be lower than in 2010 due to severe drought in autumn, lower than average rainfall in the spring and longer duration of terminal heat.

Distribution of International Nurseries

Evaluation of improved breeding lines and out-scaling of selected varieties of wheat, barley and chickpea were the major activities accomplished in 2010-2011 crop season. Over 2000 advanced breeding lines of wheat, barley, chickpea, lentil, faba bean and grass pea were distributed to the national programs in the eight countries, following their request. The number of nurseries included 31 wheat, 27 barley, 8 chickpea, 10 lentil, 3 fababean and 2 grass pea.

New varieties of winter wheat

Three winter wheat varieties originating from germplasm provided by IWWIP were registered at the SVTC of Uzbekistan by Kashkadarya Research Institute of Grain Breeding and Seed Production in collaboration with ICARDA. These varieties ("Hazrati Bashir", "Elomon" and "Gozgon") produced higher yield than the local checks in past two years. These varieties are also resistant to yellow rust, which is the most important disease constraint to wheat production in Uzbekistan. These three varieties also compare well with the local checks for other agronomic traits. Due to very early maturing period, "Hazrati Bashir" is expected to replace the early maturing and popular cultivar Tanya that is highly susceptible to yellow rust. In 2011, around three tons of breeder seed have been multiplied for each of these three registered varieties. Further multiplications will be carried out in 2011-2012.

High yielding winter wheat germplasm distributed in the CAC Region

Many high yielding winter wheat advanced lines with resistance to yellow rust were identified through collaborative research involving Kashkadarya Research Institute of Grain Breeding and Seed Production, Uzbek Research Institute of Plant Industry, ICARDA and IWWIP. Seeds of 22 superior lines were distributed to wheat improvement programs in Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Results from 2010 and 2011 across six sites in Uzbekistan showed that there were several stripe rust resistant lines that produced significantly higher grain yields than the local checks in both years. In the absence of disease in 2011, several stripe rust resistant lines had yield either equal to or greater than the most widely grown cultivar 'Krasnodar-99' in Uzbekistan. A number of these stripe rust resistant lines also possess early maturity, high 1000-

kernel weight, lodging tolerance, and preferred plant height and other agronomic traits. These lines could be useful for wheat improvement programs in Central Asia as new cultivars as well as improved parental sources of stripe rust resistance. Several of these lines are being considered as candidate cultivars in Uzbekistan.

Initiatives on dissemination of improved varieties of cereals and chickpea

In 2010-2011, ICARDA in collaboration with NARS partners started seed multiplication and dissemination of improved varieties of cereals and chickpea in the Region. In Tajikistan, seed multiplication and varietal dissemination of "Hisor 32" and "Sino" chickpea and "Pulodi" barley was initiated. Under this plan 110 and 20 farmers planted chickpea (2.5 ton) and barley (2.0 ton), respectively. The chickpea varieties released in Tajikistan were selections from ICARDA nurseries. These chickpea varieties are suitable for autumn planting, which produces up to 50% higher yield than normally adopted spring planting. In Armenia, seed of newly released chickpea varieties from ICARDA nurseries was multiplied on 6.5 ha in 2010-2011 for distribution to farmers in 2011-2012. In Kazakhstan, seed production was accomplished on more than 300 ha for chickpea variety selected from ICARDA nursery. In Azerbaijan, Georgia and Uzbekistan seed multiplication of newly released chickpea varieties from ICARDA nurseries was done in 2010-2011 for out-scaling in 2011-2012.

Seed of "Dostlik" winter wheat, which has salinity tolerance, was multiplied by the NARS partner in Uzbekistan on more than 30 ha for distributing this variety to the farmers. Due to tolerance to medium level salinity, moderate resistance to yellow rust, and high yield potential (7 t/ha) in farmers' fields, "Dostlik" is becoming popular among the farmers in southern regions of Uzbekistan and area under this variety is expected to increase in coming years.

IWWIP Regional activities in Uzbekistan

Based on the recommendation of the Wheat Strategy meeting of the Region held in 2009, wheat yield trials from IWWIP continued to be evaluated in Uzbekistan with the objective of developing targeted winter wheat yield trial for the CAC Region within the framework of IWWIP. The nurseries under evaluation at two sites in Uzbekistan include five replicated yield trials (190 advanced breeding lines), three observation nurseries of facultative and winter wheat, and winter wheat screening nurseries for Ug99 stem rust and several other miscellaneous nurseries. Many superior lines of winter/facultative wheat have been identified in the yield trials and observation nurseries. These superior lines were tested in the CAC region in 2011. The lines identified outstanding in 2011 in Uzbekistan in advanced yield trial will be distributed to national partners in the region for evaluation in 2012.

Identifying salinity tolerant winter/ facultative wheat

ICARDA, in collaboration with the NARS partners in Uzbekistan, Kazakhstan and Turkmenistan started in 2010 a project titled "Utilization of wild relatives of wheat in developing salinity tolerant winter wheat with improved quality for Central Asia", funded by BMZ/GIZ for three years. Four sets of improved materials (more than 650 accessions) have been tested under this project at four sites in Uzbekistan, Kazakhstan and Turkmenistan. Initial results suggest that several lines possess tolerance to medium level soil salinity. The superior lines from this study will be further tested for identifying new cultivars for saline soils as well as for their use in crossing programs.

Ability to germinate and maintain seedling vigor and early crop establishment appeared to be key factors associated with salinity tolerance in wheat. GreenSeeker was used to assess wheat crop health under saline condition measured as NDVI (normalized difference vegetative index) at different growth stages. Significant genotypic differences occurred among the varieties for NDVI, which was positively correlated with grain yield.

Special studies

Four research studies in wheat improvement for Ph.D. scholars were conducted in the second year in Uzbekistan in 2011. The first study involves examination of genotype-by-environment interaction for quality parameters in winter wheat. Results from the studies conducted in 2010 and 2011 across six sites showed significant effects of genotype and genotype-by-environment interactions for selected quality related traits in winter wheat. However, certain genotypes consistently showed superior performance for quality traits and grain yield.

The second study is being conducted to determine effect of timely and late harvest of

wheat on yield and quality traits. Preliminary results show the presence of genotypic variation for deterioration in quality when harvest is delayed beyond optimum period.

The third study involves identification of improved winter wheat varieties with resistance to Ug99 stem rust. Several winter wheat lines selected from the 1st Winter Wheat Stem Rust Resistance Nursery in 2010 showed more than 7 t/ha grain yield in 2011 yield trial, which was significantly higher compared to local checks. These superior lines are also resistant to yellow rust. The selected lines will be further tested to identify improved varieties.

The fourth study is being conducted to identify improved durum wheat varieties for irrigated and rainfed environments in Uzbekistan. A study on identifying improved wheat varieties with resistance to Ug99 stem rust and stripe rust was conducted in the third year in 2011. Several lines with resistance to yellow rust and Ug99 were identified, which would be further tested and used in wheat improvement program in Uzbekistan.

Another study involves identification of improved chickpea varieties suitable for autumn and spring planting. Special studies were also conducted on characterization of genetic resources for morpho-physiological traits and tolerance to salinity, drought and heat in Azerbaijan, Armenia, Georgia and Tajikistan. More than 250 accessions are being characterized.

Diversity among winter wheat germplasm for NDVI under terminal heat stress

A field study was conducted at Karshi, Uzbekistan in 2010-2011 to characterize 170 winter wheat genotypes for NDVI values using the GreenSeeker and to determine their relationship to grain yield. The winter wheat genotypes included commercial cultivars from Central Asia and advanced breeding lines from the Turkey/CIMMYT/ICARDA International Winter Wheat Improvement Program. NDVI measurements were recorded at seven crop growth stages. For several days the maximum temperatures during the grain-filling period rose to 30-40°C, resulting in considerable terminal heat stress. A range of variation for NDVI was found at each growth stage. There was significant genotype × growth stage interaction. There were several genotypes that constantly maintained higher NDVI value across all growth stages. The genotypes 'Hazrati Bashir', 'Gozgon', 'Dorade-5//KS82117/Mlt', 'Star/Bwd', 'Vorona/HD2402//Albatross Odesskiy', 'Bitarap', and 'Elomon' were most stable for NDVI across different growth stages. The genotypes showing higher NDVI values during the grain-filling period would be expected to better tolerate terminal heat stress, which is frequently encountered in Central Asia. Grain yield and NDVI showed significant positive correlation at the grain-filling "milk" (r=0.67**) and "dough" (r=0.77**) growth stages. The set of germplasm included in this study represents substantial genotypic variation for NDVI values, which could be useful for winter wheat improvement programs in the region.

Specialized training course on field experimental design and analysis in Central Asia

A training course on field experimental design and analysis was organized by ICARDA from 14 to 26 February 2011 in Tashkent, Uzbekistan. The objectives of the course were to, i) familiarize the participants with the concepts of design of experiments and analysis of experimental data; ii) acquaint the participants with the use of statistical software packages for statistical data analysis; and iii) help and advice researchers in preparing a draft research manuscript for publication. The course included theoretical explanations and practical exercises on basic statistical modules including planning, data analysis and interpretation of results using complete and incomplete block designs and Genstat statistical software. This was the first opportunity for all the participants to attend and learn the principles and practices of field experimental design. The training course was organized within the framework of an ongoing research project "Utilization of Wild Relatives of Wheat in developing salinity tolerant winter wheat with improved quality for Central Asia" undertaken in Central Asia by ICARDA with funding from BMZ/GIZ.

Capacity building

Moreover, during the reporting period ICARDA facilitated the participation of young scientists from the CAC Region in the following capacity building activities:

- One young researcher from Uzbekistan obtained 2-week training on wheat quality analysis in Turkey. This training was supported jointly by ICARDA and IWWIP.
- One young researcher from Uzbekistan obtained 2-month (15 May–15 July 2011)

training on winter wheat improvement in the International Winter Wheat Improvement Program in Turkey. This training was supported jointly by ICARDA and IWWIP.

- Nine researchers from Uzbekistan, Turkmenistan and Kazakhstan obtained training in using SPAD meter and GreenSeeker in wheat crop. This training was organized by ICARDA.
- Twenty three researchers from Armenia, Azerbaijan and Georgia participated in a training titled “Plant Genetic Resources Management and Germplasm Characterization” organized by ICARDA from 4–9 April 2011 in Tbilisi, Georgia.
- One young researcher from Uzbekistan obtained 3-month (October–December 2010) training on greenhouse screening and application of molecular markers for wheat rust research at the Institute of Plant Breeding in Australia.
- One young researcher from Azerbaijan has been selected for Norman Borlaug Fellowship to learn application of molecular techniques in wheat rust research at Kansas State University, USA.
- One young researcher from Tashkent State Agrarian University was awarded the “IFAR Grant 2011 – Thalwitz Scholarship” for undertaking a research project titled "Identifying Genetic Variation and Effective Plant-Microbe Association for Salt Tolerance in Chickpea”. This project aims to better understand the diversity of nodule and rhizobacteria associated with chickpea in saline soils and their interactions and role in soil productivity. ICARDA sponsored nomination of the candidate for this award.

Kazakhstan-Siberian Network on Wheat Improvement (KASIB)

Coordinated by CIMMYT, presently KASIB unites 14 breeding programs from Kazakhstan and Russia that have been conducting wheat breeding for the area over 20 million ha. Germplasm exchange has been undertaken through nurseries of bread (KASIB-SBW) and durum (KASIB-SDW) wheat that were formed using best samples presented by the breeding programs. Evaluation of the material was based on biological and economically valuable traits studied at different ecological conditions. The traits included vegetation period, height of plants, top internode length, yield, 1000 KW, test weight, disease resistance (leaf, stem and stripe rust, powdery mildew, septoriosis), lodging and shattering resistance. The statistical analysis of data obtained throughout two years study was made and the best cultivars were selected that demonstrated advantages as compared with the other varieties. Among the bread wheat varieties, the following were notable: Lutestsens 290/99-7 Lutestsens 363/96-4 Lutestsens 415/00 (Kurgan seed Company), Lutestsens 120-03 (Omsk SAU), Apasovka (Altay ARI), Zaulbinka (East-Kazakhstan ARI), Sary Arka 28 (Karaganda ARI), Samgau (Almaty ARI) Omskaya 39 (Omsk ARI). These varieties were 10-15% more yielding than average. Among the durum wheat varieties, the highest yield was shown by Altyn dala, Altyn shygys (Karabaklyk, Kazakhstan), Lan (Almaty, Kazakhstan), Gordeiforme 96-160-8 (Omsk, Russia), Kargala 1514/06 (Aktobe, Kazakhstan). The summarized and statistically processed results were distributed in a form of annual bulletin to all breeding programmes. About 25% of studied KASIB’s varieties are being used by breeders for crossing in their own breeding programs. Catalogue of "Classification of varieties of spring wheat nurseries KASIB on grain quality characteristics” was published.

Shuttle Breeding

The crossing program conducted in Mexico by CIMMYT, emphasizes Kazakhstan x Mexico crosses as well as top crosses with the relevant US and Canadian germplasm. The new shuttle material F5-F6ME6KAZ (461 entries) was planted and evaluated in Republican Quarantine nursery, Karabalyk Experimental Station (Kazakhstan) and Omsk Agrarian University (Russia). Data demonstrate high efficiency of the screenings. Efficiency of selection from hybrid populations in a number of institutions (Pavlodar, Novosibirsk ARIs, Tyumen and Omsk SAUs) reached 95-100%. The adaptation of the shuttle germplasm to high latitude environment is gradually improved. Some of the advanced shuttle lines were entered in PYT and YT in different breeding programs: “Fiton” Company, Karabalyk, Karaganda, Chelyabinsk. The largest amount of shuttle advance lines in YT was selected at Fiton Breeding Company. An annual bulletin of KASIB and KSBN results was published and distributed to members of KASIB Network.

Bio-fortification of wheat grain by Zinc (Zn) and Iron (Fe)

New varieties and advanced lines of 10-11th KASIB nurseries have been assessed. The

nurseries were presented by 50 varieties of spring bread wheat from 14 breeding programs. According to the data obtained by today, it is obvious that for Iron the role of genotype in the overall variation is more important than the role of location. In case of Zink the contribution of location is higher as compared to genotypes for most of the datasets. Both for Zink and Iron the genotype-by-environment interaction is significant and relatively substantial. The historical set of 55 spring wheat cultivars developed in Siberia (Russia) and Kazakhstan from 1890s till 2007 was analyzed for Fe and Zn content. These analyses aimed at identifying the impact of breeding progress on the micronutrients accumulation in the grain. It was shown that concentration of Iron in wheat grain almost did not change by years as compared to Zinc content and proved to be more conservative characteristic. As for Zinc, variation of its content was more significant both by years, and within the studied genotypes. The study of germplazm of different country origin allowed identifying varieties characterized by a high micronutrient content and good adaptation to local conditions. Varieties “Avle” (Norway), “Granite”, “Sable” (Canada), “Tarskaya 7”, “Omskaya 12” (Russia) exceed the target level up to 5-10 ppm. It gives the opportunity to identify genotypes for crossing and develop the new breeding material with high micronutrient content. In total 137 of F2 hybrid populations developed from parental lines with high Zn and Fe content were transferred to the breeding programs of KASIB network for inclusion into breeding process.

Winter wheat breeding in Kazakhstan

Winter wheat is cultivated in the south and south-east of Kazakhstan over an area of 800,000 hectares. Breeding of winter wheat is carried out through 4 breeding programs. Breeding in the south is undertaken both for irrigated and rainfed conditions, while in the north and east (Karabalyk, Ust-Kamenogorsk) for rainfed conditions. Meanwhile, the limiting factors are extremely continental climate and harsh winters, which determine the breeding trend aimed at increasing wheat frost resistance. In 2010, 760 entries from nurseries SEG POP – CAC, 11 IWWIT-IR, 10 IWWIT-SA, 16 FAWWON-IR, 16 FAWWON-SA, 8 WONSA, 9 WON-IR, 8 WWERYT, 12 IWWYT-IR, 11 IWWYT-SA and F3-F4 populations, which were released from CIMMYT in prior years, were evaluated repeatedly. Assessment has been undertaken for 350 entries identified from the environmental test under the breeding process. About 45% of entries have surpassed the check varieties in yield capacity by 0.3-2.5 t/ha. Most entries, which showed good yield capacity, are characterized by high resistance to stripe and leaf rust. Disease severity of majority varieties averaged between 0 to 10S, whereas disease severity of local checks ranges from 50 to 100S.

Severe climate and cold winters of North Kazakhstan are usually unfavourable for winter wheat production. Nevertheless the development of suitable for that conditions winter wheat varieties and appropriate agronomy practices based on no-till technologies with straw and stubble retention represents a good alternative option for crop production in a huge area of North Kazakhstan. Testing of 11,144 entries of winter bread wheat has been undertaken in Karabalyk. In addition to local materials, the study involved entries from CIMMYT, Russia, Ukraine, Bulgaria and Canada. CIMMYT material was represented by the following nurseries: 12 IWWYT-SA 17 FAWWON-SA, 17 FAWWON-IR IWWIP 09-10 and 1st WWSRRN. 14 FAWWON, 1915 FAWWON-SA, 1915 FAWWON-IR and 9 WON-SA studied in previous years were re-planted repeatedly. The promising material was selected at all stages of breeding process. A total 46 lines, 15 of which from Novosibirsk (NWWN), were studied in YT. Lutestsens 372 II and Lutestsens 209 III showed the highest yield and surpassed the local check by 0.28 t/ha. Ecological testing of winter triticale varieties has been initiated to diversify crop production.

Pathological evaluation of germplasm

A total of 1343 entries from KASIB Network (KASIB 8-10), varieties and advance lines of Siberian ARI, Omsk SAU, Karabalyk ARS, Fiton Breeding Company, Otar ARI, Samara ARI, Saratov ARI, Kurgan ARI were assessed from 2008 to 2010. About 225 entries from 6 research institutions of both Kazakhstan and Russia were evaluated during the Off-season 2009-2010, Kenya. The predominant pathotype was likely Ug99 +Sr24 (TTKST); the spreaders were based on mixture of lines with gene Sr24+Sr31 and showed susceptibility to the inoculated pathotype producing up to 100% disease. The season was very wet with more than 700 mm of rain. The disease pressure was very high and checks were almost dead in the plots. In the circumstances concerned, 93 entries (41%) were identified as resistant.

Evaluation of winter wheat varieties to stem rust during the Off-season 2009-2010, Kenya, showed that the affecting of varied from 15M to 50S. The highest resistance to Ug99 (15 M) was shown by “Egemen” variety that has been developed on basis of CIMMYT breeding material (BHR/AGA//SNI/3/TRK13; Cross IDXWN84305; Sel. hist.-J45A-3C-0WM-3YC-0YC-1YA-0YC)

Development of new varieties based on CIMMYT germplasm

On the basis of germplasm from CIMMYT International Nurseries the varieties of winter wheat, triticale and barley were developed. “Egemen” winter wheat variety has been released in the South of Kazakhstan since 2006, the variety of winter triticale “Orda” has been released since 2009.

The spring bread wheat variety “Stepnaya 60” was developed at Aktobe Agricultural Experimental Station using CIMMYT parental line (Prinia/Druzina) and, by the decision of the SVTC this variety has been released in the Central Kazakhstan region since 2010. Variety “Stepnaya 60” has the Republic of Kazakhstan Authorship Certificate No. 367 issued on 2 July 2010, according to which 25% of contribution share is given to CIMMYT. Barley variety “Kuralay”, which has been developed from the CIMMYT-ICARDA breeding material, will be released in the South of Kazakhstan from 2011. Results demonstrate a positive trend of increased participation of CIMMYT material in breeding process of different institutions, in particular, of a material developed under the shuttle breeding.

Centers: ICARDA and CIMMYT

Donors (special projects): BMZ/GIZ Germany for the grant “Utilization of Wild Relatives of Wheat in developing salinity tolerant winter wheat with improved quality for Central Asia”

Project period: ongoing

Countries: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan

Germplasm conservation and enhancement in potato

Aims and scope of work
Research has been carried out on different potato germplasm materials that were distributed to CAC countries since the opening of the CIP office in Tashkent. Among them, advanced clones in form of in-vitro plants, tuber families issued from the regional clonal selection implemented in the highlands of Tajikistan, and True Potato Seed (TPS) families used as an alternative to traditional, clonal seed potato multiplication. The above germplasm materials included 75 advanced clones, selected for resistance to viruses, abiotic stress and marketability; 14 tuber families combining adaptation to long day conditions and virus resistance; and 21 TPS families.

CIP advanced clones
A description of candidate and released varieties has been prepared for Uzbekistan (Annexes 2, 3 and 4). Summarizing, in 2010, three candidate varieties were released, two in Kazakhstan ("Alliance" or CIP 397076.16, and "Miras" or CIP 388676.1) and one in Uzbekistan ("Serkhosil" or CIP 397073.16); while 9 candidate varieties, among them "Ushkonir" (CIP 392780.1) in Kazakhstan, "Faizabad" (CIP 397077.16) in Tajikistan and "Pskem" (CIP 390478.9) and "Sarnav" (CIP 397077.16) in Uzbekistan, are still under testing by the respective SVTCs.

The growing cycle of the varieties ranges from 95 to 120 days, from planting till harvesting. Some of them have a wide adaptation potential like, for instance, CIP 397077.16 (suited to lowlands and highlands; to fertile and moderately saline soils), while others are recommended for specific agro-climatic conditions. All of them have high dry matter content (> 20%) and, therefore, are recommended for both uses, as normal culinary preparations and processed into chips or French fries.

They are also resistant against the main potato viruses, PVY, PLRV, PVX and PVS. In Georgia, at an altitude of 2,000 m above sea level, from preliminary observations clones 397077.16, 397035.26 and 391180.6 had the highest productivity with 28, 26 and 22 tubers harvested per plant, respectively, and very few Late Blight spots observed on the foliage. Observations are still ongoing to be sure that this is not a form of "vertical" resistance.

Outcomes of the shuttle-breeding scheme
Through the "shuttle-breeding scheme"[1], which started in 2005 in Tajikistan, the gathered data are used to select the clones and progenitors that will be crossed in the next cycle of breeding at CIP Headquarters in Lima (Peru). The resulting true seed families will be dispatched again for selection. Once in-vitro plantlets will be ready from those clones, samples will be sent to CIP Headquarters for virus eradication through meristematic culture, thermotherapy and chemotherapy. This scheme, for instance, has resulted in the release of five varieties to UPOV standards in Kyrgyzstan, in 2010.

Development of potato varieties resistant to abiotic stress

Field experiments

This work is carried out in collaboration with the Institute of Vegetables, Melon and Potato, the Department of Bio-organic Chemistry of the National University of Uzbekistan and the Soil Agrochemistry Institute, all based in Tashkent region. Potato is normally classified as a moderately salt-sensitive crop, having threshold salinity levels from 1.6 to 2.5 dS m^{-1}. However, as it was demonstrated in a trial in Syr Darya province under moderate salinity levels (up to 4 dS m^{-1}) and predominance of chloride-sulfate, CIP clone 397077.16 out-yielded the other entries with a marketable (tubers with size > than 35 mm) and a total yield of 17.6 and 18.6 t/ha, respectively, significantly higher than those of the Dutch variety "Sante" (9.9 and 10.3 t/ha), the most popular potato variety in Uzbekistan. The dry matter content was of 20.7% (very good for processing into chips and French fries) and the vitamin C content equivalent to 23.7 mg/%.

Conversely, in the heat tolerance trial carried out in Tashkent from July till October 2010, the average marketable yield was of 29.6 t/ha, with values ranging between 19.6 t/ha (397029.21) and 40.8 t/ha (397035.26). In general, clone 397077.16 performed better for all studied parameters, followed by 388615.22 and 397035.26. In the lowlands of

[1] or breeding across distant environments in Peru and the target countries.

Tajikistan, with planting in June and harvest at the beginning of October, CIP clones 392797.22 and 720148 were among the most performing entries with a yield above 30 and 20 t/ha in Faizabad and Muminabad, respectively, out-yielding significantly Dutch variety "Cardinal" in both sites. On the other hand, in the drought tolerance trial carried out in Tashkent consisting of a strip plot design with three treatments as the vertical factor and entries as the horizontal factor.

Vertical factors:

- control: normal irrigation;
- deficit irrigation: normal irrigation up to 40 days after planting, followed by two irrigations at 60th and 80th days after planting;
- severe drought: normal irrigation only up to 40 days after planting, followed by water deficit.

CIP-bred clones 388676.1, 392797.22, 397029.21, 397077.16, and 720139 were the best performing due to high drought tolerance index (DTI), low drought susceptibility index (DSI), and high yield maintenance under severe water stress conditions.

Laboratory experiments

Salinity tolerance was also studied under in-vitro conditions at the Institute of Plant Physiology and Genetics in Dushanbe, Tajikistan, in order to identify suitable screening methods to quickly test important amount of germplasm materials.

Using *Murashige & Skoog* nutrient media containing three different concentrations of NaCl (0.5%, 1.0%, and 1.5%), the viability of in-vitro potato plantlets at 1.5% NaCl concentration was estimated to be 100% after 42 days for CIP-bred clones 301029.18, 370120, 391580.30, 393708.31, 397006.18, and 709004 and 80% for the following clones: 301024.14, 370121, 380389.1, 380583.8, 393381.4, 393536.13, 394881.8 and 720118. In-vitro plants of the Dutch variety "Picasso" and CIP-bred clone 397077.16 were used as controls with viability of 0% and 100%, respectively. The in-vitro plantlets are considered viable when they have ability to regenerate once placed in a medium without NaCl. Furthermore, CIP-bred clones 380583.8, 381379.9, 389429.31, 391580.30, 394034.7, and 394881.8 showed good in-vitro micro tuberization at 1% NaCl with a weight ranging from 24.2 mg (CIP 381379.9) to 81.2 mg (CIP 394881.8) and an average number of micro tubers per plant ranging from 1.0 (CIP 380583.8) to 2.3 (CIP 389429.31). At the end of the work a protocol for laboratory screening of potato germplasm materials under different salinity levels was formulated. This will allow us to compare the data obtained from laboratory and field experiments.

Seed production systems

Development of a farmer-based seed potato production system using TPS

In the highlands of Central Asia, TPS technology, as an alternative seed potato technology, is particularly adapted to such local conditions as resource-poor smallholders, difficult access to farmers' fields, and unaffordable price of conventional seed. TPS shows an interesting potential especially in "niche" areas such as those in Zerafshan and Rasht Valleys, Pamir area in Tajikistan, Badakhshan area in North-Eastern Afghanistan, and the border districts in mountainous areas of Uzbekistan. Although five TPS families have been identified as the most performing under local conditions, priority has been given to the multiplication of TPS families 998010 (LT-8 x TS-15) and 988141 (MF-II x TPS-67).

A network including NARS, NGOs, UNDP "Area-Based Development" project (implemented in Kashkadarya, Uzbekistan) and smallholders was established in all the concerned countries to surrogate absent or inefficient national extension systems.

In those countries CIP tested two techniques – the direct seeding technique in nursery and the transplanting of rooted seedlings. Interesting results were reported in the districts of Jirgatal (Tajikistan) and Kitab (Uzbekistan), where TPS family 998010 showed a high average yield per unit area in the direct seeding method (7.3 and 4.6 kg/m^2, respectively), at 137 and 132 days after sowing, respectively. The only drawback to the adoption of the transplanting method might be the long duration of the growing cycle of the tested TPS families (151 days from sowing till harvesting) that would need to be shortened, requiring, therefore, additional research on new germplasm materials.

A modified seed production system for pre-basic seed production in Uzbekistan

The research work conducted at the National University of Uzbekistan, where CIP has

improved the research facilities comprising of a laboratory for tissue culture for the production of 100 000 in-vitro plantlets per year and 3 screenhouses, aphid proof of the size of 600 m^2 each, equipped with drip irrigation, resulted in the determination of a calendar of operations that can be of great use in the case of large-scale seed production activities.

In fact, according to the obtained results, two planting materials can be used with success: (i) in-vitro plants, transplanted at a high density (50 pl/m^2, or 8x25 cm) in February and (ii) in-vitro microtubers planted at the same density in September, allowing 2 cycles of minitubers' production under screenhouse conditions per year.

Minitubers are transplanted in the highlands and multiplied for 3 to 5 generations until the stage of Elite category. The research work led to a standardized in-vitro growing media for the production of in-vitro plants and microtubers from explants issued from disease-free materials. Moreover, as a result of experiments, the appropriate media for the production of minitubers under screenhouse conditions was found and a mixture of subsoil, well-decomposed organic manure, sand and rice husks recommended at the rate of 1:1:1/4/:1/2. By the introduction of crop rotation inside the screenhouses, it was possible to avoid expensive operations like soil sterilization that always represents one of the bottlenecks in the minituber production stage.

Policy support – introducing principles and practices of fair trade

The second year of a new marketing strategy called by CIP "Participatory Market Chain Approach" (PMCA) was conducted in Zeravshan Valley of Tajikistan in collaboration with staff of Welthungerhilfe (NGO German Agro Action) working for the Project "Economic development through a comprehensive seed production, marketing and extension service system in Zeravshan Valley", funded by the EU. The PMCA engages those who directly participate in the market chain – the so-called 'market chain actors' – and agricultural service providers (such as researchers, credit providers and development workers) in facilitating group processes through which market opportunities are identified and assessed and innovations are developed. The main purpose of PMCA is to establish principles and practices of fair trade among all the participants. Two phases of the PMCA were implemented so far: 1) Familiarization with the market chain and the key actors; and 2) Joint analysis of potential business opportunities. Phase 3) Development of market-driven innovations has not been implemented yet.

The major objective of PMCA in Zeravshan Valley was to bring small scale potato growers together with other market chain actors, researchers, service providers to produce and share knowledge, build trust, and develop innovations that would benefit potato growers as well as other market chain actors.

The districts of Ayni and Kuhistoni Mastchoh were selected as target districts for conducting the PMCA. The interviewing process was split in two parts with the first part aimed at interviewing market chain actors in Ayni and Kuhistoni Mastchoh districts while the second part targeted major end-user markets, i.e. wholesale markets of Dushanbe and Khujand. The obtained results of the interviews were then presented in the first PMCA workshop organized in January 2010 which gathered together all interviewed participants. The event started with the introduction of nature, objectives and structure of PMCA process and continued with general discussion of the market chain findings while at the end of the event different thematic groups were formed.

The second PMCA meeting was organized in May 2010 and aimed at continuing discussions and collaborative work in thematic groups, which were formed during the first PMCA meeting. Work was concentrated on improving the existing value chain. The major issue raised throughout the discussions was how to differentiate potatoes produced in Zeravshan Valley from those originated in other parts of Tajikistan in order to be able to create a brand name that could give an added value to the potatoes produced in the two targeted districts.

The major constraints preventing from the development and further expansion of the existing potato chain were identified in a sequential order, as follows: (1) the presence of barter trade and consequent lack of monetization; (2) the poor quality of seed planting materials; (3) the unfair relationships among different market chain actors all along the market chain; (4) difficulty of transportation; (5) the current price formation due to the scarce bargaining power of potato growers, in general; (6) lack of storage

facilities that would allow farmers to sell potatoes during more convenient periods of the year; and (7) insufficient marketability of potatoes, in the sense that potatoes are not often well sorted and graded, thus reducing their marketable impact.

Based on these constraints, the working groups proposed to introduce some innovations such as improved sorting/grading and packaging, labeling, contract farming, etc. These innovations will be further elaborated in the near future, reserving to the most promising ones their transformation into tangible products, technologies and partnerships.

The events conducted so far clearly showed the need for strong partnership among the PMCA participants. Despite the fact that each market chain actor provided extensive information about their activity in the market chain, they nonetheless showed low awareness about how his activities might have an impact in the consequent stages of the potato chain.

Capacity building

Apart from the on-the-job training of staff of partner institutions, the following events were organized by CIP-Tashkent in close collaboration with partners:

- Twelve participants attended the first PMCA workshop organized in Ayni district, Tajikistan (25-29 January 2010);
- Six staff members of the Aga Khan Foundation project in Badakhshan region of Afghanistan were trained in TPS technology and seed potato production in Tashkent, Uzbekistan (6-8 April 2010);
- Twenty nine participants attended training course on TPS technology and seed potato production for smallholders associated with NGOs Global Partners and Mercy Corps, in Garm, Tajikistan (13-14 April 2010);
- Fifteen participants benefited from the training course on Potato Seed Production through tissue culture and alternative seed production techniques (TPS), in Dushanbe, Tajikistan (19 April 2010);
- Fifteen smallholders received training in TPS technology, Kitab district, Uzbekistan (27 April 2010);
- Eighteen participants attended a second PMCA meeting, organized in Ayni district, Tajikistan (10-14 May 2010);
- Six staff members of Agro-Cartu Foundation received training in tissue culture for potato and management of in-vitro plants under screenhouse conditions, Tbilisi, Georgia (24 May 2010);
- Participation of 3 staff members of NARS partner institutions, one from the Horticulture Institute “Bogparvar”, Dushanbe, and 2 from the Institute of Vegetables and Potato, Tashkent, in the International Training Course on ”Crop Modeling for Potato and GIS applications” at CPRI, Shimla, India (5-16 July 2010) was supported.

Center: CIP

Donors (special projects): GIZ, Germany

Project period: ongoing

Countries: Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan

In Situ/On-Farm Conservation of Agricultural Biodiversity (Horticultural Crops and Wild Fruit Species) in Central Asia

Aims and scope of work

Five Central Asian countries work together to identify options for conserving horticultural crops and their wild relatives through a regional project coordinated by Bioversity International, with financial support from the Global Environmental Facility (GEF) and implementation support from the United Nations Environment Programme (UNEP). The goal of this five-year project is to equip farmers, institutes and local communities with the knowledge, methodologies and policies to enable in situ and on-farm conservation of globally significant horticultural crops and wild fruit species in Central Asia. The project focuses on traditional local varieties of fruit crops maintained by farmers and their wild relatives growing in forests, and on enhancement of farmers' capacities to conserve in situ horticultural diversity.

Conservation

Survey missions (ecological and geographical surveys, participatory assessment and household interviews) to assess distribution and level of diversity of fruit crops and wild fruit species were conducted in all five countries. These missions covered the major areas of Central Asia, where horticulture and viticulture had been historically developed. It was shown that more than 30 types of fruit crops were cultivated in farms and homegardens. Share of local varieties and forms of target fruit crops and their wild species ranged from 53% in Kazakhstan and Kyrgyzstan to 79% in Uzbekistan. Project partners identified more than 145 local varieties of apple, 143 apricot, 160 grape, 58 walnut, 32 pear, 26 pomegranate, 18 almond and 15 mulberry. Sixty-eight forms of pistachio, apple, currant, sea buckthorn and cherry plum with promising traits for further breeding and multiplication were found in the wild. Identified local diversity reveals valuable traits as early maturation, resistance to spring frosts, tolerance to salinity and drought. Most of them acquired pomological descriptions, which are published and available to breeders and farmers. On the basis of the information collected during survey missions, digital databases with information on assessment of diversity distribution and level in priority fruit species were established in all five countries. Sixty-three demonstration plots/matrix gardens were set up in existing farmers' orchards and forest sites, which maintain 430 local varieties and forms of apple, apricot, grape, pear, pomegranate, walnut, pistachio and almond. These demonstration plots are used for training of farmers on local fruit varieties management practices and as mother orchards for obtaining grafting material for multiplication. Moreover, 54 nurseries were strengthened or established within the project, producing annually 800,000 saplings for distribution to farmers.

Enabling legislation

Existing national legislation on conservation of wild fruit species in protected areas and other forest lands, plus relevant legislation on agriculture and farm development were analyzed in all five Central Asian countries. As a result, in Uzbekistan the national project implementation unit prepared and submitted proposals to the new version of "Action Plan on Biodiversity Conservation" on strengthening *in situ* conservation of wild fruit species through establishment of new nature reserve for conservation of wild pistachio (*Pistacia vera* L.) in Babatag forestry farm and Sangardag forestry in Uzun forestry farm, refugium for wild walnut and fruit species in Sidjak forestry of Bruchmulla forestry farm in Tashkent Province and in Tupalang river basin in Surkhandarya Province. In Kyrgyzstan, national partners submitted proposals to "National Biodiversity Conservation Strategy" and "Action Plan on Biodiversity Conservation" for 2011-2014 on restoration of genetic resources of wild apple, cherry plum, and other associated fruit species in the forest cover of walnut forests. In Tajikistan, legislation "About conservation and sustainable utilization of crop genetic resources" was developed and submitted to the Low Chamber of the Parliament. For broadening farmers' understanding and knowledge on national legislation in Kazakhstan, a manual was released "Assistance to farmers - fruit growers", which in understandable language explains the national legal provisions supporting farm development, production and marketing of fruit products.

The project has given high attention to Farmers' Rights protection. In Kazakhstan and Uzbekistan, national rosters of local varieties of fruit crops with indication of farmers-custodians of this diversity were drafted to protect farmers' rights as germplasm holders. In Kyrgyzstan, a booklet on national law "About protection of traditional knowledge" was prepared by the national project team to increase farmers' knowledge on existing legal framework protecting their rights on intellectual property related to maintenance and use of local agrobiodiversity. In Tajikistan, proposals were made for amendments to national law "Breeding achievements and protection of breeders' rights" to protect farmers' rights on local varieties. In Turkmenistan, draft law "Protection of farmers' rights and benefit sharing mechanism" was developed and submitted to Ministry of Agriculture. In Uzbekistan, national partners prepared and submitted proposals to the State Variety Testing Commission on establishment of testing and patenting procedure of fruit crops varieties developed by the farmers in the demonstration plots.

National legislation frameworks were also strengthened to support plant genetic resources conservation in Central Asian countries. Model Law "About Conservation and sustainable utilization of crop genetic resources" was developed and submitted to the Low Chamber of the Parliament of Tajikistan. Proposals on conservation of crop wild relatives were submitted for inclusion in the national law "About protection of flora" in Kazakhstan. Agreements on access and sharing benefits arising from the use of fruit crops genetic resources were developed and are being tested in the countries. Recommendations on recognition of farmers' intellectual property rights on their varieties were submitted by the national team in Uzbekistan to the Ministry of Agriculture. The efforts aimed at recognition of farmers' role in conservation of crop diversity are underpinned by public awareness raising campaigns.

Raising public awareness

Public awareness activities played a significant role in creating an enabling environment for change in legal and policy frameworks on conservation and sustainable use of diversity of horticultural crops. During the reporting national project teams in all five countries produced and disseminated a number of public awareness materials. In Uzbekistan, posters and leaflets about farmers as custodians of agrobiodiversity and their knowledge were produced. Press conferences and media tours to the project sites were organized by national partners to inform on the project's outcomes. As a result of these events information on the project was shown in several national TV channels. National project partners and students of Tashkent State Agrarian University participated in a talk show devoted to International Forests Year on national TV channel "Tashkent" (11 June 11 2011). In Kyrgyzstan a video film "Conservation and use of intraspecific diversity of sea-buckthorn (*Hippophae rhamnoides* L.) in Issyk-kul was prepared. Tajikistan national partners produced video films: "Local varieties of fruit crops", "Region of famous apricot", "Grapevine of farmer Mr. Khodji Nemat", "Nursery keeper Mr. A. Barotov", "Fruit crops and wild fruit species in the Pamirs" and "Diversity of fruit crops in Kulyab Province".

Scientific guidelines and manuals

During the past year, 13 scientific manuals and guidelines on characterization of fruit crops local varieties and promising forms of wild fruit species, technologies of their cultivation and management were produced by national project teams in all five partner countries for farmers and researchers use.

Farmers' fairs

Three farmers' fairs were organized in Kazakhstan where products of local varieties of fruit crops were presented. In Kyrgyzstan two fairs with saplings of local varieties of apple and promising forms of wild apple and walnut were organized and 550 saplings of local varieties of apple were distributed free of charge among farmers and local people from neighboring villages. In Tajikistan two fairs with young trees of fruit crops were organized where saplings of more than 50 varieties were exchanged. In Uzbekistan farmers supported by the project participated in the International Fair of Agricultural Products (September 2010) and presented products of 5 local varieties of pomegranate and 10 local varieties of grapevine.

Capacity building

Bioversity International organized training workshops at regional and national levels for policy makers, researches, farmers and local communities. During the reporting period a number of regional training workshops were organized within the Project:

- Regional Workshop on "Information and Communication Technologies (ICT)", March 28-30, 2011 in

Tashkent, to discuss database format and agree on data type to be loaded in central database.

- Regional workshop on "Socio-economic aspects of agrobiodiversity conservation", April 13-15, 2011 in Tashkent, to develop the questionnaire for collection of socio-economic data on management of local diversity of fruit crops for assessing the project impact on farmers' livelihoods.
- Regional workshop on "Legislative framework of agrobiodiversity and access and benefit sharing", 4-6 May, 2011 in Tashkent.
- Regional workshop on "Capacity Building", May 24-26, in Tashkent, to review status of training manuals and to agree on mechanisms for their updating and exchange, ensure sustainability of national and regional training centres and information exchange among them after project completion.
- Regional Workshop on Public Awareness, June 6-8, 2011 in Tashkent, to review the progress in PA activities made during the project at national and regional levels and to assess its role in improvement of legal and policy framework in the partner countries.
- Regional Training Workshop on "Application of molecular markers technologies in assessment of plant genetic resources diversity", June 13-17, 2011, Tashkent. Sixteen national partners from Kazakhstan, Kyrgyzstan, Tajikistan and postgraduate students from Tashkent State Agrarian University and Uzbek National University participated.
- Regional Workshop on "Agrobiodiversity Level Assessment", June 27-29, 2011, Tashkent, to assess population sizes of fruit tree resources in cultivated and wild ecosystems, review collected data on conservation management methods for wild and on-farm diversity, analyze existing formal and informal seed systems and link access to seeds to diversity on-farm.
- Regional workshop on apricot diversity and multiplication was conducted at the Regional Training Centre on Apricot on 18-22 July 2011 in Khudjand, Tajikistan, and regional workshop on natural regeneration and selection of promising forms of walnut at the Regional Training Centre on Walnut on 28-31 July, 2011, in Kyrgyzstan.
- Uzbekistan National Scientific conference of young scientists "Current issues of conservation of biodiversity of fruit crops and wild fruit species" devoted to International Year of Forests was held on 20 May 2011 at Tashkent State Agrarian University. Sixty young scientists from universities and research institutes participated in the conference. The best three presentations were awarded.
- In Kyrgyzstan National Scientific and practical conference "Conservation and sustainable use of biodiversity of fruit crops and wild fruit species", on June 17, 2011 at Kyrgyz National Agrarian University.
- International Scientific Conference on "Conservation and Sustainable Use of Biodiversity of Fruit Crops and Wild Fruit Species" was organized on 23-26 August 2011 by Uzbekistan national project implementation unit in Tashkent. The participants shared the lessons learnt during project implementation.

In the reporting period in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan 450 farmers improved their skills in technologies for multiplication of fruit and nut bearing crops, fruit trees pruning technologies, increased their knowledge on farmers' rights in access to land and water resources, agronomy practices in fruit crops cultivation, fruits processing technologies and marketing of fruit products. 130 forest dwellers were trained on methods of facilitation of natural regeneration of wild fruit species, conservation and restoration of nut and fruit species forests, pest and diseases control in forests. Twenty-five orphan children in Tajikistan gained knowledge on conservation of local varieties and wild relatives of fruit, nut-bearing crops and grapevine under guidance of NGO "Zumrad".

Five Regional Training Centers were established and are now fully operational. Eight National Training Centres on target fruit crops are functioning in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Partnerships
Collaboration and partnerships have been strengthened among all stakeholder groups dealing with the conservation and utilization of fruit crops diversity, including farmers, researchers and policy makers at national and regional levels. Forty-three Multidisciplinary Site Committees (MSC) are now operational in the project sites to facilitate activities at the site level.

Representatives of Farmers' Associations and Site Coordination Committees in Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, and individual farmers in Turkmenistan are members of National Project Steering Committees participating in their meetings to review and plan project activities on regular basis.

Agreement on access and exchange of information was developed at the Regional workshop on "Legislative framework of agrobiodiversity and access and benefit sharing", in May 2011. The agreement was signed by Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan.

In Kyrgyzstan, an Association of farmers – growers of fruit crops in Issyk-kul Province was established in the reporting period. In Tajikistan two Associations of Farmers, growing fruit crops were established, which unite 30 farmers. In Uzbekistan, National Farmers' Association was established in 2005 by the President's Decree and its local representatives actively participate in implementation of the activities in the project sites.

Centers: Bioversity International

Donors (special projects): UNEP/GEF

Project period: 2006-2011

Countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

Regeneration and Safety Duplication of Priority Crop Collections

Bioversity International supports the Global Crop Diversity Trust in implementation of 2 regeneration projects in Uzbekistan: “Regeneration and Safety Duplication of Sorghum Collection” (April 2008 – March 2011) and “Regeneration and Safety Duplication of Priority Crop Collections for Barley, Maize and Wheat” (February 2010 – March 2011) on the base of Uzbekistan Research Institute of Plant Industry. To date, 257 accessions of wheat, 157 accessions of barley, 102 accessions of maize and 257 of sorghum collection accessions have been regenerated by the way of self-pollination. Methodical instructions of VIR (N.I.Vavilov All-Russian Research Institute of Plant Industry) and crop descriptors developed by Bioversity International were used for regeneration, evaluation and documentation of regenerated accessions. The accessions were characterized and documented on morphological, biological and economically valuable traits in field and laboratory conditions. Obtained data will be provided to the Trust, made available in Regional Database System and published in the Institute’s web-site (www.uzripi.org) in 2011. Accessions of regenerated seeds will be transferred for safety duplication to VIR, ICARDA and CIMMYT genebanks. These projects provide a possibility to preserve valuable collection materials for future generations.

Centers: Bioversity International

Donor: Global Crop Diversity Trust

Project period:

Countries: Uzbekistan

Conserving Halophytes Diversity

Aims and scope of work
Regional survey of wild/underutilized halophytic flora was initiated by ICBA in collaboration with NARS in Uzbekistan and Turkmenistan to identify alternative low cost options in the rehabilitation of wetlands (waterlogged) and abandoned saline sandy desert rangelands. The habitat of target fodder species for rehabilitation of degraded pastures; sand-fixing; water-table and soil erosion control; haymaking and silage, traditional medicinal wild/underutilized species were mapped, characterized and documented on morphological, biological and economically valuable traits in field and under laboratory conditions.

Collecting missions
Three seasonal field expedition missions (in May, June and November 2010) led to the Mirzachuli steppe, southern-western part of Uzbekistan and Aral Sea Basin, near Muynak city. During these missions, more than 380 species of different groups of salt-loving plants (wild halophytes representing 19 taxonomical families) were described and documented. The study areas showed a high degree of endemism in plants (about 3.4%). Most noticeable is the relative richness of the *Chenopodiaceae* family with nearly 33%, equivalent only to *Australia chenopods*. It is also quite rich in *Asteraceae* (20%), *Poaceae* (11%); *Fabaceae* and *Brassicaceae* (about 11%). Species belonging to *Polygonaceae*, *Plumbaginaceae*, *Zygophyllaceae*, *Cyperaceae*, *Tamaricaceae* account for a smaller share (3-5%), whereas, *Elaeagnaceae*, *Plantaginaceae* and *Frankeniaceae* make up an even smaller part (<1.0%) of rangelands halophytic pastures. Among cited plant resources there are a number of native and exotic halophytes both C_3 and C_4 plants suitable for reclamation of arid and semi-arid, salt/affected and waterlogging lands. Among them are 38 species of forage value, 25 species of trees and shrubs as food, fuel, wood, bio-drainage and landscaping value, 15 medicinal species and 8 dying plants. Seeds of most indigenous trees and shrubs and perennial halophytes were collected. They were intercropped with agricultural salt tolerant crops into a biosaline agriculture demonstration plots at the Kyzylkesek site (Central Kyzylkum). Seeds were collected, documented and are being stored at the Gulistan State University and Institute of Karakul Sheep Breeding and Desert Ecology in Samarkand, Uzbekistan.

Centers: ICBA

Donors: International Center for Biosaline Agriculture, Grant from Ministry of Education, Culture, Sports, Science, and Technology (MEXT) and State Committee for Science and Technology of Uzbekistan

Project period: ongoing

Countries: Uzbekistan

Identifying salinity tolerant and high yielding dual-purpose crops

Aims and scope of work

Research activities on germplasm enhancement have focused on testing and identifying the most promising breeding materials with resistance to both biotic and abiotic stresses. Under a collaborative ICBA/ICARDA/ICRISAT grant, germplasm of 42 populations and improved breeding lines of dual-purpose (grain and fodder) nutrition cereals (*Pennisetum glaucum*) and 14 varieties of *Sorghum bicolor* with limited irrigation were taken up as prime and second crops.

Multi-location trials were established in Uzbekistan, Tajikistan and Turkmenistan under different agro-climatic zones that significantly differed in soil salinity level. Among the tested sorghum accessions Speed Feed, Super Dan, Sugar Graze, Pioneer 858, SP 40516 and SP 39269 showed significant advantage for seed germination (85-90%), growth rate, plant height and forage green biomass, when compared to local varieties. Majority of low –growing and late-maturing populations of sorghum, namely ICSV 112, ICSV 745, SP 3905, SP 712 were characterized by having a thick succulent stem and long and ramified panicles that make them useful both for grain and forage (silage) production.

Among the pearl millet that have been tested so far, Sudan Pop III, JBV 2, Raj 171 (W), Dauro Genepool, IP 13151, ICTP 8203, MC 94 C_2, and ICMS 7704 showed high-yielding (both forage and seed production) ability, thus being suitable for spring planting as the main crop in non-saline and moderately saline areas in Uzbekistan. Improved early-maturing populations such as ICMV 221 (62 days to 50% flower), GB 8735, and Raj 171 (W) (63 days), RCB-IC-956 and MC 94 C_2 (65 days), JBV 3 and HHVBC tall (74 days) were found well adapted as a second planting crop after barley and wheat harvest under moderately saline (Navoi and Syrdarya regions and highly saline conditions in Karakalpakstan. The highest grain yield was obtained for Sudan Pop III, JBV 2, Raj 171 (W), ICTP 8203, MC 94 C_2 and ICMS 7704. The evaluation of green fodder biomass under different salinity level and under various agroclimatic zones showed advantages of IP 13150 followed by Dauro Genepool and IP 13151. The highest decrease in grain production with increasing soil salinity level was observed for ICMS 7704 (81%), MC94 C_2 (70%) and RCB-IC-956 (67%), while JBV-2 showed the highest salt tolerance with only 0.5% decrease in grain yield under salinity environments. Introduced pearl millet and sorghum germplasm were more water efficient, high salt and drought tolerant and did not require much leaching work before planting. Furthermore, pearl millet could become a possible and economically interesting alternative in the marginal salt affected lands that would also reduce summer fallow practices by increasing the land use ratio, improve biodiversity and generate alternative flexible options for improved livelihoods of poor farmers.

Based on previous (2006-2009) multi-trial experiments conducted by ICBA in collaboration with Uzbek Corn Station, Zangyota site, Tashkent region, a new promising dual purpose variety of pearl millet named “Hashaki 1” has been created as result of selection of high productive open pollinated population of improved line HHVBC tall (ICRISAT) with local varieties. “Hashaki 1” in 2010 was submitted to the SVTC of Uzbekistan. This new variety of Uzbek Corn Station (Tashkent region) was developed jointly with ICBA and ICRISAT.

“Hashaki 1” is a dual-purpose variety mostly used as green forage in early spring and in summer cultivated fields as forage for all kinds of animals. It was found that two cuts (first at time to 50% flower) and second cutting – before autumn frosts is available. The average yield of green biomass after two cuts is about 45.0 t/ha, while the local varieties deliver 27.68-30.54 t/ha. The variety is distinguished by its impressive tillering and re-growing ability. It is well used for livestock and showed good palatability. “Hashaki 1” selected variety yielded 25-30% more than local *Panicum* varieties. Yield productivity is characterized as green biomass – 36.07 t/ha with absolute dry substances – 14.43 t/ha; grain yield varies between 2.96 and 3.4 t/ha. In 2011 industrial spatially isolated plantation of this variety has been established in order to obtain pure and high quality seeds.

Capacity building

Three PhD students continue their research on sorghum and pearl millet: two at the

Uzbek Corn Station in Uzbekistan on breeding and seed production system; and one at the Soil Institute of the Tajik Academy of Agriculture on development of technology packages of cultivation of sorghum and pearl millet.

Centers: ICBA

Donors: Islamic Development Bank

Project period: 2006-2011

Countries: Tajikistan, Turkmenistan and Uzbekistan

Crop diversification: vegetables

Evaluating new germplasm

Within a Regional varietal trial initiated in 2010, a total of 94 accessions of six crop species were introduced from AVRDC – The World Vegetable Center – to eight CAC countries for testing, including eggplant (five lines in four countries), sweet pepper (five lines in three countries), cucumber (six lines in four countries), soybean and mungbean (five lines in two countries). In addition, 106 lines of nine vegetable crop species were introduced for new trials in the countries responding to their requests (see Table 1 in Annex 1). As a result, a number of promising AVRDC lines (early maturing, higher yielding, resistant to diseases, fruit quality, etc.) were selected in each country in 2010, including cucumber line 08TWFC 34x37 in Armenia and Turkmenistan, 08TWFC 35x37 in Tajikistan and 08TWFC 37 Bulk in Uzbekistan; hot pepper line PP03377508 in Armenia and Kyrgyzstan; sweet pepper line PP0437-7031 in Azerbaijan, Tajikistan and Turkmenistan; eggplant line TS02890 in Azerbaijan and S00658, S00733 and TS01406 in Uzbekistan; mungbean line VC6372(45-8-1) in Georgia and Kazakhstan; vegetable soybean line AGS437 in Georgia and AGS359 in Kyrgyzstan. A number of promising lines of tomato, sweet pepper, hot pepper, eggplant, cucumber, broccoli, marrow, common bean and soybean were also selected from the new trials in countries. The best promising lines revealed in 2010 are in Table2. Multiplied seeds of studied germplasm (lines/varieties) were conserved in UzRIPI gene bank for future assessment and utilization. Seeds of promising lines were multiplied in 2010 in order to provide material for conducting a competitive trial in 2011.

In 2011, a new AVRDC Regional varietal trial has been initiated in eight CAC countries. A total of 86 accessions of six vegetable species were introduced from AVRDC, including tomato (6 lines to 5 countries), sweet pepper (5 lines to 6 countries), eggplant (3 lines to 2 countries) and hot pepper (5 lines), soybean (5 lines) and cabbage (7 lines). Additional 111 accessions of 13 vegetable species were also introduced to the countries in 2011. At present time all trials are under evaluation.

Competitive variety trials of 38 promising lines of nine vegetable crop species selected on the base of study in previous years were continued in eight CAC countries. A number of new varieties will be submitted to SVTC in the following years. Altogether 23 varieties of seven species including tomato, sweet and hot pepper, eggplant, vegetable soybean, mungbean, long yard bean and cabbage were under state variety trials in Armenia, Azerbaijan, Kazakhstan, Tajikistan and Uzbekistan in 2010. It is widely agreed that these varieties have no analogues in the CAC countries because of their superior morphological and economically marketable traits.

Released varieties

Five new varieties including mungbean “Durdona”, soybean “Sulton”, long yard bean “Oltin soch”, leafy cabbage “Shark guzali” and hot pepper “Tillarang” were released in Uzbekistan in 2010. Five new varieties were released in Armenia in 2010, including tomato “Janna” and ”Zeytun”, hot pepper ”Zspanak” and ”Gita” and sweet pepper “Natali”. Two sweet pepper varieties “Kaz-Tai” and “Bayan Sulu” and hot pepper variety “Piquant” have been released in Kazakhstan in 2010 (Tables 3, 4 and 5). Seed multiplication of promising and released varieties was conducted to supply farmers with high quality seeds for a wide cultivation. Growing new varieties helps farmers to increase their income and improve livelihoods. The private sector also grows new varieties. The released varieties have a good potential to increase the area of cultivation and production, to diversify diets, to increase the export potential of fresh and processed products and increase farmers’ income.

Implementing state projects in Uzbekistan and Kyrgyzstan

The joint project of AVRDC and the Uzbek Research Institute of Plant Industry entitled “Complex evaluation of vegetable germplasm with unique traits, promising lines selection and submission to the state varietal trial” (2009-2011) is being conducted in Uzbekistan through a grant obtained from the government scheme. In 2010, based on study of new germplasm introduced from AVRDC, including 100 lines of ten vegetable crop species, a number of promising lines of various crops were identified for further complex evaluation. Two promising lines were submitted to SVTC in 2010 including mungbean variety “Turon” and sweet pepper “Sabo”.

Research within the project "Study of the world gene fund of tomato and revealing of promising lines for processing" (2009-2011) received state grant and is being implemented in the Kyrgyz Agrarian University in Kyrgyzstan. Allocation of state funds for variety trials emphasizes the efficiency of the network activities facilitated by AVRDC in the CAC Region.

Capacity building
Two postgraduate students continue their research on tomato and broccoli in Armenia. Moreover, one graduate, three postgraduate and one post doctoral research students continue their study on AVRDC germplasm, including tomato, vegetable soybean, hot pepper, long yard bean and leafy cabbage in Uzbekistan. Approval of their thesis titles by Scientific Councils in countries emphasizes the efficiency of the research facilitated by AVRDC-CAC Program.

Promotion events to increase production, utilization and consumption of nutrient-rich vegetables
During recent years, AVRDC pays more attention to vegetables nutritional value for diet diversification and human health, especially non-traditional crops for Central Asia (vegetable soybean, leafy cabbage, daikon, etc.). A number of recipes were elaborated, including vegetable soybean (5), leafy cabbage (20) and daikon (16) recipes for healthy diet and its broader popularization.

In 2010, a new initiative was launched by the AVRDC-CAC Program jointly with the Tashkent State Agrarian University and Bostanlyk college of Tashkent region, Uzbekistan on establishment of the school garden of AVRDC varieties. The purpose is to teach pupils about the nutrient and healthy value of vegetable crops and to introduce into the college kitchen nutrient vegetables to improve school diet. This activity is continuing in 2011 on a larger area in Bostanlyk.

Jointly with the NGO "Fond Forum" in Uzbekistan, the AVRDC-CAC Program conducted a number lectures during meetings in medical centers and workshops on healthy diet and involving of nutrient non-traditional crops into diet. As the result of this joint activity and submitted recommendations the Decree on "Healthy Nutrient in all Educational Organization of the Republic of Uzbekistan" was issued by the Cabinet of Ministers in August 2010.

Center: AVRDC

Donors (special projects): state grants in Uzbekistan and Kyrgyzstan

Project period: ongoing

Countries: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan

Integrated Approaches for the Sustainable Use of saline prone lands through innovative agroforestry research, introduction of biosaline technologies and development of renewable sources of energy

Aims and scope of work

Research has been carried out on improving productivity of marginal (low productive) land and water resources through the use of drainage mineralized water and introduction of biosaline agriculture technologies (cultivation and proper management of local and introduced salt-tolerant and halophytic species), which have economic and environmental values for the local farmers in all three countries within framework of ICBA Bilateral Projects in Uzbekistan (Institute of Karakul Sheep Breeding and Desert Ecology; Samarkand Division of the Academy of Sciences of Uzbekistan) in Tajikistan (Academy of Agricultural Sciences TAAS) and in Turkmenistan (Institute of Desert, Flora and Fauna; Institute of Agriculture in Dashauz).

Multipurpose tree species intercropped with forage grass and legumes

Herbaceous fodder crops planted within the inter-spaces of salt-tolerant trees or shrubs plantations improve productivity of saline prone soils, solve the animal feed gaps in the lands degraded both by overgrazing and salinity and increase profits of farmers. Wild halophytes planted in widely spaced patterns allow for easy mechanical cultivation and harvesting of forage grass and legumes. An agro-silvipastoral model of trees intercropped with complementary crops was evaluated on marginal lands in Uzbekistan (Central Kyzylkum) and northern Tajikistan (Yangiobod Farm) and Dashauz province (Turkmenistan).

Our findings from the screening of 14 multipurpose tree species (MTS) showed high survival rate, quick relative growth rate, high adaptive features and utility value of firewood and/or foliage. Following a pre-planting leaching and a deficient irrigation of 80-160 mm $year^{-1}$ during the first two years, the trees entirely relied on the shallow (0.9–2.0 m) slightly-to-moderately saline groundwater table. The soil salinity remained comparatively high and by the second year averaged 6-8 dS m^{-1} in the root-zone. Gradually thinning the plantations (in the third year), they generated a significant energy value. The leaf nutritive value of *E. angustifolia* ranked 87-89 relative to barley (100), indicating that tree fodder is potentially suitable to complement the low quality wheat and rice straw, commonly used as livestock feed.

The most promising were *Haloxylon aphyllum*, *Populus euphratica*, *P. pruinosus*, *P. nigra var. pyramidalis*, *Elaeagnus angustifolia, Robinia pseudoacacia, Tamarix hispida, Salix babylonica,* and shrubs: *Atriplex canescens*, *A. nitens*, and *A. undulata* & *Ribes niger* including native rangeland halophytes alone, or mixed with various traditional salt tolerant fodder crops. Trees/shrubs plantation requires limited irrigation during the initial stage of growth before sole reliance on available drain water resources become possible. Species of *Tamarix, Elaeagnus angustifolia, Ulmus densa* and *Salix babylonica* having an exceptional ion-salt translocation/bio-remediation mechanism are often referred to as aggressive colonizers since they tend to invade natural habitats and push out less salt tolerant species. *E. angustifolia, Morus alba, M. nigra* and *Atriplex* species offer possibilities as supplementary feed to the low-quality roughages throughout the off-season.

Additionally, *Diospyros kaki* Thunb (persimmon), *M. alba, M. nigra, Cynadon oblonga, Armeniaca vulgare* (syn. *Prunus armeniaca*) variety “Mirsangili” and wild species of *Malus silvestris* (Ledeb.) M. Roem, *Amygdalus bucharica, Crataegus turkestanica* showed elevated survival rates, growth characteristics and adaptability to saline environments in northern Tajikistan and south-western Uzbekistan.

The potential value of possible agroforestry products (biomass, honey, wood, essential oils, etc.) will depend on local markets, and may not be high. However, the agroforestry concept can provide a means of on-farm drain water management, thus alleviating the need for expensive and potentially hazardous evaporation ponds. Moreover, it could create conditions for maintaining the

investigated target remote desert and semidesert areas as viable farming regions. Immediate actions to direct research towards reclamation of saline prone and desert lands, generation of useful non-timber products and achieving co-benefits of C sequestration by conserving natural resources and reducing poverty through improving household food and nutrition security have been formulated.

Strip-alley cropping system and mobilization of underutilized plant resources

There are significant advantages in growing mixed cereal/annual/perennial legumes alternated by strips of halophytes, a practice, which both increases fresh forage and grain yields and improves the quality of the soil on degraded, abandoned and salt affected marginal lands of Syr Darya, Central Kyzylkum and Dashauz province, where slightly mineralized water is available. Planting herbaceous fodder crops within the inter-row spaces of fodder – salt tolerant tress and shrubs on intensive agro-forestry plantations significantly improved the productivity of lands, controlled the water table and accumulation of salts in the root zone. Fresh biomass of alfalfa (first seasonal cutting) in pure stand was 7.20 t/ha^{-1}, while mixed sowing with Triticale increased to 16.40 t/ha^{-1}. Experiments suggest that *A. undulata* mixed with various short-term (*Vicia angustifoilia, Linum* spp*., Indigofera subfruticosa, and Onobrychis chorsanica Bge*) and long term vegetation legumes like alfalfa, *Melilotus officinalis, M. album, Lathyrus sativa* may be successfully integrated into a farming livestock feeding system. Growing salt-tolerant high-yielding alfalfa in combination with cereals, alternated by strips of *Atriplex undulata* could assist farmers produce more high protein nutritional values of forage (both fresh and as hay).

Trials for breeder seeds and seeds production plots were maintained and monitored at Kyzylkesek site (Uzbekistan), Yangiobod Farm, Asht district (Tajikistan) and at Dashauz province (Turkmenistan) in order to produce pure and high quality of seed of salt tolerant crops (3 varieties of alfalfa; dual-purpose varieties of sorghum (Speed Feed and Sugar Graze) and pearl millet (IP 13150 and Raj171) and 2 varieties of sorghum for grain (ICSV 172 and ICSV 745)). Two farms under supervision of ICBA scientific/technical staff became a permanent unit in crop diversification and seed production programs on marginal lands in each country. Farmer-participatory research on village level showed positive results in transferring and adoption of the biosaline technologies of cultivation of salt tolerant crops. At Kyzylkesek site, for instance, in 2010 the research focused on increasing the productivity of salt tolerant ICBA varieties of alfalfa ("Sceptre" and "Eureka") and strengthening alfalfa seed delivery systems at village level from farmer to farmers. More than 280 kg of each of the new high yielding alfalfa varieties, "Eureka", "Sceptre" and "Kyzylkesekskaya" were produced and distributed among farmers last year.

Utilization of low quality water and reclamation of abandoned saline lands by promotion of herbaceous energy crops

Irrigation with low quality water (artesian and drainage) can act as an alternative water source and, thus, plays an important role in saving freshwater resources as well as promoting agriculture in the marginal arid lands of Aral Sea Basin. ICBA in partnership with NARS in 2010-2011 pioneered the evaluation of two varieties of topinambur ("Fayz Baraka" and "Mujiza") on abandoned salt affected lands in Dashauz (Turkmenistan), Takhtakupur and Kazakhdarya (Karakalpakstan) and on saline sandy soils at the Kyzylkesek site (Uzbekistan). Topinambur (*Helianthus tuberosus L.)* is a tuberous-rooted perennial herbaceous energy crop, which is economically useful for human consumption, feeding livestock and a best feedstock source for renewable energy. Evaluated topinambur cultivars were sown as main crops in the middle of April 2010. Under highly saline environments (soil salinity of about 5.0-7.8 dS/m, ground water salinity of ~ EC_{iw} 10-15 dS/m with high concentration of Na^+ and Cl^- (in Takhtakupur) and SO_4^{2-} (in Kyzylkesek) ions at the stage of seed bedding) these crops successfully flower, producing viable seeds and ground tubers. Evaluated varieties were more water-use efficient, highly tolerant to salt and do not require preparatory fine leaching work before planting. These two varieties have a high plant density (67-89 th/ha) that makes them useful for cultivation of industrial fields in early spring-summer as green forage for any kind of animals. They can also be included in an inter-cropping system. Densely covering the salt-affected lands, they can also contribute to the soil improvement and moisture holding that should be taken into consideration when

determining crop rotations. Yields of fresh biomass on sandy saline soils varied from 58.2 to 87.9 t/ha, when yield of tuber was 35.6-42.0 t/ha. Tuber yield was more sensitive to water and soil salinity than aboveground green biomass.

Utilization of non palatable biomass of halophytes as a valuable source of renewable energy production

Research was conducted by ICBA in collaboration with Department of Applied Ecology, National University of Uzbekistan and Faculty of Environmental Engineering, Kitakiyushu University, Japan, to indentify the benefits of cultivation and sustainable utilization of wild and/or domesticated halophytes and salt-tolerant crops for salinity control, remediation of saline lands and improving soils fertility. It is known, that many halophytes are used as forage, grain, fodder, technical, and medicinal plants. Until recently, no major research efforts had been made in Central Asia on the utilization of non-palatable biomass of halophytes. It was revealed that halophytes contain very high concentrations of mineral compounds (about 40-50% of dry matter (DM)) in contrast to conventional grass (5% of DM). It confirms that they are strong aboveground biomass source and can remove significant amounts of various salts from saline environment and accumulate them in aboveground plant tissues. Due to high content of mineral salts, the aboveground plant biomass could gradually be introduced into diet of all kinds of animals and used as forage. Therefore, the non-palatable biomass has been suggested both for biogas production and other products (bio-fertilizers, bio-humus and technical salt). A lab-scale anaerobic degradation of three wild growing halophytes (*Kalidium caspicum, Salicornia europaea* and *Climacoptera lanata*) from highly saline biotopes of Kyzylkum desert compared with conventional glycophyte *Panicum coloratum* (as a control). Time differences in the anaerobic decomposition of the halophytes are related to the variation of lignin content, different nutrients concentrations and chemical compounds of plant biomass. Preliminary study of anaerobic digestion of plant biomass under continuous mode demonstrated that it is possible to get about 300-500 mL CH_4 from 1L of anaerobic digestion sludge per day.

Reclamation of degraded pastures through biosaline technologies

Within bilateral Project between ICBA and Institute of Flora and Fauna, Ministry of Nature Protection “Improving Livelihoods of Rural Communities under Saline Desert Environments in Turkmenistan (Development of sustainable water, rangelands and livestock management)” the evaluation of biosaline technologies for non-conventional water use in agri-silvi-horticultural and silvi-pastoral systems to meet the food and feed demands and develop adaptation strategies for the vulnerable communities due to climate change and water resources shortage was initiated. It was found that promotion of biosaline technologies are most suitable for agri-pastoralists and herders, who are living in remote desert and semidesert areas. Since such categories of lands are not suitable for cultivation of traditional crops the promotion of halophytic industrial plantations does not induce competition with grain cereals (glycophytes). It has been shown that planting pure stands of halophytes or mixed with trees/shrubs and winter/summer grasses actually improves the soils by removing salts and increasing organic matter, so that rotational systems can be envisaged in the long term. This means that industrial plantations with halophytes are rotated through tree/shrubs/grasses plantations on the local communities’ lands and gradually improve it. The realization of biosaline technologies contribute significantly to the diversification of agro-ecosystems and development of new agricultural capacities to increase income source of rural population and farmers, who often depend on traditional crops. Furthermore, cultivation of native wild halophytes on highly saline lands contributes to carbon (C) sequestration by large scale biomass production and leaf litter fall, which will build up the soil organic matter. Integration of water, rangelands and livestock management system on-farm level make farmers more resilient against climate change.

Another alternative of land use evaluated by ICBA in collaboration with NARS in Turkmenistan was related to the reclamation of degraded sandy psammophytic pastures at Karukyli experimental station located about 80 km from Ashgabat in the Karakum desert with an average annual rainfall of 80-100 mm. Indigenous tree plantation of salt and drought tolerant Pistachio vera alternated with shelterbelts of woody fodder halophytes on kara takyr soils was established. Takyr’ surface rainfall collected water and high mineralized (8.7-9.0 g/l)

ground water were used for irrigation at the early stages of seedling transplantation. These sources of non-conventional water provide a valuable alternative for improving pastures productivity and pastoral livelihoods in remote areas of the Karakum desert.

Dissemination and capacity building

In June 2010, ICBA in collaboration with Islamic Development Bank and Ministry of Agriculture of Azerbaijan organized the workshop on "Marginal Quality Water Utilization in Agriculture with Special Reference to Central Asia" in Baku, Azerbaijan.

A Farmer Day on "Introduction of biosaline agriculture technologies for improvement of abandoned farms in Tajikistan" has been conducted on 19-20 August 2010 at the Yangiobod Farm, Asht district, Northern Tajikistan. This event was organized also by ICBA and soil-melioration station of the Academy of Agriculture of Tajikistan and Khukumat of Asht district. Administrative leaders, policy makers, farmers and herders from Asht region showed a great interest on introduction of salt tolerant germplasm for forages and grain production under arid saline environments.

Another Field training was organized by ICBA in collaboration with the Department of Applied Ecology, National University on "Using of Plant Vital" sensor for identifying of photosynthetic activity and accumulation of green biomass for fodder halophytes under the sandy saline environments in the Kyzylkum Desert. PhD, MSc students and local younger technicians attended the training.

Rangelands Assessment and Productivity

In 2010-2011 ongoing investigations on monitoring and assessment of *Artemisia* associated rangelands and psamophytic pastures of Uzbekistan were directed to the i) assessment of spatial and temporal vegetation succession; ii) development and evaluation of State & Transition Model to assess the successive vegetation changes caused by grazing; detecting grazing-induced vegetation patterns of rangelands as apparent by the Normalized Difference Vegetation Index (NDVI) values derived from Landsat ETM+ 7 and MSS 5 satellite imagery; assessment of the past and current condition of arid rangelands based on RS and GIS technologies.

It was recommended to create halophytic rangelands (as a arid oasis model) by using of mixture of C3/C4 fodder rangelands species planted within the inter-spaces of salt-tolerant trees/shrubs plantations. The coexistence of C3 and C4 species is facilitated because C3 species can colonize nutrient rich microsites, while C4 species canopy nutrient poor microsites. The selection for trees with low δ13C and, therefore, high transpiration efficiency, has the potential to increase total tree biomass growth in water-limited arid saline environments. The productivity of haloxerophyte plant community is determined by C4 species, which consists of 87% of total biomass. From spring to autumn the decreasing of biomass of C3 and increasing of C4 plants in the cover vegetation of desert rangelands was revealed. Optimal spatial combination of C3/C4 plants by considering their phenoritms and mechanisms of adaptation to drought cycles and soil salinity guarantees high plant survival and biomass accumulation on salt affected rangelands. Coexistence of C3/C4 plants under wide ranges of soil salinity and limited available water was considered the essential factor in afforestation landscape planning and rehabilitation of salt affected desert lands. The successful performance of drylands afforestation trial on natural saline depression showed a partial overlapping of natural niches of C3/C4 species. The optimal integrated pastoral-agroforestry farming system comprising of 15-20% wild xerohalophytes, 10-12% of tree cover, 38% of alfalfa and 27-30% of annual forage crops provide satisfactory drainage – control of saline environments preventing accumulation of salts at the root zone area.

Investigation done by ICBA in collaboration with Department of Desert Ecology and Water Resources Research, Academy of Sciences of Uzbekistan and Institute of Karakul Sheep Breeding and Desert Ecology showed that by using re-seeding technology the grazing capacity of pasture can be increased about 1.5-2.0 times. The effective and simple method of rehabilitation of overgrazed rangelands is the use of mixed seeds of valuable drought and salt tolerant species in a planting ratio: 25% shrubs; 45% dwarf shrubs and 25-30% annual forage species. The artificially created 'seed isles' as results of seed dispersion by wind produced up to 1.2-3.9 t DM/ha forage availability, compared with original vegetation, thus reducing the need for extra feed storage and possible increasing the

stocking rate. The optimal period for the rangeland seeding is from November to February during the cold and wet weather. Sometimes after a light snowfall, the seed gets natural stratification and germinates quickly.

Establishment of halophytic pastures as livestock feeding alternative

Experiments of 2010-2011 on the establishment of irrigated halophytic rangelands (in pure stands or intercropped with different salt tolerant crops) at the Kyzylkesek site by using thermal water for irrigation showed that increased fodder availability near the desert settlements will improve survival of the livestock, consequently the income of agropastoralists. Highly tolerant to drought and salt stress are *Salsola orientalis, Ceratoides ewersmanniana, Kochia prostrata, K. scoparia, Agropyron desertorum, Halopthamnus subaphylla, Atriplex nitens, Alhagi pseudoalhagi, Climacoptera lanata* were planted in the Kyzylkum desert in Uzbekistan. For instance, planted in spring 2010, the green biomass of the *Kochia scoparia* was 24.0 t/ha^{-1}, *Climacoptera lanata* yielded 67.0 t/ha^{-1}, *Atriplex nitens* yielded 56.0 t/ha^{-1} green biomass. By using fresh and dry biomass of pure halophytes different nutrition diet for animals was developed. Fodder rations including 30-50% halophytes only, however, were most willingly consumed by the animals as compared to other halophyte-mixtures with a higher halophyte share. In comparison, the edibility of the 30% halophyte-hay mixture was 84% that of the 50% halophyte-hay mixture 80%, and the ration consisting of 100% halophyte-hay was 75%.

Center: ICBA

Donors (special projects): bilateral grants with State Committee for Science and Technology of the Republic of Uzbekistan; Islamic Development Bank

Project period: in Tajikistan 2008-2010; in Turkmenistan 2010-2012; in Uzbekistan 2006-ongoing

Countries: Tajikistan, Turkmenistan, Uzbekistan

Development and Delivery of Ecologically-Based IPM Packages in Central Asia

Aims and scope of work

Building on the strong foundation and the regional network established during past years, the project, funded by USAID, is implementing a five-year collaborative strategy to develop and deliver ecologically-based IPM packages for key food security crops - wheat, tomato and potato. The IPM packages for these three crops are aimed at addressing key pest management problems in Tajikistan, Kyrgyzstan and Uzbekistan. The project places a strong emphasis on scholarships, publications and dissemination of research results through both electronic and print media.

IPM of Wheat Crop in Tajikistan

Screening of wheat varieties for resistance to cereal leaf beetle (CLB) (Oulema melanopa L. Coleoptera: Chrysomelidae)

In the last decade, cereal leaf beetle became one of the most dangerous pests for wheat crop in Central Asia. Researchers at ICARDA have identified different wheat lines that may be resistant to this pest. The objective of this study was to screen and select best lines that show resistance to cereal leaf beetle. Wheat seeds were received from ICARDA. Subsequently, in November 2009, a total of 130 wheat entries were planted with susceptible check of the local wheat variety “Sadoqat” repeated after every nine entries at a research plot site of Research Institute of Farming “Zemledeliya” of the Academy of Agricultural Science of Tajikistan. The lines showing high resistance to CLB were “Krasnokolosaya”, “Frunsenskaya 60”, and “Lutescens 1207\1”.

Sunn pest monitoring

During May-June 2010, a survey was conducted to determine the distribution of Sunn pest in Tajikistan. The survey confirmed this pest has established only in northern region of Tajikistan. The project activities on IPM outreach and education focused on both academic and nonacademic stakeholders through student field schools (SFS) and farmers field schools (FFS) have been conducted in collaboration with NGOs, government institutes and local universities in Tajikistan. To enhance university education, an inventory of IPM educational programs in Tajik National University was conducted. SFS on wheat IPM for 12 third-year students (5 female and 7 male) of the Biological faculty was implemented. The program course curriculum was prepared, consisting of 22 hour class/theoretical and 16 IPM practical/field parts.

Tomato Crop in Uzbekistan

In Uzbekistan, tomato is the fourth most important vegetable after pepper, onion and potato. Tomato is grown mostly for the local market and a minor proportion is exported to other countries of the region. The potential for growing tomato in Uzbekistan is great because it is labor intensive, thus generating rural employment, improves nutrition of the people, has export potential, and increases the income of growers. However, compared to cotton and wheat, it gets less attention from the government. The common tomato varieties grown in Uzbekistan are “Shannon”, “Uysupovskiy”, “Avitsena” and “Bull heart”. Common diseases observed are Early Blight (*Alternaria solani*), *Fusarium oxysporum,* Late Blight (*Phytophthora infestans*) and Downey mildew (*Pseudoperenospora cubenis*). Early Blight caused by *A. solani* was the most widespread pathogen on tomato crop in Uzbekistan. Leaf Mold caused by *Cladosporium fulvum* appeared only in greenhouses. The common pests were whiteflies, leaf miners, tomato fruit worm (*Helicoverpa armigera*) and russet mites *Aculops lycopersici*. Whiteflies, tomato fruit worm and russet mites in the open fields, and leaf miners, whiteflies and aphids in green houses were serious pests observed during the reporting period.

Since October 2010, AVRDC has been conducting the activities of two components (tomato resistant lines and tomato grafting) within the project. In 2010, four tomato lines were introduced from AVRDC to Kyrgyzstan, Tajikistan and Uzbekistan and studied in open field in related research institutes. In 2011, six tomato lines resistant to diseases are under trial in these countries. Sixteen tomato lines were introduced from AVRDC to Tashkent State Agrarian University and a grafting of local variety scions on disease-resistant tomato rootstocks has been conducted to control diseases. Primary evaluation of grafted tomato in a greenhouse condition showed a potential of grafting methodology. Using this environment-friendly biological method will allow farmers to

increase productivity and quality of tomato production in greenhouses and open fields.

Development of artificial diets for rearing of predator mite *Amblyseius mckenziei*

In Uzbekistan, sale of biological control agents account only for about 1% compared to pesticide sales. Predatory mites *Phytoseiulus persimilis*, *Metaseiulus occidentalis*, *Amblyseius californicus*, and other natural enemies have become expensive for use on most crops because of the high cost of production. In most cases, these natural enemies are raised on host mites, which must first be reared, often on a host plant. This process is very labor and space intensive. Replacement of the prey or host with an artificial diet, and development of associated mass production technology with decreased labor inputs, could cut down the cost. In the laboratory of Uzbek Research Institute for Plant Protection, we have been conducting research on production of predatory mite *Amblyseius sp.* in different artificial diets. There were prepared three kinds of artificial diets marked as AD1, AD2 and AD3, where AD1 had 300g bran, 20g yolk, 10g sucrose, 0,01g of vitamin mixture and 0.03g streptomycin sulphate in one liter container. Medium AD2 is nearly the same, but instead of yolk, yeast autolysate 10g was added. AD3 had 300g mixture bran with flour, 100g of sugar, 50 g of margarine and 50 ml of milk. *Amblyseius mckenziei* developed normally from egg to adult on the three artificial diets. However, the longevity of the adult females varied. AD3 showed the best results comparing to others where female longevity of *A. mckenziei* was 65 days, much longer then on AD1 (50 days), AD2 (55 days) and on natural diet (37 days). Eggs showed no abnormalities; larvae fed on diets had normal development; and adults were comparable in size to those reared on a natural diet. This cost-effective method of rearing of *A. mchenziei* has the potential for dramatically reducing the use of conventional insecticides.

Potato Crop in Kyrgyzstan

Important fungal diseases are *Macrosporiu*m leaf spot, *Alternaria* leaf spot, Black scurf, and Late Blight on potato leaves. These fungus diseases cause serious damage under damp weather conditions, resulting in up to 60% rotten tubers. Late Blight occurred 10-35%, and the incidence of bacterial diseases, such as Bacterial ring rot and a Black leg, was 5%. About 20% of the farmers use fungicides and a few apply Trichodermin or Baikal M-1. Common potato varieties grown are “Picasso”, “Neva”, “Mondial”, the “Drag”, “Sante”, the “Symbol”, “Latona”, “Chelpek”, etc. Potato varieties: “Picasso”, the “Symbol”, “Nur”, “Latona”, “Neva”, “Dzhelli”, and “Beluga” showed resistance to late blight. Colorado potato beetle is the most serious insect pest.

Centers: Michigan State University, AVRDC

Donors: USAID

Project period: 2009-2012

Countries: Kyrgyzstan, Tajikistan, Uzbekistan

Conservation Agriculture in Irrigated Areas of Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan

Aims and scope of work
The expected long-term impact of a new project launched in 2011 is to improve rural livelihoods and food security through increased productivity of irrigated farming systems in Kazakhstan, Turkmenistan, Uzbekistan and Azerbaijan, using the principles and practices of conservation agriculture (CA). It is expected that at the end of the project improved water and soil conservation techniques will be sufficiently validated by a core group of farmers and an expanded programme will be prepared for farmers in a broader geographic area.

Launching the project
A two day Inception Workshop was organized by ICARDA in technical collaboration with FAO and held on 31 January - 1 February 2011 in Tashkent. Subsequently, National Seminars were held in Azerbaijan and Kazakhstan at end February and beginning of March. The National seminars brought together national consultants, different research institutes and private farms from the respective countries, giving the opportunity to discuss project timeframes and detailed work plans. Pilot farms were selected in Azerbaijan, Kazakhstan and Uzbekistan according to the selection criteria developed by the project team in the respective countries. Milestones for the detailed project work plan were identified. A detailed crop rotation scheme for each farm was prepared with participation of farmers and national project partners. A baseline study has been started in the three project countries including Azerbaijan, Kazakhstan and Uzbekistan. The sampling methodology was also developed and sample sizes were determined.

Experiments on bed-planting technology were set up on research stations in Azerbaijan (winter wheat and sugar beet), Kazakhstan (spring barley and maize) and Uzbekistan (cotton, soy bean and maize). The research on bed planted barley technology was initiated in Chimkent, Kazakhstan, in March, 2011, in order to save on irrigation water, seed and to reduce the cost of cultivation. The observations indicated that the winter wheat and spring barley crop under bed planting had germinated well, and savings in irrigation water are being monitored.

Field days
Two field days were organized so far. The first one was held in Kazakhstan on 16 June 2011, with the support of South-Western Research Institute of Livestock and Plant Industry. A total 35 participants/ farmers including staff of Sayram district administration, mass-media and scientists of the research institute attended this event. The conservation agriculture field day highlighting bed planting technologies for agricultural crops widely distributed in the South-Kazakhstan Province. The day included presentations by the project coordinator, national consultants on bed planted winter wheat and spring barley, water saving technologies and socio-economic issues. They answered participants' questions on conservation agriculture.

Another field day was organized at the farm of Ehtibar Jumshudov, a project farmer, Zumirjan village, Terter district, Ganja region, Azerbaijan, on 21 May 2011. There were 33 participants including 17 farmers. Winter wheat production technology, the main focus of the training program, was explained to the participants by the experts of the project. During the discussions, it was highlighted that conservation agriculture is the need of the time in view of the declining water availability, labour shortages, emerging water erosion issues, increasing fuel and fertilizer prices, etc. For the benefit of the farmers, the results of the farmer participatory field trials on winter wheat planting on beds from previous projects in Azerbaijan were discussed. Main conclusion of the field day was that farmers are keen to adopt bed planting technology because it reduces water consumption, production costs and increases yield.

Center: ICARDA

Donors (special projects): FAO in the framework of the FAO-Turkey Partnership Program

Project period: 2011-2013

Countries: Azerbaijan, Kazakhstan, Uzbekistan

Conservation Agriculture in Kazakhstan

Rainfed cropping system of North and Central Kazakhstan

In the beginning of the 2000's, CIMMYT in cooperation with NARS and Ministry of Agriculture of Kazakhstan initiated large-scale Conservation Agriculture activities in the rainfed area of North and Central Kazakhstan. Due to these efforts, the area under CA-based practices has been increasing from virtually none to an estimated area of 500,000 – 600,000 ha in 2007, up to 1,500,000 ha in 2009. The utilization of CA-based practices has become an official state policy in agriculture in Kazakhstan. Since 2008, the government of Kazakhstan has been subsidizing farmers who are adopting CA-based technologies. With this Kazakhstan is now included among the top 10 countries with the largest areas under no-tillage in the world. Presently, CIMMYT supports activities on CA for rainfed cropping system focusing on weed control, crop rotation/diversification, and fertilization strategies.

Study of no-till efficiency in grain production in the agricultural landscapes of Central Kazakhstan was conducted at "Vlad" Farm. Inserting a legume crop into the cereal-fallow crop rotation, especially under no-till technologies, can effectively resolve two issues namely diversification of crops produced and crops preceding the spring wheat. Taking into account that legume tubercles cannot develop under drought conditions, which is typical for Karagandy province, there still may be an increase in the nitrogen content after legume crops and residuals decompose. Legume aboveground mass and roots are known to possess higher nitrogen than those of cereals. Data obtained suggests that the highest grain yield was achieved on pea-involved trials followed by lentil-involved one. The lowest grain yield was produced on the trial involving mixed oat and vetch. Replacement of cereals by legumes or by vetch/oat mixture is necessary to improve crop protection control reducing diseases and pests and raising incomes and profitability. Use of zero tillage that implies no soil disturbance is based on herbicide weed control both when chemical fallow is used and during the pre-planting period. Of special importance is date of the first fallow treatment in case Common Wormwood *(Artemisia absinthium)* widely spread in Central Kazakhstan is reported. Even two chemical treatments may not kill all of the Common Wormwood plants. However, weed control treatment in mid August when the weed is at the rosette phase and in early May when the weed plants are not yet covered with cuticle layer are reported to be effective.

CIMMYT and Karabalyk Experimental Station have conducted joint research on CA and crop diversification in North-West Kazakhstan. Weather conditions in 2010 were characterized with higher above-zero temperatures within the crop growth period, extreme drought in the first half summer and uneven rainfall distribution in the second half crop growth period. Zero tillage practices increased the yield thanks to plant residues that provided for better moisture accumulation and conservation in the soil. Yield surplus of post-fallow crops under conventional and zero tillage was based on N and P fertilizers. Though the spring wheat yield after the fallow was higher than that of preceding crop with residues retained, this fact did not compensate loss of one-fourth of crop rotation area under the fallow. As a result, the highest grain yield across the entire cropping area was produced by the continuous cropping treatment especially when N and P fertilizers were applied during the pre-planting period combined with zero tillage. Zero tillage treatments were also characterized by low weed level during the spring wheat vegetation. Pea and rape yield was higher under zero tillage.

Irrigated and Rainfed cropping systems of South Kazakhstan

Since 2002, CIMMYT agronomy activities in South Kazakhstan have focused mainly on furrow irrigation and raised bed wheat planting showing high efficiency for seed multiplication and wheat production in comparison with traditional way. Last year CIMMYT started combining of raised bed planting and furrow irrigation with zero tillage, i.e. direct seeding on permanent beds. The first results demonstrated advantages of this technology, including tillage cost reduction, better residue management, weed control, improved irrigation conditions, reduced seed rate, economic efficiency of the crops production. The CA activities in South Kazakhstan undertaken within the framework of the International agreement between Washington State University (WSU) and CIMMYT aimed at three main objectives:

- Conservation Agriculture. On-farm trials and demonstrations of Conservation Agriculture technologies such as direct seeding, zero soil tillage, and bed planting.
- Crop Diversification. Introduction of alternative crops in the agricultural zones of the region, including small scale hoop houses systems.
- Drip Irrigation. Introduction of resource- and water saving technologies for irrigated farms of the region.

In autumn period of 2010 six farms in Dzhambul district planted 160 hectares of winter wheat under CA. The farms were largely interested in growing diverse crops (rape, pea, and safflower). But lack of their ensured market prevents them from expansion of these crops. Demo trials of direct-planted alternative crops were of interest for the farmers as an opportunity to raise farming incomes through the crop production diversification. Farm "Svetlana" adopted the drip irrigation technique on the area of two hectares to grow vegetable crops (tomato, pepper and cucumber) in an attempt to double their profits. Farm "Kokshebayev" produced green crops in autumn (dill, lettuce, celery) in the 96 m^2 greenhouse installed by CIMMYT, thereby, diversifying its production. In the following spring this farm is planning to raise tomato and cabbage from seed in the greenhouse with further planting of the seedlings on 10 hectare area. The most important achievement of CIMMYT on CA introduction in irrigated and rainfed areas of South Kazakhstan in 2009-2010 is that farmers of the region got evidences of CA advantages and changed mindset. For comparison: 2008 – 5 ha under CA in Dzhambul district, Almaty province; 2009 – 40 ha; 2010 – 160 ha of irrigated and rainfed under CA.

For the reporting period CIMMYT organized 8 seminars on Conservation Agriculture and Crop Diversification; 4 Field Days for farmers; 2 workshops on Agriculture and Breeding; 2 Travelling Seminars on Biotechnology, Breeding, and PGR; 2-monthly English Language Training courses (see Annex 5). In order to improve the breeding of the most important crops through application of biotechnology methods and effective use of Plant Genetic Resources (PGR), identification of priorities and actions for the further development of these directions in research institutions of Kazakhstan and their active interrelation, in 2010 FAO, CIMMYT and National Center for Biotechnology have jointly launched TCP/KAZ/3202 Project "Strengthening the Plant Biotechnology Capacity for Sustainable Utilization of Plant Genetic Resources for Food and Agriculture in Kazakhstan". As part of this project CIMMYT organized in 2010-2011 two Travelling Seminars on Breeding, Plant genetic resources (PGR) and Biotechnology in Central, North and South Kazakhstan (with total length of the routes more 3000 km) for 40 national scientists, have been very successful.

Center: CIMMYT

Project period: ongoing

Countries: Kazakhstan

Transboundary Water Management

Aims and scope of work
Goal of the project is to help local water management administrations of selected transboundary river basins to gain the necessary knowledge and capabilities for integrated water resource management by improving their spatial database on land use, especially irrigated areas, and by training of local personnel in using satellite images, GPS and GIS tools.

Creating geographic information systems
The following activities were implemented by IWMI during the period within Transboundary Water Management Project (TWMP):

- created land use/land cover maps for selected sites using bimonthly Moderate Resolution Imaging Spectroradiometer (MODIS) satellite images;
- delineated watersheds of selected rivers from high spatial resolution (30m) to create a Digital Elevation Model (DEM);
- delineated irrigated areas of selected canals or basins in 2009 from Landsat 5/7 satellite images; and
- assisted local specialists in the creation of thematic geographic information system (GIS) layers and the practical use of satellite images.

In the possible extension to Phase II, it is planned to integrate GIS layers created during Phase I into database system developed by SIC-ICWC within the project.

Capacity building
In April 2011, IWMI jointly with Tashkent Institute of Irrigation and Melioration (TIIM) provided training on ArcGIS for 16 local specialists (2 from almost each study area besides Chu-Talas)**.** Additional practical training events in using GIS tools, GPS device and satellite data were provided by IWMI team in Samarkand, Ashgabad, Kyzil Orda, Khojand, Bishkek and Osh. It is expected that the trained local specialists will be creating and updating following main thematic GIS layers:

- Lines of rivers, canals (first and second order), collectors;
- Points of intakes, outfalls, gauges, pump stations and other hydro-technical constructions;
- Polygons of reservoirs, administrative districts, farms/WUAs.

Database will be constantly updated, which leads to better decision making and efficient water use in the sector of water management at the selected regions.

Fifteen copies of GPS manuals, draft maps were distributed for regional partners.

Centers: IWMI

Donors (special projects): GIZ, Germany

Project period: 2009-ongoing

Countries:

Integrated Water Resources Management in the Fergana Valley

Aims and scope of work
Contribution to more secure livelihoods, increased environmental sustainability, and greater social harmony, through improved effectiveness of water resources management in the Fergana Valley.

Specific objectives of the project are:
A: Pilot Areas and selected small transboundary tributaries (STT) function according to IWRM principles. Approaches are consolidated and ready to be promoted in other areas of the region.
B: Governments and donors follow the same principles concerning the roles and scope of IWRM institutions from WUA to basin level.
C: There is clarity on financial and economic aspects as well as the ability to pay at the different operational and management levels.

Implementing IWRM principles
In the reporting period IWMI and SIC-ICWC continued facilitation and support of the reformed water use management systems in the project areas of the Fergana Valley, aiming to improve and sustain their across-the-board performances through implementation of IWRM principles. This led to better irrigation performance and services, higher productivity of irrigated agriculture and as a result wider acknowledgment and acceptance of IWRM principles among water users, water managers, and policy and decision makers. More specifically, the following outputs have been accomplished:

- Extended hydrographization of water management units along pilot main canals and small transboundary tributaries (STTs);
- Prolongation of joint governance agreements between Unions of water users and respective governmental water authorities; and
- Conclusion of water delivery agreements between WUAs and canal and other service organizations on shared obligations towards operation and maintenance of inter-WUA canals, land reclamation service etc.

As a result, the WUA status as well as water users' confidence in the WUA rose with the farmers agreeing to increase their WUA water service fee and their willingness to pay. The WUA fee collection in 2010 in the project areas was as high as 70% on average in all three countries as opposed to 30% in non-project WUAs.

Impact assessment
The project's impact assessment study finalized in August 2010 through field evidence and systematic comparisons between project and non-project areas has found that:

- The impacts of the project are most positive and significant with overall irrigation service performance.
- Positive effects partially attributable to the project were found on crop yields, contributing from a minimum of 7% and to a maximum of 60% to overall crop yield increases.

Policy linkages
The project has made substantial contributions in bringing IWRM principles to strategic and policy leverage. Co-financing of large irrigation infrastructure projects with international financial institutions (World Bank and ADB) in Uzbekistan has increased IWRM coverage by 230% in the country. Implementers earned a solid field-level credibility that is widely acknowledged in the region and among the major players in the irrigation sector. Also, the IWRM-FV project is fully aligned with the relevant government strategies and harmonized with the activities of other donors.

Capacity building
The project has developed a Capacity building Strategy, which was implemented through partners in the project countries (Kyrgyzstan, Tajikistan and Uzbekistan). The strategy has addressed throughout the reporting period the needs of IWRM institutions at various levels –from the field to the national level including some representatives of the national education system. To accommodate and reach wider needs the project has also created knowledge hubs and web-based info platforms.

Representatives from 6 types of IWRM institutions have been trained. Including: 422 WUGs, 92 WUAs, 6 Canal/System Management Organisation (C/SMOs), 6 Union of Water Users (UWUs), 5 Canal/System Water Committees (C/SWCs), 3 National Coordination and Support Groups (NCSGs). A total of 8644 people (6% women) affiliated with these institutions have

been trained or consulted in one way or the other.

Capacity building activities have been also involving educational institutions such as schools, colleges and universities. A number of key academic institutions in project countries have also incorporated project materials into their curricula: e.g. the Kyrgyz Agrarian University (KAU) introduced taught module on IWRM based on IWRM-FV project knowledge and experience. Similarly the agricultural college in Fergana is training 30 hydrotechnicians on the basis of project training material.

Workshops:

- IWMI and State Committee on Water and Melioration (SCWM) of Kyrgyz Republic organized jointly with its key partner in CA – SIC ICWC, a roundtable meeting for the members of the inter-ministerial group to discuss IWRM adoption in Kyrgyzstan. This group was organized under the Project and is titled National Coordination and Support Group (NCSG). The main idea of this group was to support national efforts at policy level to create the legal and political environment for IWRM including the legal frameworks for WUA and participatory canal management. Similar groups were established in the other two project countries sharing the Fergana Valley – Tajikistan and Uzbekistan.
- In 2011, two stakeholder workshops were conducted on the Kyrgyzstan sides of two pilot small rivers aiming at establishment of Sub-basin Water Committees - public-state governing bodies for joint decision making at sub-basin level. For this a team of 8 local practitioners from the Osh Province of Kyrgyzstan were involved and trained to lead and facilitate the local process. As a result 2 sub-basin water committees for the Kyrgyzstan parts of 2 small rivers were established.
- Most recently in late May 2011, the project facilitated an interactive basin-wide workshop for the Khojabakirgan River on Cooperation for Adaptation to Natural Disasters. Participants were representatives of Provincial and District-level water management institutions and representatives and members of Water User Associations and communities in both the Kyrgyzstan and Tajikistan parts of the Khojabakirgan river basin. Participants listened to and provided feedback on a summary report from a recently conducted field study on adaptation to natural disasters in the basin and contributed to developing effective, collaborative and locally sustainable ideas on adaptation to and prevention of natural disasters in the basin as well as strengthening transboundary cooperation.

Dissemination
In the reporting period the IWRM-Fergana project has published 35 different titles on various technical and institutional aspects of water management in the form of brochures, manuals and booklets. These were presented and widely disseminated both in the project areas and beyond through multiple project workshops, seminars and outreach events including mass media.

Centers: IWMI

Donors (special projects): Swiss Development Corporation

Project period:

Phase 4: 05.2008 – 02.2011
Phase 5: 03.2011 – 02.2012

Countries: Kyrgyzstan, Tajikistan, Uzbekistan

Groundwater in Central Asia

Aims and scope of work
The main aims of Phase III of the project were: a) to test the feasibility of water banking in the Isfara and the Sokh aquifers of the Fergana Valley; b) to conduct a detailed study of positive and negative impacts of water management in the Fergana Valley on the downstream environment and provision of irrigation water for downstream use in Kazakhstan and Uzbekistan; and c) to disseminate the findings of the project among a wide range of stakeholders.

Methods of groundwater management tested
Outcomes of the project indicate and suggest an alternative way of water management in the Syr Darya River Basin with accumulating hydropower releases from the upstream reservoir in the aquifers of the Fergana Valley in winter and recovery for irrigation in summer. This could be a reasonable alternative for solving the hydropower-irrigation nexus in Syr Darya River Basin and elsewhere. There are numerous benefits of this approach, such as improved river water quality in the downstream and reduced non-productive water losses at least by 2 km^3 in the Syr Darya River Basin. The studies demonstrated that clogging of the topsoil may reduce the infiltration rates; nevertheless there are options to maintain low turbidity of percolating water.

Two methods of groundwater recharge tested in the Fergana Valley demonstrated their suitability for wide scale application. These are: enhancing natural recharge from the river flood plains and river channels and using trenches or depressions for groundwater recharge. Surface water banking in the Fergana Valley may amount to 1 km^3 per year. Shallow bore wells are found to be very effective technology of groundwater recovery for small scale farmers of the Central Asia. Farmers of the Fergana Valley growing orchards and vegetables are widely adapting this technology in water scarce areas. This technology is 10-20 times cheaper than deep wells that have been used by farmers in Central Asia.

Studies conducted within the project demonstrated that increasing the area of market oriented crops will increase the area under groundwater irrigation. While farmers growing cotton and wheat under the State quota system are expecting that the government will provide free water for irrigation, farmers growing cash crops are investing own funds to get access to groundwater.

Capacity building
Three bachelor degree and one M.Sc. degree students of the Tashkent Institute of Irrigation and Melioration were involved in the project activities and defended their dissertations during the year.

Centers: IWMI

Donors (special projects): Organization of the Petroleum Exporting Countries (OPEC) Fund for International Development (OFID)

Project period: 2005-ongoing

Countries: Uzbekistan, Tajikistan and Kazakhstan

Water Productivity Improvement at Plot Level

Aims and scope of work

The overall goal of improving water management on plot level 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.

It is expected by the end of the project to achieve establishment of provincial level of irrigation extension services of dissemination knowledge and practices through establishing innovate partnership starting from farmers up to national research organizations.

Innovation cycle developed and adopted by water users

Over the past period, the IWMI and SIC-ICWC within Water Productivity Improvement at Plot Level (WPI-PL) project identified main ways of solving the problems hindering improvement of land and water productivity at field level. In all three countries, the project has established a mechanism for rapid assessment of the situation in irrigated agriculture and transfer of innovative solutions through the "innovation cycle" consisting of different entities. The project was successful in attracting the interest of water users to apply these innovations, which laid the basis for the economic benefit of water users. A basis was created for the design and development of the mechanism for interaction between the water users and the WUA, attracting the WUA key specialists as consultants. The system, based on continuous monitoring, makes efficient use of specialists not only for farmers (by eliminating their shortcomings through the consultations) but also for the WUAs (by adjusting the water supply schedules).

Partnerships and dissemination

IWMI and SIC-ICWC work with altogether 16 partners in three countries which consist of Research Institutes, Information and Training Centers and Disseminators (extension services). Research institutions build capacity of Information Centers on new technologies and approaches on on-farm water management, Information Centers focus on simplification of materials to the farmer friendly language and conduct training of trainers, which convey knowledge to farmers on new technologies, approaches and practices that need to be taken in order to solve on-farm water issues.

The total project coverage is 13,147 ha. In each district demo plots and trainers-disseminators were selected in order to conduct works according to the project objectives. Training needs and requirements are identified by disseminators in the beginning of the year based on questionnaires prepared by the Research Institute and further to be submitted to IC. IC carries out analysis, and training themes for trainers are determined on the basis of analysis results. If farmers have some questions or problems which cannot be solved by the trainer on his own, requests are submitted to the Research Institute and then the simplified version of answer received through IC is given to farmers (feedback), i.e. there is a cycle "farmer – developer – information center – farmer". In addition to individual visits (trainers regularly visit farmers) workshops consisting of theoretical and practical sections are conducted 1-2 times a month. Practical section is conducted on demo plots of one of the farmers. About 90 training programs and workshops were conducted, which were attended by over 1,800 people.

Impact

Farmers have tremendously benefited within and outside of the project area. For example, average income in the area was $362.5/ha in 2008 and now average income increased up to $704/ha, which is 51.5 %. WPI-PL project is covering 13,147 hectares in Fergana Valley and if net increment benefit due to project is $341.5/ha and benefit cost analysis ratio is equal to 2.12, which indicates positive effect of the project. In the above calculations, income per hectare for 2008 was considered as a benchmark, and averages of values for 2009 and 2010 were used for comparison purposes.

Capacity building

Project materials are widely used during lectures in different academic institutions in all 3 countries and within the following projects:

- Kyrgyzstan - Helvetas, SEP, KSAP, LMD, STAR projects; UNDP, Water Resources Management project in Batken province; FAO, Modernization of irrigation in small scale farms project; Rational Use of Soil project, WB: Improvement of Water Resources Management project;

- Uzbekistan – RESP-2, Marhamat district agriculture and water department, district water management organizations,
- Tajikistan – Partners of SEP project (Helvetas), SENAS, OVCD, LMD, GIZ, World Bank.

Centers: IWMI

Donors (special projects): Swiss Development Corporation

Project period: 2008-2011

Countries: Kyrgyzstan, Tajikistan and Uzbekistan

Adaptation to Climate Change

Aims and scope of work
In order to access the biophysical impact of climate change on wheat (*Triticum aestivum*) production and productivity in the framework of the joint multi-disciplinary project implemented jointly by ICARDA and IFPRI "Adaptation to Climate Change in Central Asia and People's Republic of China", in close collaboration with NARS partners from Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan, calibration of the CropSyst model was carried out for 14 winter, spring and facultative wheat varieties.

Calibration of CropSyst model
This was done on the basis of experimental data obtained from 19 sites within different agro-ecological zones. Information on currently used farmer's management practices, including Nitrogen fertilizers application and irrigation for the selected agro-ecosystems obtained from the results of survey carried out by socio-economical group of the project were statistically processed and fed into the model. Monthly meteorological data estimated by combining long-term average data for the reference period of 1961-1990 and absolute deviation of air temperature and relative deviation of precipitation provided by GIS Unit of ICARDA-HQ for chosen climate change scenarios for all considered sites are being disaggregated (transferred into daily data) using two weather generators, LARS-WG and ClimGen. Results of on-going assessment of impact of climate change on wheat production and productivity will be provided to the socio-economics group of this wider project along with recommendations on improving of management techniques for better adaptation to climate change.

Surveys
Household survey data collection on the impact of climate change and adaptation options in Central Asia started in May 2010 under the same project in Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan and finished in December 2010. The surveys have been completed by NARS partners in all the project countries in Central Asia. Detailed experimental data on major crops in Central Asia for subsequent agro-economic modeling was collected. Detailed multiyear multi-treatment data have been collected on more than 100 experiments on all major crops grown in various agro-ecologies and farming systems in Central Asia. Multi-year weather data was collected across Central Asian countries where experimental data were collected. Household survey data analysis consisted of:

- Perception of climate change
- Adaptation strategies
- Identify crop simulation scenarios
- Constraints to adaptation to climate change
- Farmer typology scenarios
- BCA of adaptation strategies
- Adaptation with low or no adoption
- Farmer adaptation strategy
- Cost/Benefit of an adaptation
- Data collection, Data entry & clean up
- Data cleaning completed

DSSAT4 crop modeling envisaged:

- Main crop data collected for the model
- Number of experiments, yield points and yield ranges across the experiments
- The collected data structured into an Excel database format
- Data collection procedure for DSSAT4 crop model
- Weather and soil data collected
- Model calibration completed
- Model evaluation started

Dissemination
The Wrap–up workshop was held on 1-3 March 2011 in Aleppo, Syria. The objective was to build a common understanding in combining the outputs of different components of the project, including reviewing the achievements in farm surveys, climate change scenarios building, crop and economic modeling, as well as their current status and completion deadlines. In total, 25 scientists participated in the workshop, including participants from Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan and China along with ICARDA and IFPRI staff members. A multi-lingual version of the CropSyst model's graphical user interface was translated into Russian, Uzbek, German and Arabic, tested on the job and shared with interested scientists in the region. Members of the project's team consult users on demand via e-mail.

Centers: ICARDA, IFPRI

Donors: Asian Development Bank

Project period: 2007-2011

Countries: Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan

Strategic dual purpose crops and mobilization of underutilized plants as part of a climate change adaptation strategy

Project period: 2010-2011

Countries: Uzbekistan

The project, implemented by ICARDA in collaboration with ICBA, assessed vulnerability (exposure, sensitivity and adaptive capacity) to climate change by case studies in Kadog (foothills) and Papanaya (settlement) and introduced dual purpose crops alternate by fruit trees and forage shrubs in strip-alley-system as adaptation measures. The objectives of the Project are to promote both economic diversification and sustainable options to increase forage production and resilience of ecosystems. Two self-help women groups have been established and training on cultivation and seed multiplication of valuable dual-purpose crops and forage shrubs were provided.

Several field rangelands inventories were organized between autumn 2010 and summer 2011 and more than 180 wild and underutilized species were evaluated and documented. Among them there are native endemic trees, shrubs and perennial herbs, which face the highest risk of extinction due to climate change and anthropogenic pressure. Seed collection for ex-situ and in-situ conservation for more than 28 arid fodders, medicinal, technical and dying plants has been conducted in the Nurata district. Overgrazing in the up- and foothills, as well as across the large territories of Artemisia-ephemeroids semidesert pastures led to the mass destruction of vegetation, especially around settlements, farms and watering points. Large areas of mountain slopes are severely degraded as results of water, wind and soil erosion. The intense grazing of animals and the cutting down of shrubs and trees induces the replacement of woody vegetation with grassy less palatable vegetation. It was estimated that there is more than 52% of shortage of forage, especially in late autumn and winter seasons.

Centers: ICARDA and ICBA

Donors: Federal Ministry for the Environment, Nature Protection and Nuclear Safety, Germany

Improving Livelihoods of Smallholders and Rural Women through Value-Added Processing and Export of Cashmere, Wool and Mohair

Aims and scope of work

The project works on sites in Kyrgyzstan and Tajikistan, as well as in Iran. The overall goal is to improve the livelihoods and income of small livestock producers and rural women through improved production, processing and export of value-added fiber.

During the past year, the project team worked on developing of all components of mohair and cashmere value chains in northern and southern Tajikistan: (1) Angora and cashmere goat breeding; (2) fiber collection and processing and (3) production and export of luxury yarn and products. In Kyrgyzstan, the project continued training women group in producing exportable felt handicrafts and strengthening connections between wool producers and felting groups.

Evaluation of goat breeding in Badakhshan, southern Tajikistan

The project team worked with Cashmere goat producers in eight pilot villages to evaluate goat breeding and assess the condition of local flocks. The assessment showed that none of the interviewed households practice selection of breeding animals; producers select bucks for breeding mostly randomly. They do not trade or purchase bucks from other villages and do not have a community breeding system in place.

Evaluation of goat production in the pilot region

In northern Tajikistan, the cooperative farms do not have a long-term future in Angora goat production, and village households lack the capacity to produce purebred Angoras in community flocks where breeding happens randomly. Therefore, the future of Angora goat production in Tajikistan depends on effective development of private Angora goat farms. Whether private farmers develop competitive Angora goat production depends on their incentives to invest in producing quality Angora goats versus other livestock such as sheep or meat goats.

In the Badakhshan site, southern Tajikistan, where shortage of land and feed constrains livestock production, women are responsible for livestock. Sheep and goats are grazed on summer and winter pastures and stalled in winter. Animals are kept primarily for meat during celebrations and as a form of emergency savings. Sheared goat fiber currently provides a small source of income in the spring. The productivity of household flocks is low due to the lack of a breeding system and poor animal husbandry practices. Extension services to help villages and households to improve livestock production do not exist. The social context for improving conditions in livestock production is favorable.

Import of Altai breeding goats to Badakhshan

To improve characteristics of the goat fiber produced in the Badakhshan site, Tajikistan, the project imported eight Altai cashgora goats from Russia. This import of the improved animals is the initial step on establishing of a sustainable breeding system in the mountain villages of Badakhshan that would eventually allow improving incomes of the rural women through goat fiber processing.

Import of American Angora goat semen to Tajikistan

The project decided to bring in American genetics to improve the local breeding stock in Northern Tajikistan. It purchased eight Angora goats in Texas, USA in the summer of 2010. The goats were purchased at an auction that followed a performance test organized by the Texas A&M University[2]. They were sent to American Genetics and Biologicals at Bryan, Texas for semen collection. Tajik farmers will benefit not only from having access to new genetics but also from learning about American mohair producers, their animals and the fiber the American Angora goats produce. This information will help them to assess their own goats and mohair and become aware of the global community of Angora goat producers who share many interests.

IFAD's supervision mission to Tajikistan on developing market channels for wool yarn products was conducted in May 2010. Major findings and recommendations were as follows:

- The economic crisis in the US had adversely affected the luxury yarn

[2] http://safiles.tamu.edu/genetics/angoratest.htm

market meaning that competition is stronger as there is less demand.

- The yarn produced in Tajikistan competes not only with mohair yarns but also with yarns made from other fibers (Merino, Alpaca), and it is important to make sure that the produced mohair yarn is unique enough to keep a special place in the market.
- Marketing handspun yarns is very different from marketing of machine made yarns. There is always some difference between the batches of handspun yarn, while there is no such problem in case of the machine made mohair. That is why marketing and distribution of the handspun yarn is more complicated for wholesalers. As the project will produce smaller non-uniform batches the best strategy would be the direct marketing to the retailers who can handle the diversity of yarn, marketing at different fairs and through the internet.
- It is necessary to diversify the production. In addition to the kid mohair, the project would focus on adult goat mohair for production of carpets and blankets. The first samples have been already produced, and 10 kg of yarn were sent to Herat in Afghanistan for making a carpet using the natural dyes.
- There is a need to set up a local marketing center for training local entrepreneurs and women producing yarn and knitting to build a marketing capacity that will remain after the end of the project.

Capacity building

Training on primary wool processing and hollow-form felted products was conducted in June 2010 for artisans of 2 pilot groups in Lahol (10 women) and At-Bashi (15 women) villages located in the Naryn province of Kyrgyzstan. It was organized by CACSARC-kg Public Foundation collaborating with ICARDA on project implementation in Kyrgyzstan. Training program contained the description of the main technological operations of the primary wool processing.

CACSARC-kg organized three training courses in Kyrgyzstan in November 2010. Two of them were held for artisan women and focused on marketing and export of felt products produced by artisans, and one training for the leaders and activists of the pilot groups addressed institutional development and strategic planning.

Also, the project worked with CACSARC-kg to organize three training courses for women's groups: in dying mohair with natural dyes, in spinning mohair on a silk cord (making a new type of yarn) and in carpet-making. These courses took place in October–November 2010 in Northern Tajikistan.

The project team also conducted five training workshops with livestock producers on goat production and management in Badakhshan (from 27 October to 4 November 2010). They covered topics such as the technology of goat nutrition and other aspects of goat husbandry. Methods of using the imported Altai bucks for breeding improvements were also discussed.

By June 2010, the project developed a short video on fiber dehairing and trained spinners how to select mohair fleeces according to fineness and how to dehair fleeces from kemp. Specialized training using the video was conducted with 76 women in Ukh, Oshoba, Markhamat, Alma, Shvar, Gulshan, Terakli, Taboshar and Khujand, Northern Tajikistan.

Center: ICARDA

Donors: International Fund for Agricultural Development

Project period: 2009-2013

Countries: Kyrgyzstan, Tajikistan

AWARDS AND RECOGNITIONS

In April, 2011, the Ministry of Agriculture of the Republic of Kazakhstan awarded Professor Murat Karabayev, CIMMYT Representative in Kazakhstan, with a Honorary Diploma for his great contribution to the agricultural development of the Republic of Kazakhstan

Diploma awarded on 12 June 2011 in the 'Ashgabat' Exhibition Hall to CGIAR Program in Central Asia and Caucasus for participation in the International Exhibition «Science, technique and innovation technologies in the Great Revival epoch» organized by Academy of Science of Turkmenistan and Chamber of Commerce and Industry of Turkmenistan.

In 2010 Dr. Natalya Akinshina, leader researcher, Department of Applied Ecology of National University of Uzbekistan (NUU) in collaboration with Dr. Kristina Toderich, ICBA-CAC has awarded with a Grant from the Municipality of Kitakiyushu city, Japan, to implement a research study on "Utilization of biomass of halophytes as renewable energy source".

Ms Aralova Dildora, PhD of ICBA had received the scholarship from "Kasa Mianowskiego" Foundation of Polish Academy of Sciences. She conducted her research from April-August 2010 at the Department of Geoinformatics and Remote Sensing, Warsaw University. She also got a scholarship from "TOSCA" by Erasmus Mundus Project to finalize her PhD thesis on Desert Pastures Ecology at the Justus – Leibig University in Germany from August 2011- July2012.

Farmer from WUA "Komiljon Umarov" were WPI project demonstration site is located in 2010 received "The best Farmer of the Year" award from Government Officials of Tashlak District, Fergana Province. The award was given due to production the highest yield of wheat in the district.

PUBLICATIONS

Journal Articles:

Asad S.Q., Eshmuratov D. & Bezborodov, G. 2010. Determining optimal groundwater table depth for maximizing cotton production in the Sirdarya province of Uzbekistan. Irrigation and Drainage 60:241–252 (2011).

Carli, C., Khalikov, D. & Rasulov, A.I. 2010. An improved method to produce rooted seedlings from TPS in the highlands of Uzbekistan. Potato Journal 37 (3-4):110-116. ISSN: 0970-8235.

Carli, C., Mihovilovich, E., Yuldashev, F., Khalikov, D. & Kadian, M.S. 2010. Assessment of dormancy and sprouting behavior of CIP elite and advanced clones under different storage conditions in Uzbekistan. Potato Research, 53 (4):313-23. ISSN: 0014-3065.

Christmann, S., Aw-Hassan, A.A. 2011. Should agricultural research in Central Asia and Caucasus (CAC) re-prioritze its agenda with view to climate change? Agriculture, Ecosystems and Environment 140:314-316.

Gunchinmaa, T. & Yakubov, M. 2010. Institutions and transition: does a better institutional environment make water users associations more effective in Central Asia? Water Policy 12:165-185.
http://www.ifad.org/newsletter/pi/jan_special.htm

Junna, M.R., Matyakubov, B. & Jumaboev, K. 2011. Algorithm for equitable water distribution on the base of EXCEL Journal. “Agrarian science”. Edition 4, Moscow, Russia, ISSN 0869-8155., p. 26-29.

Karimov, A., Smakhtin, V., Mavlonov, A. & Gracheva, I. 2010. "Water 'banking' in Fergana valley aquifers - A solution to water allocation in the Syrdarya river basin?" Agricultural Water Management 97:1461-1468.

Karimov, A., Yakubov, M., Noble, A., Jumabaev, K., Anarbekov, O., Kazbekov, J., Mirzaev, N., & Alimdjanov, A. 2010. Alternative water allocation in Kyrgyzstan: lessons from the Lower Colorado River Basin and New South Wales. Water 2:510-529.

Kunypiyaeva, G. & Zhapayev, R. 2010. Crop production characteristic properties under Conservation Agriculture. Vestnik SH, Kazakhstan, 8:12-15.

Kunypiyaeva, G. & Zhapayev, R. 2010. Crop productivity increase habits. Vestnik SH, Kazakhstan, 9:17-20.

Mavlyanova, R. 2010. Home made tomato and pepper slices, powder, and pickles in Uzbekistan. In: FEEDBACK from the field, AVRDC issue 8:5-6.

Neupane, A., R.C. Sharma, E. Duveiller & S.M. Shrestha. 2010. Sources of Cochliobolus sativus inoculum causing spot blotch under warm wheat growing conditions in South Asia. Cereal Research Communications 38:541-549.

Nishanov, N. & Aw-Hassan, A. 2011. Middlemen in the Central Asian livestock markets: help or hindrance? Electronic IFAD Newsletter. Special issue “Generating knowledge and innovation through grants”, January 2011.

Nurbekov, A., S.A. Abdraimov, N. Khalilov & Z. Ziyadullaev. 2009. Effect of different planting methods on productivity of agricultural crops. J: Uzbekistan Agrar xarbarnomasi 1-2 (35-36):21-25.

Nurbekov, A.I. 2009. Conservation agriculture - benefits and problems. J: Uzbekistan Agrar xarbarnomasi.1-2 (35-36):92-96.

Olsson, O., Gassmann, M., Wegerich, K. & Bauer, M. 2010. Identification of the effective water availability from streamflows in the Zerafshan river basin, Central Asia, Journal of Hydrology 390 (3-4):190–197.

Rajabov, T.F. 2010. Some peculiarities of spatio-temporal changes of vegetation of Karnabchul rangelands under different condition of grazing. Journal of Agro Ilm. 4:31-32. (in Russian).

Rajabov, T.F., Mardonov, B.K., Nasyrov, M.G., Muminov, M.A. & Mukimov, T.X. 2010. Application of Remote Sensing and Geographical Information Systems for Rangeland Monitoring in Uzbekistan. Journal of Environmental Science and Engineering. 6: 78-82.

Rakhmatullaev, S., Huneau, F., Kazbekov, J., Le Coustumer, P., Jumanov, J., El Oifi, B., Motelica-Heino, M. & Hrkal, Z. 2010. Groundwater resources use and management in the Amu Darya River Basin (Central Asia). Environmental Earth Sciences 59(6):1183-1193.

Rosyara, U.R., S. Subedi, E. Duveiller & R.C. Sharma. 2010. Phytochemical efficiency and SPAD value as indirect selection criteria for combined selection of spot blotch and terminal heat stress in wheat. Journal of Phytopathology 158:813-821.
Sri Wahyuni, Satoru Oishi, Kengo Sunada & Toderich, K.N. 2010. The estimation of groundwater exchange in Aydarkul–Arnasay Lake System by a Lake Water Balance Model. Annual Journal of Hydraulic Engineering (JSCE) 54:16-22.
Thomas, V., Osmani, O. & K. Wegerich. 2011. Local challenges for IWRM in Afghanistan. International Journal of Environmental Studies 68(3):313-331.
Tleubayeva, T., Kunypiyaeva, G. & Zhapayev, R. 2010. New practices of seeds reproduction. Vestnik SH, Kazakhstan, 9:36-39.
Toderich, K., Khujanazarov, T., Oishi, S., Myagkov, S. & Wegerich, K. 2011. A Comprehensive Assessment of Water Resources Management of Aral Sea Basin: challenges and ecosystem based adaptations. Pp 9-24 in: Journal "Water Resources Management under climate Changes' Kyoto University, Vol.3.
Toderich, K.N., Shuyskaya, E.V., Ozturk, M., Juylova, E.A. & Gismatulina, L.G. 2010. Pollen morphology of some Asiatic Species of genus Salsola (Chenopodiaceae) and its taxonomic relationships. Pak. Journal of Botany: 42:155-174.
Wegerich, K. & O. Olsson. 2011. Response to David B. Brooks Water International 36(3):410-413.
Wegerich, K. & Olsson, O. 2010. Late developers and the inequity of "equitable utilization" and the harm of "do no harm". Water International 35(6):707–717.
Wegerich, K. 2010. The Afghan water law: "a legal solution foreign to reality"?. Water International 35(3):298–312.
Wegerich, K. 2011. Water resources in Central Asia: regional stability or patchy make-up? Central Asian Survey 30(2):275—290.
Ziyaev, Z.M., R.C. Sharma, K. Nazari, A.I. Morgounov, A.A. Amanov, Z.F. Ziyadullaev, Z.I. Khalikulov & S.M. Alikulov. 2011. Improving wheat stripe rust resistance in Central Asia and the Caucasus. Euphytica 179:197-207.

Proceedings:

Amirov, B., Kiseleva, N., Mavlyanova, R. & Gniffke, P. 2010. Results of AVRDC sweet pepper regional varietal trial (in Kazakhstan). Pp. 94-96 in Proceedings of the Conference "The role of the agrarian science and scientific-technical information in the innovation development of the agriculture" held on 29 December 2010, Tashkent, Uzbekistan, vol.1 (in Russian).
Anarbekov, O. & Pinkhasov, M. 2010. 'Business plan and its role in development of water management organizations'. P. 67 in Proceedings of the Scientific Practical Conference "Efficient Agricultural Water Use and Urgent Issues in Land Reclamation" organized by Ministry of Agriculture and Water Resources of Republic Uzbekistan, SIC-ICWC, Scientific-Research Institute of Irrigation (SANIIRI) and IWMI. Tashkent, Uzbekistan. www.cawater-info.net/6wwf/conference_tashkent2011/.../yakubov_e.pdf.
Carli, C., Yuldashev, F., Khalikov, D., Kadian, M.S. & Bonierbale, M. 2010. Adaptation of micronutrient-dense advanced CIP-bred clones to different environments of Central Asia. Pp. 95-104 in: Proceedings of the first triennial meeting of the Agronomy & Physiology Section of the European Association for Potato Research. Nevsehir, Turkey, 20-24 September, 2010. Vol. 1. ISSN: 978-605-88385-0-5.
Jumaboev K., Eshmurodov, D., Junna M.R., Anarbekov, O. & Kazbekov, J. 2010 'Prediction of improved water productivity on-farm level in selected cotton farms of Fergana and Andijan Provinces of Uzbekistan'. P 12 in Proceedings of the Scientific Practical Conference "Efficient Agricultural Water Use and Urgent Issues in Land Reclamation" organized by Ministry of Agriculture and Water Resources of Republic Uzbekistan, SIC-ICWC, Scientific-Research Institute of Irrigation (SANIIRI) and IWMI. Tashkent, Uzbekistan.
Junna, M.R., 2011. 'Approaches for improving water productivity towards global food security'. Towards the 6th World Water Forum – cooperative actions for water security, International Conference, May 13, 2011, Tashkent, Uzbekistan www.cawater-info.net/6wwf/conference_tashkent2011/files/mohan_e.pdf;
Khalikulov, Z., M. Turdieva, J. Mohan, C. Carli, M. Karabaev, K. Toderich, R. Mavlyanova & N. Saidov. 2010. CGIAR Consortium for sustainable agricultural development in Central Asia and the Caucasus. Pp. 8-11 in Proceedings of the workshop "World diversity of

cotton germplasm – a base for fundamental and applied investigations" held on 5 August 2010, Tashkent, Uzbekistan.

Kumar, P., Sharma, N., Kadian, M.S., Carli, C., Pandey, S.K., Bonierbale, M., Luthra, S.K., Schafleitner, R., Gopal, J., Singh, S.V., Singh, B.P., Rawal, S. & Kumar, R. 2010. Screening of CIP clones for drought tolerance in Indo-Gangetic plains. Pp. 76-83 in: Proceedings of the first triennial meeting of the Agronomy & Physiology Section of the European Association for Potato Research. Nevsehir, Turkey, 20-24 September, 2010. Vol. 1. ISSN: 978-605-88385-0-5.

Kunypiyaeva, G. & Zhapayev, R. 2010. Plants carbon assimilation system forming under bed-planting. Pp. 379-380 in Int. Conference "Achievements and perspectives of crop farming, breeding and biology", 24-25 June, Almaty, Kazakhstan.

Kunypiyaeva, G. & Zhapayev, R. 2010. Winter wheat varieties - rapid reproduction depending on seed rate and seeding methods. Pp. 424-425 in Int. Conference "Achievements and perspectives of crop farming, breeding and biology", 24-25 June, Almaty, Kazakhstan.

Matyakubov, B. & Matyakubov J. 2010. Water saving methods applied on farms in Khorezm Province of Uzbekistan. Pp. 134-140 in Proceedings of International Scientific Practical Conference "Social economical problems of agriculture and water" Section III: "Water facilities: condition, issues and solutions". Organized by the Ministry of Agriculture of Russian Federation, Federal State Educational Institution of Higher Vocational Education and Moscow State University of Environment. Moscow, Russia. ISBN 978-5-89231-318-6.

Matyakubov, B. 2010. The water seepage into the soil when determining the irrigation mode of agricultural crops in Khorezm. Pp. 177-182 in Proceedings of the Scientific Practical Conference "Efficient agricultural water use and topical issues in land reclamation". Organized by the Research Institute SANIIRI and MAWR with IWMI Central Asia. Tashkent, Uzbekistan.

Mavlyanova, R. 2010. Vegetable systems in Central Asia and the Caucasus: research and development to improve livelihood security. Pp. 2026-2034 in Sulladmath, U.V. & Swamy, K.R.M. (eds.). Proceedings of International Conference "Horticulture for Livelihood Security and Economic Growth" held on 9-12 November 2010, PNASF, Bangalore, India.

Mavlyanova, R. & Azimov, B. 2010. Study of hot pepper collection in the Tashkent region conditions of Uzbekistan. Pp. 87-90 in Proceedings of the Conference "Modern technologies in gene fund, breeding and seed production of agricultural crops" held on 18-19 August 2010, Tashkent, Uzbekistan (in Russian).

Mavlyanova, R., Pirnazarov, J. & Alimov, J. 2010. Study of new mungbean germplasm. Pp. 55-57 in Proceedings of the Conference "The role of the agrarian science and scientific-technical information in the innovation development of the agriculture" held on 29 December 2010, Tashkent, Uzbekistan, Vol. I. (in Russian).

Mukhamedjanov, Sh., Kazbekov, J., Reddy, J.M., Manthrithilake, H., Averina, L., Eshmuratov, D., Ruziev, I. & Sagdullaev, R. 2010. Promoting Agricultural Innovation System in Central Asia for Better Water Productivity at Plot level. P. 16 in Proceedings of the Scientific Practical Conference "Efficient agricultural water use and topical issues in land reclamation". Organized by the Research Institute SANIIRI and MAWR with IWMI-Central Asia. Tashkent, Uzbekistan.

Singh, S.V., Kadian, M.S., Patel, N.H., Luthra, S.K., Carli, C., Pandey, S.K., Kumar, D., Kumar, P., Sharma, N., Bonierbale, M., Gopal, J. & Singh, B.P. 2010. Evaluation of CIP advanced clones for hot climate in Gujarat State, India. Pp. 84-88 in: Proceedings of the first triennial meeting of the Agronomy & Physiology Section of the European Association for Potato Research. Nevsehir, Turkey, 20-24 September, 2010. Vol. 1. ISSN: 978-605-88385-0-5.

Toderich, K.N., Shuyskaya, E.V., Mukimov, T.H., Taha, F., Ismail, S., Radjabov, T.F. & Matsuo N. 2010. Pp. 293-308 in Biosaline agroforestry approach for improvement of rangelands-livestock feeding resources in the desert margins of Aral Sea Basin. Samarkand, Uzbekistan.

Toderich, K.N., Ismail, S., Turok, J. & Nepesov, M. 2011. Utilization of Marginal Quality Water for Agriculture in Dryland Areas of Turkmenistan Pp. 177-181 in "Science Achievements and Advanced Technologies on Reclamation of Saline Lands and Improvement of Exploitation of Irrigation Facilities". Tashkent, Uzbekistan.

Toderich, K., Ismail, S & Squires, V. 2011. Participatory Management of Desert Rangelands to Improve Food Security and Sustain the Natural Resource Base in Uzbekistan. Pp. 26-28

in Proceedings of the International Conference “The pastures of Tajikistan: challenges and perspectives”.

Turdieva, M.K. 2011. The role of plant genetic resources in agriculture adaptation to climate changes. Proceedings of International Conference “Achievements and perspectives of agriculture, plant breeding and biology of crops”, p 87-94.

Wegerich, K., Kazbekov, J. & Yakubov, M. 2010. Integration and disintegration of small transboundary tributaries from the larger Syr Darya basin. P. 80 in Abstracts of the International Scientific Symposium “Water in Central Asia”, Tashkent, Uzbekistan 24-26 November 2010.

Wichelns, D., Anarbekov, O., Jumaboev, K. & Manthrithilake, H. 2010. Irrigation pricing alternatives for water user associations in Central Asia. P. 24 in Proceedings of the Scientific Practical Conference “Efficient Agricultural Water Use and Urgent Issues in Land Reclamation” organized by Ministry of Agriculture and Water Resources of Uzbekistan, SIC-ICWC, Scientific-Research Institute of Irrigation (SANIIRI) and IWMI. Tashkent, Uzbekistan.

Yakubov, M., Kazbekov, J., & Wegerich, K. 2010. IWRM at the higher: Basins of Small Transboundary Tributaries. Towards the 6th World Water Forum – cooperative actions for water security, International Conference, 13 May 2011, Tashkent, Uzbekistan.

Zelenskiy, Yu., Koishybayev, M. & Morgounov, A. 2010. Wheat rust resistance in North Kazakhstan. Pp. 123-126 in Proceedings of 6th Int. Conference “Plant bioprotection as the basis of ecological agriculture”. Krasnodar, Russia.

Zhapayev, R. & Kunypiyaeva, G. 2010. Soil water-physical properties under Conservation Agriculture. Pp. 362-364 in Int. Conference “Achievements and perspectives of crop farming, breeding and biology”, 24-25 June, Almaty, Kazakhstan.

Abstracts:

Akinshina, N., Yusui, H., Naka, D., Toderich, K. & Azizov, A. 2011. Anaerobic Degradation of Halophyte Biomass for Biogas Production: First International Conference on Arid Land. Narita-Tokyo, Japan, May 24-28, 2011. Abstracts of presentations, p. 63.

Belan, I., Rosseeva, L., Laikova, L., Rosseev, V., Pershina, A., Morgounov, A. & Zelenskiy Yu. 2010. Utilization of new wheat genepool in breeding of spring bread wheat. 8th Int. Wheat Conference, June 1-4, 2010, St.Petersburg, Russia. Abstracts of presentations, p.69-70.

Dzhunusova, M.K., Morgounov, A.I., Sharma, R., Islamov, H. & D. Ten. 2010. Breeding of wheat in Kyrgyzstan and international collaboration. 8th Int. Wheat Conference, 1-4 June 2010, St. Petersburg, Russia. Abstracts of presentations, p. 366.

Karabayev, M., Wall, P., Sayre, K., Yushenko, N., Pozdnyakov, V., Ospanbayev, Zh., Yushenko, D., Baitassov, A., Morgounov, A. & Braun, H.-J. 2010. Adoption of Conservation Agriculture in Kazakhstan. 8th Int. Wheat Conference, June 1-4, 2010, St.Petersburg, Russia. Abstracts of presentations, p.48.

Keser, M., A. Morgounov, Y. Kaya, B. Akin, A. Dababat, R. Sharma & R.T. Waletaw. 2011. Overview of winter and facultative wheat in Central and West Asia and North Africa: impact of international winter wheat improvement program. First International Winter Wheat Symposium, Increasing Productivity and Sustainable Production, 25-27 June 2011, Tabriz, Iran. Abstracts of presentations, pp. 1-19.

Khalikulov, Z., R.C. Sharma & J. Turok. 2011. Status and utilization of genetic resources in winter wheat improvement in Central Asia and the Caucasus – an analysis of constraints and opportunities. In: Abstracts, First International Winter Wheat Symposium, Increasing Productivity and Sustainable Production, 25-27 June 2011, Tabriz, Iran. Abstracts of presentations, pp. 57-58.

Morgounov, A., B. Akin, Y. Kaya, M. Keser, Z. Mertz, I. Ozseven, I. Ozturk, R. Sharma & R. Wanyera. 2011. Identification of winter wheat germplasm with multiple rust resistance and relative germplasm performance of IWWIP international nurseries at Maragheh (Iran). First International Winter Wheat Symposium, Increasing Productivity and Sustainable Production, 25-27 June 2011, Tabriz, Iran. Abstracts of presentations, pp. 61-62.

Nurbekov, A., M. Suleimenov, T. Friedrich, F. Taher, R. Ikramov & N. Nurjanov. 2011. Effect of tillage methods on productivity of winter wheat in the Aral Sea Basin of Uzbekistan. First International Conference on Arid Land. Narita-Tokyo, Japan, May 24-28, 2011. Abstracts of presentations, p. 103.

Rajabov, T.F. 2011. Development of a State and Transition Model for Vegetation Succession of Artemisia-ephemeral Semi-arid Rangelands in Uzbekistan. IX International Rangeland Congress - Diverse Rangelands for a Sustainable Society. Rosario, Argentina. Abstracts of presentations, p. 389.

Shamanin, V., Morgounov, A., Zelenskiy, Yu., Manes, Y., Chursin, A. & Levshunov, M. 2010. Spring wheat breeding for leaf and stem rusts under West Siberia environment. 8th Int. Wheat Conference, June 1-4, 2010, St.Petersburg, Russia. Abstracts of presentations, p.314.

Sharma, R.C., S. Rajaram, A. Morgounov, Z. Khalikulov, M. Keser, Y. Kaya, & J. Turok. 2011. Collaborative winter wheat improvement in Central Asia and the Caucasus. First International Winter Wheat Symposium: Increasing Productivity and Sustainable Production, 25-27 June 2011, Tabriz, Iran. Abstracts of presentations, pp. 52-54.

Sharma R.C., Z. Khalikulov, M. Keser, A. Morgounov & A. Yahyaoui. 2010. Wheat improvement challenges and opportunities in Central Asia and the Caucasus. 8th International Wheat Conference, 1-4 June 2010, St. Petersburg, Russia. Abstracts of presentations, p. 64.

Siddikov, R., Z. Khalikulov, A. Amanov & R.C. Sharma. 2011. Status of winter improvement in Uzbekistan. First International Winter Wheat Symposium, Increasing Productivity and Sustainable Production, 25-27 June 2011, Tabriz, Iran. Abstracts of presentations, pp. 50-51.

Suyskaya, E., Naoko, M. Toderich, K., Gismatullina, L., Radjabov, T., Voronin, P. & Yamanaka, N. 2011. Seasonal Variation of δ13 C of Asiatic Desert Trees Related to Landscape Planning and Rehabilitation on Salt Affected Lands. First International Conference on Arid Land.Narita-Tokyo, Japan, May 24-28. Abstracts of presentations, p. 91.

Temur, K., Ichikawa, Y. & Toderich, K. 2011. Water Quality and Geospatial Visualization of Hydrological Data of Zarafshan River Basin. Adaptive Fruit Structural Mechanisms of Asiatic Salsola species towards its Germplasm Conservation and Utilization. First International Conference on Arid Land. Narita-Tokyo, Japan, May 24-28, 2011. Abstracts of presentations, p. 78.

Toderich, K.N, Shuyskaya, E.V., Taha, F. Ismail, S., Rajabov, T.F. & Matsuo, N. 2010. Sustainable utilization of low quality water and saline prone lands under arid climate conditions in Aral Sea Basin. International Conference on Soil Classification and Reclamation of Degraded Lands in Arid Environments, 17-19 May 2010, Abu Dhabi. Abstracts of presentations, p. 93.

Toderich, K., Shuyskaya, E., Taha, F., Ismail, S., Gismatulina, L. & Li, E. 2011. Adaptive Fruit Structural Mechanisms of Asiatic Salsola species towards its Germplasm Conservation and Utilization. First International Conference on Arid Land. Narita-Tokyo, Japan, May 24-28, 2011. Abstracts of presentations, p. 21.

Zelenskiy, Yu., Morgounov, A., Manes, Y., Singh, D., Karabayev, M. & Baitassov, A. 2010. Results of evaluation of spring wheat germplasm through Kazakhstan-Siberia Network. 8th Int. Wheat Conference, June 1-4, 2010, St.Petersburg, Russia. Abstracts of presentations, p.200-201.

Ziyaev, Z.M., R.C. Sharma, K. Nazari , A.I. Morgounov, A.A. Amanov, Z.F. Ziyadullaev, Z.I. Khalikulov & S.M. Alikulov. 2010. Improving wheat stripe rust resistance in Central Asia and the Caucasus. BGRI 2010, 30-31 May 2010, St. Petersburg, Russia, Abstracts of presentations, p. 33.

Working Papers:

Abugalieva, A., Zelenskiy, Yu. & Savin, T. 2010. Kazakhstan-Siberia Network's spring bread wheat varieties classification on grain quality. Astana, Kazakhstan, 61 p.

Carli, C., Gulbani, A., Khidesheli, Z. & Kobalatse, K. 2010. Strengthening the potato seed system in Georgia: preliminary results. International Potato Center (CIP), Lima, Peru. Integrated Crop Management Working Paper No. 2010-1. 14p. ISBN: 978-92-9060-387-0.

Karabayev, M., Baitassov, A., Yushenko, N., Karipov, R., Stybayev, G. & Ishmukhanbetov, S. 2010. Conservation Agriculture adoption for pastures and grassland improvement, developing "Green Conveyer" under insufficient moistening conditions of Central Kazakhstan. INAT-AGRO, GEF, UNDP, CIMMYT. Astana, Kazakhstan, 48 p.

Morgounov, A., Zykin, V., Belan, I., Roseeva, L., Zelenskiy, Yu., Gomes-Becerra, H.F., Budak, H. & Bekes, F. 2010. Genetic gains for grain yield in high latitude spring wheat grown in Western Siberia in 1900-2008. Field Crops Res. 117(1):101-112.

Shamanin, V., Morgounov, A., Zelenskiy, Y., Manes, Y., Chursin, A., Levshunov, M. 2010. Spring wheat breeding for Ug99 resistance in West Siberia. Vestnik VOGIS, Novosibirsk, 14(2): 223-231.

Dissertations/Thesis:

Radjabov, Toshpulat. 2011. Spatial-temporal changes of vegetation of semidesert rangelands under a grazing gradient (Karnabchul steppe as a case study).

Books:

Christmann, S., C. Martius, D. Bedoshvili, I. Bobojonov, C. Carli, K. Devkota, Z. Ibragimov, Z. Khalikulov, K. Kienzler, H. Manthrithilake, R. Mavlyanova, A. Mirzabaev, N. Nishanov, R.C. Sharma, B. Tashpulatova, K. Toderich & M. Turdieva. 2009. Food Security and Climate Change in Central Asia and the Caucasus. Tashkent, CGIAR Program Facilitation Unit.

Dukhovny, V., Mukhamedjanov, S., Manthrithilake, H., Averina, L., Kazbekov, J., Platonov, A., Ruziyev, I., Umirzakov, G. & Sagdullayev, R. 2010. Innovative partnership: on the way to water productivity improvement. Tashkent, Uzbekistan: International Water Management Institute (IWMI); Tashkent, Uzbekistan: Water Productivity Improvement at Pilot Level Project (WPI-PL); Scientific Information Center (SIC ICWC), Tashkent, Uzbekistan;

Wegerich, K. & Warner, J. (eds.) 2010. Politics of Water: A Survey, Routledge, London and New York.

Wegerich, K. 2010. Handing over the sunset - External factors influencing the establishment of water user associations in Uzbekistan: Evidence from Khorezm Province, Cuvillier Verlag, Göttingen.

Book Chapters:

Abdullayev, I., Manthrithilake, H. & Kazbekov, J. 2010. Water and geopolitics in Central Asia. Pp. 125-143 in Arsel, M. & Spoor, M. (Eds.). Water, environmental security and sustainable rural development: conflict and cooperation in Central Eurasia. London, UK: Routledge.

Mavlyanova, R. 2010. Vegetable systems in Central Asia and the Caucasus: research and development to improve livelihood security. Pp. 479-491 in Nath, P. & Gaddagimath, P.B. (Eds.). Horticulture and livelihood security. Scientific Publishers. Jodhpur, Rajasthan, India.

Mukhamedjanov, Sh., Kazbekov, J., Averina, L., Ruziev, I. & Sagdullaev, R. 2010. Assessment of the results of water use and productivity in the pilot sites of the Water Productivity Improvement Project. Pp. 204-217 in Rakhimov, Sh., Mamatov S., Begimov, I., Shirokova, Yu., Glovatzkiy, O., Ikramov, R., Ismagilov, Kh., Ikramova, M., Abirov, A., Taganova, G., & Anan'eva, N. (Eds.). Collection of Scientific Chapters dedicated to the 85th Anniversary of the SANIIRI Irrigation Research Institute (1925-2010) – "SANNIRI on its way to Integrated Water Resources Management". SANIIRI and ICWC Publishing. Tashkent, Uzbekistan.

Toderich, K., Tsukatani, T., Ismail, S., Massino, I., Wilhelm, M., Yusupov, S., Kuliev, T. & Ruziev, S. 2010. Extent of salt-affected land in Central Asia: Biosaline Agriculture and Utilization of the salt affected resources. Pp. 196-204 in World Soil Resources Report No. 104. FAO, Rome, Italy.

Toderich, K.N., Shuyskaya, E.V., Khujanazarov T.M., Ismail S. & Kawabata, Y. 2010. The Structural and Functional Characteristics of Asiatic Desert Halophytes for Phytostabilization of Polluted Sites. Pp. 245-274 in Ashraf, M., Ahmad, M.S.A. & Ozturk, M. (Eds.). Plant Adaptation and Phytoremediation. Springer-Verlag, Germany.

Treffner, J., Mioc, V. & Wegerich, K. 2010. A–Z Glossary. Pp. 215-320 in Wegerich, K. & Warner, J. (Eds.). Politics of Water: A Survey. Routledge, London and New York.

Treffner, J., Mioc, V., & Wegerich, K. 2010. International River Basins. Pp. 321-369 in Wegerich, K. & Warner, J. (Eds.). Politics of Water: A Survey. Routledge, London and New York.

Warner, J. and Wegerich, K. 2010. Is water politics? Towards international water relations. Pp. 3-17 in Wegerich, K. & Warner, J. (Eds.). Politics of Water: A Survey. Routledge, London and New York.

Wegerich, K. 2010. Rural poverty reduction: What's irrigation got to do with it? Pp. 201-213 in Wegerich, K. & Warner, J. (Eds.). Politics of Water: A Survey. Routledge, London and New York.

Wegerich, K. 2010. Have your cake and eat it too: Agenda Setting In Central Asian Transboundary Rivers. Pp. 175-190 in Arsel, M. & M. Spoor (Eds.). Water, Environmental Security and Sustainable Rural Development: Conflict and Cooperation in Central Eurasia, London and New York: Routledge.

Wegerich, K. 2010. Politics of water in post-soviet Central Asia. Pp. 43-47 in: Dominic Heaney (Ed.). Eastern Europe, Russia and Central Asia 2011, 11th Edition. London: Routledge.

Brochures:

Esimbekova, M., Morgounov, A., Zykin, V., Zelenskiy, Yu., Sereda, G., Bekenova, L., Tsygankov, V., Shpigun, S., Baitassov, A. & Bulatova, K. 2010. Spring bread wheat genetic resources for breeding on adaptivity and productivity. Kazakhstan-Siberia Network on spring wheat improvement – KASIB. Almaty, Kazakhstan, 15 p.

Ospanbayev, Zh., Koishibayev, M., Karabayev, M., Zhapayev, R., Bedoshvili, D. & Zhunusov, K. 2010. Bed-planting crop production in irrigated lands of submountain zone of South Kazakhstan. Recommendations for farmers, Almaty, Kazakhstan, 20 p.

Ospanbayev, Zh., Koishibayev, M., Karabayev, M., Zhapayev, R., Bedoshvili, D. & Zhunusov, K. 2010. Winter wheat direct seeding technology on rainfed lands. Recommendations for farmers, Almaty, Kazakhstan, 13 p.

TABLES and FIGURES

Annex 1.

Table 1. AVRDC germplasm introduced to Central Asia and the Caucasus in 2010

Country	Regional Varietal Trial	Entries	New trials on countries requests
Armenia	Eggplant Cucumber	5 6	Tomato -5, Sweet pepper-5, Hot pepper-5, Cucumber-3, Broccoli-3, Marrow-2
Azerbaijan	Sweet pepper Eggplant	5 5	Cucumber
Georgia	Soybean Mungbean	5 5	Bean -11, Pack-choi (pai-tsai)-2
Kazakhstan	Eggplant Mungbean	5 5	Sweet pepper-5, Soybean-5, Cucumber-6, Bean -1
Kyrgyzstan	Hot pepper Soybean	5 14	Tomato (for KRICH)-4 Tomato (for KAU)-10
Tajikistan	Sweet pepper Cucumber	5 6	Tomato-4 Pack-choi (pai-tsai)-2, Hot pepper-3
Turkmenistan	Sweet pepper Cucumber	5 6	Cucumber-7, Hot pepper-4
Uzbekistan	Eggplant Cucumber	5 6	Tomato -5 (UzRIPI) Tomato -4 (UzRIPI) Tomato -16 (TSAU)
TOTAL:	6 crops in 8 countries	94	9 crops in 8 countries (106 acc.)

Table 2. Promising AVRDC lines revealed in CAC countries in 2010

Country	Regional Varietal Trial 2010	Selected AVRDC lines	Revealed germplasm provided on countries requests
Armenia	Hot pepper Cucumber	PP03377508 08TWFC 34x37	Tomato - CLN3125F2-21-27-15 Sweet pepper - PP0437 7031 and PP0436 6006 Eggplant - S00658 Cucumber - 08TWFC 27x28 Broccoli - AV 515 Marrow - 10AVRDC S-3
Azerbaijan	Sweet pepper Eggplant	PP0437-7031 TS02890	
Georgia	Vegetable soybean Mungbean	AGS 437. 6372(45-8-1	Bean - TOT 5976
Kazakhstan	Mungbean	VC6372(45-8-1)	Cucumber - C – 01 Soybean - AGS-437 Sweet pepper - 0737-7016
Kyrgyzstan	Hot pepper	PP0537-7541 и PP0237-7508	
	Soybean	AGS359	
Tajikistan	Sweet pepper Cucumber	PP0437-7031 08TWFC 35 x 37	Hot pepper - PP0407-7538
Turkmenistan	Sweet pepper Cucumber	PP0437-7031 PP0437-7016 08TWFC 34x37 08TWFC 103 Bulk	Hot pepper – PP9955-15
Uzbekistan	Eggplant	S00658,S00733, TS01406	Tomato - CLN3136F1-21-1-12-6-16 and CLN3136F1-21-1-29-11-4
	Cucumber	08TWFC 37 Bulk	

Table 3. Released new varieties in CAC countries in 2010

Crop	From AVRDC acc./line	Variety name	Country	Released year
Tomato	CH154	Zeytun	Armenia	2010
Tomato	L01448	Armine	Armenia	2010
Hot pepper	C02408 or Lami Spiral	Zspanak	Armenia	2010
Hot pepper	0337-7546	Gita	Armenia	2010
Sweet pepper	0137-7025	Natali	Armenia	2010
Sweet pepper	PBC 762 (TL791C/691) or PI659102. Collection from Hungary (GRSU TC06795).	Kaz-Tai	Kazakhstan	2010
Sweet pepper	PP0037-7645.	Bayan Sulu	Kazakhstan	2010
Hot pepper	IPP0107-7058 (or 9950-5197).	Piquant	Kazakhstan	2010
Soybean	AGS 423	Sulton	Uzbekistan	Since 2011
Mungbean	NM-94	Durdona	Uzbekistan	Since 2011
Long yard bean	White Silk	Oltin soch	Uzbekistan	Since 2011

Table 4. Marketable traits of released new varieties in Armenia in 2010

New Variety	Advantage compare local varieties
Tomato 'Armine'	No analogies on a type of bush, color and shape of fruits and weight (20 g). Early maturing (100 days), yield (80 t/ha, transportability is good, Very good for a processing.
Tomato 'Zeytun'	No analogies on a type of bush, color and shape of fruits and weight (5-8 g). Early maturing (95 days), yield (29 t/ha, transportability is good, Very good for a processing.
Hot pepper 'Zspanak'	No analogies on a type of bush, color and shape of fruits and weight (27 g). Yield 25-28 t/ha. High vitamin C content – 253,4 mg/%, transportability is good, Very good for a processing.
Hot pepper 'Gita'	No analogies on a type of bush, color and shape of fruits and weight (5-7 g). Yield (28 t/ha, transportability is good, Very good for a processing. Appropriate for growing in an open field and greenhouses.
Sweet pepper 'Natali'	No analogies on a color and shape of fruits and weight (150 g). Yield (57 t/ha, transportability is good, Very good for a processing.

Table 5. Marketable traits of released new varieties in Kazakhstan and Uzbekistan in 2010

Country	Crop	Variety	Advantage compare local varieties
Kazakhstan	Sweet Pepper	Kaz-Tai Bayan Sulu	No analogies on a yield, fruit duration, large of fruits and transportability. Very good for a processing.
	Hot pepper	Piquant	No analogies on a yield, fruit duration, and transportability. Very good for a processing.
Uzbekistan	Hot pepper	Uchkun and Tillarang	No analogies on a yield (27 t/ha), fruit duration, large of fruits (30-40 g) and transportability. Very good for a processing.

Annex 2.

Varietal description of CIP-bred clone No. 390478.9 – PSKEM

Morphology	
Habit	**Height:** Medium-tall **Description**: not compact, vigorous **Stem Solidity:** hollow
Stem	**Quantity:** Many **Description:** medium thick, green with secondary purple lightly scattered colour **Stem cross section:** round.
Leaf	**Size:** Large **Description:** medium structure, green, leaflet ovate, smooth, margin entire, coalescence no present **Folioles:** few, large, rachis green
Flower	**Description**: Flowering - profuse, calyx - green, corolla - white, anthers - pale yellow, well developed; pollen - not fertile, anther cone formation- normal, inflorescence type - simple, pedicel articulation position - above the middle
Tuber	**Skin colour**: white-cream, **Size:** medium to large **Description:** round-oval, cream, smooth, eyes shallow, normal eyebrows, flesh white.
Sprout	**Description:** Dark purple, conical, sprout tip closed, pubescence present and hairy
Other attributes	
Maturity	Mid-early (90-100 days)
Specific gravity	1.0884
Tuber dry matter	24.9%
Keeping quality	Good, better than Sante, dormancy long (14 weeks)
Cooking quality	Good, cooks well in 30 minutes, floury texture, mild flavour, free from after-cooking discoloration

Annex 3.

Varietal description of CIP-bred clone CIP No. 397073.16 – SERKHOSIL

Morphology	
Habit	**Height:** Medium tall **Description:** semi-erect, not compact, medium vigorous **Stem solidity:** solid
Stem	**Quantity:** Not many **Description:** medium thick, green with secondary purple colour at the base **Stem cross section**: round
Leaf	**Size:** Medium **Description:** moderate medium structure, green, leaflet oval, margin entire, coalescence absent, leaflet shape ovate **Folioles:** many, medium, rachis green
Flower	**Description:** flowering - moderate, calyx - green, corolla- white, anthers- pale yellow, well developed; pollen- fertile (78.3%), anther cone formation- normal, inflorescence type -simple, pedicel articulation position - above the middle
Tuber	**Skin colour**: white-cream **Size:** medium **Description:** long-oblong, cream, smooth, eyes shallow, eyebrows, flesh cream
Sprout	**Description:** Dark purple, conical, sprout tip open, pubescence present and slightly hairy
Other attributes	
Maturity	Medium (100-110 days)
Specific gravity	1.0959
Tuber dry matter	22.5%
Keeping quality	Good, better than Sante, dormancy medium (12 weeks)
Cooking quality	Good, cooks well in 30 minutes, floury texture, mild flavour, free from after-cooking discoloration

Annex 4.

Varietal description of CIP-bred clone CIP No 397077.16 SARNAV

Morphology	
Habit	**Height:** Medium-tall **Description:** erect, compact, vigorous **Stem Solidity:** solid
Stem	**Quantity:** Not many **Description:** very thick, green **Stem Cross Section:** angular
Leaf	**Size:** Large **Description:** medium structure, green, leaflet oval, margin entire, coalescence absent **Folioles:** many, medium, rachis green
Flower	**Description:** Flowering - profuse, calyx- green, corolla- white, anthers- pale yellow, well developed; pollen - fertile (88.3%), anther cone formation - normal, inflorescence type - simple, pedicel articulation position- above the middle
Tuber	**Skin colour**: yellow **Size**: medium to large **Description:** long-oblong, yellow, smooth, eyes shallow, normal eyebrows, yellow flesh.
Sprout	**Description:** Dark purple, bulbous, sprout tip open, pubescence present and slightly hairy
Other attributes	
Maturity	Mid-late (110-120 days)
Specific gravity	1.0989
Tuber dry matter	24.1%
Keeping quality	Good, better than Sante, dormancy medium (13 weeks)
Cooking quality	Very good, cooks well in 30 minutes, floury texture, mild flavour, free from after-cooking discoloration

Annex 5.

Conferences, workshops, field days and other human resource development activities of CIMMYT-Kazakhstan in 2010-2011

#	Date	Activities	Location	Number of people involved	Comments
1	1 Mar – 30 Apr	English language training course	Kostanay province, Kaz	9	For young scientists of Karabalyk Experimental Station
2	12 May	Seminar on crop protection of winter wheat	Almaty province, Kaz	15	Participants: farmers, agricultural specialists, scientists, students
3	12 May	Seminar for farmers of Central Kazakhstan on CA	Karaganda province, Kaz	35	Participants: farmers, agricultural specialists
4	20 May	Seminar on bed planting practrices for winter wheat in South Kazakhstan	Almaty province, Kaz	20	Participants: farmers, agricultural specialists, scientists, students
6	29 Jun	Field Day on winter wheat direct seeding practices	Almaty province, Kaz	40	Participants: farmers, agricultural specialists, scientists, students
7	27 Jul	Seminar on Crop Diversification in South-East Kazakhstan	Almaty province, Kaz		Participants: farmers, agricultural specialists, scientists, students
8	3-6 Aug	International Workshop of Kazakhstan-Siberian Wheat Improvement Network (KASIB)	Chelyabinsk, Russia	60	Regular 2-year meeting/workshop of the KASIB members
9	8-16 Aug	Traveling Seminar on Breeding, PGR and Biotechnology	Central, North, North-West Kazakhstan (1500 km)	20	National specialists and scientists on biotechnology, PGR and breeding
10	9 Aug	Field Day on CA in Central Kazakhstan	Karaganda province, Kaz	39	
11	25 Aug	Field Day on CA in Central Kazakhstan	Karaganda province, Kaz	32	
12	21 Sep	Seminar on direct seeding on irrigated lands	Almaty province, Kaz	28	
13	27 Sep	Meeting "Sustainable Agriculture Program for Kazakhstan"	Almaty, Kaz	21	Within the framework of JTI-WSU-CIMMYT Project
14	28 Sep	Seminar "Introduction to Performance Management"	Almaty, Kaz	10	Within the framework of JTI-WSU-CIMMYT Project
15	13 Oct	Field Seminar "Bed Planting and Hoop houses"	Almaty province, Kaz	43	Within the framework of JTI-WSU-CIMMYT Project
16	21 Oct	Workshop "Sustainable Agriculture Program for Kazakhstan"	Astana, Kaz	25	Within the framework of JTI-WSU-CIMMYT Project
17	27 Oct	Seminar on CA and crop diversification for farmers of Central Kazakhstan	Karaganda province, Kaz	31	
18	22-24 Dec	Seminar on bed planting practices in irrigated areas	Almaty, Kaz	22	Within the framework of JTI-WSU-CIMMYT Project
19	6-14 June, 2011	Traveling Seminar on Breeding, PGR and Biotechnology	South-East, South, and South-West Kazakhstan (1500 km)	20	National specialists and scientists on biotechnology, PGR and breeding

ACRONYMS

ADB	Asian Development Bank
AVRDC	The World Vegetable Center
BISA	Basin Irrigation System Administration
CAC	Central Asia and the Caucasus
CACSARC-kg	Central Asia Crafts Support Association's Resource Center in Kyrgyzstan
CACVEG	Regional Network for Vegetable Systems Research & Development
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Centre
CIP	International Potato Centre
CMO	Canal Management Organization - in charge of day-to-day canal management
CWC	Canal Water Committees – the governing body for CMO
GIS	Geographic Information System
GW CA	Groundwater Central Asia project
ICARDA	International Center for Agricultural Research in the Dry Areas
ICBA	International Centre for Biosaline Agriculture
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
IWRM-FV	Integrated Water Resources Management-Fergana Valley Project
MAWR	Ministry of Agriculture and Water Resources, Uzbekistan
NCSG	National Coordination and Support Group
NGO	Non Governmental Organization
PFU	Program Facilitation Unit
RESP-2	Rural Enterprise Support Project - Phase II (funded by World Bank)
SDC	Swiss Agency for Development and Cooperation
SIC ICWC	Scientific Information Center of the Interstate Commission on Water Coordination
STR	Small Transboundary Rivers
STT	Small Transboundary Tributaries
SVTC	State Variety Testing Commission
TSAU	Tashkent State Agrarian University
TSR	Transboundary Small Rivers
TWMP	Transboundary Water Management Project
UCWU	Union of Canal Water Users
USWU	Union of System Water Users
UWU	Union of Water Users (same as UCWU)
UzRIPI	Uzbek Research Institute of Plant Industry
WB	World Bank
WG	Working Groups
WMO	Water Management Organization
WPI-PL	Water Productivity Improvement on Plot Level project
WUA	Water Users' Association
WUG	Water Users Group