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

Annual Report

2011 – 2012

Contents

Acronyms

ADB	Asian Development Bank
AVRDC	The World Vegetable Center
BISA	Basin Irrigation System Administration
BMZ	Federal Ministry for Economic Cooperation and Development, Germany
CA	Conservation Agriculture
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
CC	climate change
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
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
GIS	Geographic Information System
GIZ	German Agency for International Cooperation
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
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
IWRM-FV	Integrated Water Resources Management-Fergana Valley Project
IWWIP	International Winter Wheat Improvement Program
KASIB	Kazakhstan-Siberian Network on Wheat Improvement
KSBN	Kazakh-Siberian Shuttle Breeding Nursery
MoA	Ministry of Agriculture
MSU	Michigan State University
NIDFF	National Institute of Deserts, Flora and Fauna
NCSG	National Coordination and Support Group
NGO	Non Governmental Organization
OFID	OPEC Fund for International Development
OPEC	Organization of the Petroleum Exporting Countries
PFU	Program Facilitation Unit
RSBN	Russian Shuttle Breeding Nurseries
SBW	Soft Bread Wheat
SDC	Swiss Agency for Development and Cooperation
SDW	Soft Durum Wheat
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
SWCA	South-West and Central Asia
TIIM	Tashkent Institute of Irrigation and Melioration
TPS	True Potato Seeds
TSAU	Tashkent State Agrarian University

TSR	Transboundary Small River
TWMP	Transboundary Water Management Project
UCWU	Union of Canal Water Users
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
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
YT	Yield Trials

Introduction

This Annual Report provides an overview of the collaborative work carried out together by the international agricultural research centers and their national partners from eight countries under the umbrella of the CGIAR Regional Program for Central Asia and the Caucasus (CAC). It covers the period of one year, from mid-2011 to mid-2012.

The Program builds upon its fourteen years of applied research that produces results for increasing the productivity of agricultural systems through germplasm enhancement, crop improvement and diversification as well as natural resource management (including on-farm soil and water management, irrigation, drainage and water basin analysis), underpinned by socio-economic and public policy research. The conservation, study and evaluation of genetic resources also represents a priority area of work in CAC, an important center of diversity for many crops cultivated worldwide. The research undertaken by the Centers and their national research partners supports the broader strategic goals of ensuring food and nutritional security, and improving livelihoods of the local populations. In achieving its objectives, the Program relies on the significant scientific capacity, resources and germplasm available from the international Centers combined with local knowledge and outstanding partnerships in the CAC Region. Considerable progress has been made in all these areas during the past year, as this Annual Report describes in a degree of detail. Germplasm enhancement and crop improvement in cereals (wheat and barley), food legumes, vegetables and potato has traditionally been the key strength of the Program. The introduction, testing and breeding of genetic material has lead to development of new varieties with higher yield, improved quality traits and tolerance to drought, high soil salinity and climatic extremes. Eight new varieties were released during the past year alone, and further 13 were registered with the respective State Variety Testing Commissions.

Conservation agriculture, a concept not used in the CAC until the last decade, and now promoted by the Centers, is gaining recognition. The development of minimum tillage, a key pillar for conservation agriculture in rainfed areas, radically changed the way of agriculture in the vast steppes of North and Central Kazakhstan and allowed to reduce soil degradation on dozens of millions hectares. Conservation agriculture is much more difficult to apply on a wide scale on irrigated land, but with its minimum tillage and raised-bed planting technologies, it is making its way into the farmers' fields in Azerbaijan, South Kazakhstan and Uzbekistan.

Traning and capacity building is invariably a strong component of all research initiatives undertaken by the CAC Program. During the year, thirty capacity building events were organized in different areas of work, including on cereals germplasm enhancement, fruit and nut genetic resources, conservation agriculture, vegetable cultivation, integrated pest management and transboundary water and role of gender in water management.

At end of June 2012, a Regional Inception Workshop for the new global CGIAR Research Program "Dryland Systems" was held in Tashkent. This is an ambitious strategic framework that tackles the challenges of sustainable agricultural development under the harsh environmental conditions characterized by drought, high soil salinity and extreme climatic conditions in CAC. It combines an integrated agro-ecosystems approach with site-specific implementation plans. Its development brought together an interdisciplinary research team composed of the different international Centers together with partners from research, government, universities, farmers' associations, the private sector and civil society. The new strategic research framework is expected to further strengthen the collaborative agricultural research and to mobilize new resources for Program implementation in the CAC Region.

As always, we acknowledge the contributions of all our partners with whom we have worked in our efforts throughout the year, the guidance, support and encouragement received from the Program Steering Committee and from ICARDA as the host Center, and the highly dedicated team of scientists and support staff in Central Asia and the Caucasus.

Germplasm Conservation and Crop Improvement in Wheat, Barley and Food Legumes

Aims and scope of work

Wheat improvement activities in Central Asia and the Caucuses are carried out to introduce and test improved varieties of winter and spring wheat that possess high yield, improved end-use quality as well as tolerance to biotic and abiotic stresses prevalent in the Region. Winter wheat improvement work is carried out jointly by ICARDA, CIMMYT and IWWIP in partnership with national wheat improvement programs in the CAC countries. In addition, the improved germplasm of spring wheat is received from ICARDA and CIMMYT. Each year, more than 1000 advanced breeding lines and improved germplasm of wheat received as international nurseries are tested and superior lines are selected for further testing or release as new varieties. Similarly, ICARDA in collaboration with national partners introduces and tests more than 1000 advanced breeding lines of food legumes namely barley, chickpea, lentil, faba bean and grass pea 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 conservation, characterization and crop improvement. In order to make improved varieties of cereals and food legumes available to the rural farmers, 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.

Weather conditions during the winter crop season

The winter crop season 2011-20112 was favorable for production of winter wheat in most part of the CAC Region. Warm early spring followed by dry conditions during late spring caused lower wheat yields in some part of the southern Caucasus. The late autumn months in 2011 were wetter than normal resulting in very late planting of wheat in some parts of the Region. Winter started earlier than normal and lasted about three weeks later than the normal. This resulted generally in late maturity of winter crops. The winter temperatures were somewhat cooler than normal, followed by wet spring. There was little evidence of major pests and diseases; in particular, yellow rust of wheat was not a problem across the Region. Consequently, cereals and legumes production in 2012 is expected to be higher than in 2011.

Distribution of International Nurseries

Evaluation of improved advanced breeding lines and out-scaling of selected varieties of wheat, barley and chickpea were the major activities accomplished in the 2011-2012 crop season. Over 2500 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 16 bread wheat (51 sets), 3 durum (15 sets), 26 barley (59 sets), 7 chickpea (30 sets), 6 lentil (18 sets), 1 faba bean and 1 grass pea.

New varieties of winter wheat

Kashkadarya Research Institute of Grain Breeding and Seed Production registered three winter wheat varieties, originating from germplasm provided by IWWIP, at the SVTC of Uzbekistan in collaboration with ICARDA. These varieties ("Amirbek", "Humo" and

“Iftihor”) produced higher yield than the local checks in past two years in yield trials conducted over seven locations. These varieties are also resistant to yellow rust, which is the most important disease constraint to winter wheat production in Uzbekistan. These three varieties also compare well with the local checks for other agronomic traits. Initial seed multiplication of these varieties was also undertaken in order to follow accelerated seed multiplication program. This will give an early adoption of these varieties upon official release by the SVTC. Farming Research Institute under Tajik Academy of Agricultural Sciences released one winter wheat variety “Chumon” originating from the germplasm developed and provided by the IWWIP. “Chumon” has produced significantly higher yield than the local check “Navruz”. Besides being high yielding, “Chumon” also possess early maturity and agronomic traits comparable to the local check.

Varietal promotion activities

Seed multiplication of four winter wheat varieties (“Dostlik”, “Hazrati Bashir”, “Elmon” and “Gozgon”) was implemented in Uzbekistan. Several tons of seeds were produced, which will be further multiplied in 2012-2013 for making them available to wheat farmers. Seed multiplication of “Ormon” and “Chumon” winter wheat varieties was accomplished in Tajikistan. Seed multiplication of “Ormon” was done on farmers’ fields under a joint initiative undertaken by the Tajik Farming Institute and ICARDA.

In Tajikistan, Uzbekistan and Armenia seed multiplication of newly released chickpea varieties from ICARDA nurseries was done. Besides, seed multiplied in 2011 were distributed to the farmers under varietal out-scaling activities jointly done by the partners in the respective countries and ICARDA-CAC. In Tajikistan, this involved 267 small farmers in 18 districts.

IWWIP activities in Uzbekistan

Based on the recommendation of the Regional Wheat Strategy meeting 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 (270 advanced breeding lines), three observation nurseries of facultative and winter wheat, and winter wheat screening nurseries for Ug99 stem rust, and other miscellaneous nurseries. Many superior lines of winter/facultative wheat have been identified in the yield trials and nurseries. The lines identified outstanding in 2012 in Uzbekistan in advanced yield trial will be distributed to national partners in the Region for the further evaluation in 2013.

Identifying high yielding, yellow rust resistant winter wheat for CAC

IWWIP conducted a study to determine stripe rust resistance and agronomic performance of a set of recently developed advanced breeding lines. Replicated field studies were conducted in 2010 and 2011 to identify winter wheat genotypes with high yield, yellow rust resistance and acceptable agronomic traits. A set of 40 genotypes including 38 experimental lines, one regional check (“Konya”) and one local check was used in the study. Stripe rust scores were recorded at Karshi, Uzbekistan, Karaj, and Mashhad, Iran in 2010 where disease infection was high, as evidenced by 90 to 100% severity on susceptible genotypes. Grain yield was recorded at two sites each in Uzbekistan (Karshi and Kibray) and Iran (Karaj and Mashhad) and one site in Turkey (Eskisehir). Thirty-eight genotypes showed a range of variation for stripe rust severity, grain yield, 1000-kernel weight, days to heading and plant height. There were 25, 24 and 26 genotypes resistant (<20% severity) to stripe rust in Karshi, Karaj and Mashhad, respectively. Thirteen resistant genotypes were common across the three sites. Several stripe rust resistant genotypes produced grain yield either higher than or equal to the local checks at different sites. In 2011, based on yellow rust resistance and yield performance in 2010, a set of 16 genotypes was selected and evaluated in yield trials within four locations of Uzbekistan.

All 16 genotypes were resistant to stripe in Almaty, Kazakhstan and Dushanbe, Tajikistan in 2011. Nine of the 16 genotypes were resistant to yellow rust in Terter, Azerbaijan. Several of these sixteen lines showed high grain yield and superior agronomic performance in 2011 across four sites in Uzbekistan and one site in Tajikistan. Superior genotypes identified in this study could be valuable for wheat improvement programs in Central and West Asia as new cultivars as well as improved parents for crossing. One genotype in Uzbekistan “Amirbek” and one in Tajikistan “Chumon” were selected as new variety and registered in the State Variety Testing Commissions of the respective countries. The promising lines were further evaluated in Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan.

Identifying salinity tolerant winter/ facultative wheat

ICARDA, in collaboration with the national 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. In 2011-2012, two sets of improved materials (304 accessions) were tested at four sites in Uzbekistan and Turkmenistan. Initial results suggest that several lines possess tolerance to medium level soil salinity. Many experimental lines showed significantly higher grain yield than the local checks. 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.

A lab study of 20 genetically diverse winter wheat varieties for salt tolerance at seedling stage has shown the presence of genotypic difference for seedling growth in terms of seedling height and dry matter. This will be confirmed through field study in 2012-2013.

Supporting Ph.D. research

ICARDA-CAC through its scientific expertise has been helping the graduate students undertake thesis research studies in Azerbaijan and Uzbekistan. Four research studies in wheat improvement for Ph.D. scholars were conducted in the third year in Uzbekistan in 2012. Two additional Ph.D. research studies were started in 2011-2012. These doctoral studies are expected to greatly enhance the scientific capacity of the young researchers.

The first study involves examination of genotype-by-environment interaction for quality parameters in winter wheat. Preliminary results from the studies across eight environments 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. Based on the results from 2011 and 2012, two high yield lines with resistance to Ug99 and yellow rust are being considered for submission to the SVTC in 2012.

The fourth study was conducted in the third year to identify improved durum wheat varieties for irrigated and rainfed environments in Uzbekistan. At least one outstanding line is being considered for submission to the SVTC.

Three Ph.D. students continued their thesis research in the second year in 2011-2012 in Azerbaijan. One study involved understanding of salt tolerance in winter wheat as well as identifying resistant lines from a set of 50 accessions including improved germplasm and landraces of winter wheat. The second study involves exploring heat and drought tolerance in 50 accessions each of bread wheat and durum. The third study is undertaken to study genetics of selected morphological and physiological traits associated with heat tolerance in winter wheat.

Identifying winter wheat genotypes tolerant to terminal heat stress

A study was conducted at two sites in 2010 and 2011 using 30 winter wheat genotypes to examine genotypic variations for normalized difference vegetation index (NDVI) which is a measure of leaf greenness (chlorophyll content) and its relationship with grain yield under terminal heat stress in Uzbekistan. The 30 wheat genotypes showed arrays of variation for NDVI at booting, heading, milk and dough stages. All genotypes showed reduction in NDVI value from booting to grain-filling stage; however, these reductions were lower in higher yielding than in lower yielding genotypes. There were significant positive correlations between grain yield and NDVI at milk and dough stage. The findings suggest that the change in NDVI during heat stress could be a measure of tolerance. The positive correlation of NDVI with grain yield suggests that it could be used as an indirect selection criterion for identifying physiologically superior, high yielding wheat lines under terminal heat stress.

Training

Several short and long-term training events were organized during the reporting period. ICARDA facilitated the participation of young scientists from the CAC Region in the following capacity building activities:

- Five young researchers (two from Uzbekistan and one each from Azerbaijan, Kazakhstan and Tajikistan) participated in the 3 to 5 months training in wheat improvement held by the IWWIP in Turkey. This relatively long-term training allowed the young researchers to learn different activities on wheat improvement directly at the IWWIP facility. Another young researcher from Uzbekistan received 4-month training in wheat improvement in CIMMYT, Mexico. These practical training activities are expected to enhance the wheat breeding skills of the young researchers.
- One young researcher from Azerbaijan participated in 2-month training in advanced biotechnological methods in ICARDA, Aleppo.
- Twenty-one researchers from Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan participated in a training titled “Plant Genetic Resources Management and Germplasm Characterization” organized by ICARDA in collaboration with UNESCO from 21–26 November 2011 in Dushanbe, Tajikistan.
- A 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 was successfully completed in 2012. ICARDA had sponsored the nomination of the candidate for this award and co-supervised the research undertaken. The two goals of the project included identification of salt tolerant genotypes of chickpea and bacterial strains that could tolerate salinity by promoting plant growth. Among 30 chickpea genotypes tested for salinity tolerance in laboratory and pot experiments, nine (“Uzbekiston-32”, “Xalima” (FLIP 1-23), “Miroz”, “FLIP 1-33”, “CIEN-45”, “FLIP 03-74”, “FLIP 06-66”, “FLIP 06-102” and “FLIP 06-155”) were tolerant based on their higher germination, seedling growth and dry matter production. These nine genotypes were also field tested in saline soil. Forty-five strains of bacteria were isolated from chickpea roots and were screened for their capability to establish nodules in the root. Only four strains were able to develop nodules in the root of chickpea, which were selected for inoculation experiments. The 9 salinity tolerant chickpea varieties when

inoculated with the bacteria produced significantly better plant growth than non-inoculated treatment at 50 and 100 mm NaCl. This showed that bacterial strains significantly improved root and shoot growth, and nodulation of chickpea in saline soil.

Traveling Seminar and Field Days

On 11 and 12 May 2012, ICARDA-CAC and Uzbek Scientific Production Center for Agriculture under the Ministry of Agriculture and Water Resources of Uzbekistan jointly organized a Wheat Traveling Seminar in Uzbekistan to evaluate the collaborative wheat research activities. More than 30 wheat researchers from different research institutes in Uzbekistan, wheat breeders from Kazakhstan, Turkey and ICARDA participated in the event. More than half of the participants were young researchers from Uzbekistan. The participants visited collaborative wheat research fields of the institutes in Karshi, Gallaral and Kibray. The participants had an opportunity to observe and evaluate improved germplasm of wheat, which has been received from ICARDA and the IWWIP. Besides, advanced yield trials resulting from selection in past years by different wheat improvement programs in Uzbekistan were also visited and discussed during the event. The young scientists participating in the event had an excellent opportunity to learn from the experienced wheat experts. The participants were highly appreciative of the event and ICARDA's extensive collaboration on wheat research with Uzbekistan.

Another Wheat Breeding Traveling Seminar was organized jointly by Lomtagora Farm, Lomouri Institute of Farming of Agricultural University of Georgia, ICARDA and CIMMYT in Georgia, from 24 to 25 May 2012. More than 50 participants included farmers, researchers, and seed experts, representatives of private sector, non-governmental organizations, farmers' organizations, mass media and policy makers from Georgia. The objective of the traveling seminar was to demonstrate the performance of new improved varieties of wheat to different partners and jointly evaluate the advanced materials. Highlights of the achievements resulting from international collaboration in wheat improvement in Georgia, in terms of new improved varieties and capacity building, were presented. The participants visited the wheat research and seed multiplication field of Lomtagora Farm and Farming Institutes. During this visit, international experts and national scientists discussed and jointly evaluated the experimental materials and selected superior lines for further testing and release.

On 21 June 2012, the Research Institute of Farming under Tajik Academy of Agricultural Sciences and ICARDA-CAC jointly organized a Farmers' Field Day in Fayzabad district in the mountains of Tajikistan to demonstrate and evaluate performance of improved varieties of chickpea, wheat and barley. These included "Hisor-32" and "Sino" chickpea, "Ormon" wheat and "Puloudi" barley varieties. The chickpea and barley varieties were selected from the ICARDA international nurseries evaluated in Tajikistan, whereas the wheat variety originates from the IWWIP. The farmers had planted these crop varieties on different dates to demonstrate variation in their productivity in order for the farmers in the district to adopt a suitable planting date. More than 30 women and men farmers participated in the event, which included nine farmers' organizations. During the half-day event in the farmers' fields, the participants discussed different issues related to management of wheat, barley and chickpea. The farmers asked many questions related to soil, water, disease and pest management of wheat, barley and chickpea, which were answered by the experts. The farmers were highly appreciative of the efforts in bringing improved varieties of crops to their fields, which could improve income and food security for the resource poor farmers in the Fayzabad district in Tajikistan. It is to be noted that, in 2012, the Research Institute of Farming and ICARDA-CAC implement activities on out-scaling of improved varieties of wheat, chickpea and barley across 18 districts in Tajikistan.

Workshop on Introduction, evaluation and utilization of International Nurseries of Cereals and Legumes in CAC

Since 1995, ICARDA has been providing improved germplasm of cereals and legumes packaged as “International Nurseries” to the national research institutions in the Region. Each year a new menu of nurseries is made available to choose from, based on the germplasm need for specific research purpose in individual countries. Over 40 varieties of cereals and food legumes have been released in the past 12 years. Even though these improved varieties give much higher yield than the local cultivars, area under their cultivation has not expanded in the Region as expected for farmers to benefit from new varieties. There is tremendous scope of expanding these improved varieties further and faster. However, the absence of accelerated seed multiplication mechanisms and inefficient extension system in most countries in the CAC is considered to be the key bottleneck in out-scaling of improved varieties.

A workshop “Introduction, evaluation and utilization of ICARDA’s International Nurseries of cereals and legumes in Central Asia and the Caucasus: Achievements and Prospects” was organized on 28-29 February 2012, which brought together directors and scientists from research institutes and leaders of agricultural research, collaborating with ICARDA. The objectives of the workshop were to (i) highlight past achievements through a publication, (ii) discuss adequacy of evaluation and selection procedures used by the collaborators in the international nurseries, (iii) discuss ways to improve collection of quality data and return of data and feedback sheets, and (iv) outline possible mechanisms of accelerated germplasm testing, seed multiplication and out-scaling of improved varieties.

The representatives from all eight CAC countries as well as ICARDA and IWWIP made presentations about the different aspects of international nurseries including development, evaluation and utilization. The major outputs of the workshop were (i) national collaborators become better aware of and feel more responsible towards data collection and returning data sheets, (ii) improvement in experimental procedure and collection quality of data in international nurseries evaluated by the national collaborators, (iii) better awareness towards improving the procedures of variety release, seed multiplication and adoption of new varieties in the countries.

Centers: ICARDA, CIMMYT
Donors: CGIAR Research Program “Wheat”; 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

Kazakhstan-Siberian Network on Wheat Improvement (KASIB)

Aims and scope of work

KASIB was established in 2000 as the result of cooperation between wheat breeding research institutes in Northern Kazakhstan and Western Siberia (Russia). The objective of KASIB is to improve the efficiency of spring wheat breeding in Northern Kazakhstan and in Western Siberia through the exchange of new varieties, breeding material, and coordinated assessment of germplasm, exchanging information, knowledge and discussions. At present, KASIB unites 19 breeding programs in Kazakhstan and Russia that have been conducting wheat breeding for the area over 20 million ha. Regular exchange is undertaken through the nurseries of bread wheat (KASIB-SBW) and durum wheat (KASIB-SDW), which are developed from the best materials presented by the breeding programs.

The study of the 12th KASIB nursery was started in 2011 and consisted of 52 spring bread wheat and 21 spring durum wheat varieties. As part of a structural change, the 12th KASIB nursery included new commercial varieties such as “Pamyaty Azieva”, “Tertsiya”, “Astana 2” and “Omskaya 35”; the old but still cultivated variety “Saratovskaya 29”; and three lines (Fiton C 50, Line C 19 and Lutestsens 24) derived from the shuttle-breeding program, were submitted for the Yield Trial (YT). The statistical analysis of data obtained was finished and the best cultivars that demonstrated advantages (as compared with the other varieties) were selected. The screening of variety resistance to leaf and stem rusts was carried out in natural and artificial conditions. The genotypes “Ekada 113”, “Lutestsens 151-03-85”, “Omskaya 41”, “Eritrospermum 23390” showed high resistance to leaf rust. Varieties “Fiton C 50”, “Lutestsens C 19”, “Stepnaya volna”, “Omskaya 41”, “Eritrospermum 23390” showed high resistance to stem rust. Varieties were also selected based on the other biological and economically valuable traits. Among the durum wheat varieties, the highest yield was shown by Line 653d-44, 688d-4 (Samara, Russia), “Hordeiforme 677” (Altay, Russia), “Omskiy izumrud”, “Hordeiforme 00-96-8” (Omsk, Russia), “Kargala 1538” (Aktobe, Kazakhstan). The results were distributed in annual bulletin among all breeding programs. Breeders are using about 25% of studied KASIB’s varieties for crossing in their own breeding programs.

Within the framework of a project entitled “Increasing of wheat quality improvement for sustainable grain production in Kazakhstan” of the World Bank Agricultural Competitiveness Project 130, wheat varieties of KASIB 4-5, KASIB 6-7, KASIB 8-9 nurseries were studied. Comparative assessment of grain quality analysis methods used in Kazakhstan was carried out. A statistical analysis of genotype-environment interactions of quality and productivity of wheat was performed. Based on these studies, the catalogue "Classification of varieties of spring wheat nurseries KASIB by grain quality characteristics” was published.

Shuttle Breeding between Kazakhstan and CIMMYT Mexico

The crossing program conducted in Mexico emphasizes Kazakhstan and Mexico crosses as well as top crosses with the relevant US and Canadian germplasm. The best entries of F5-F6 progenies were selected to develop the Kazakh-Siberian Shuttle Breeding Nursery (KSBN). KSBN was distributed among all cooperators in Kazakhstan and Russia. Since 2009, in order to enhance breeding efficiency and expand shuttle-breeding network, multiplication and initial assessment of F5-F6ME6KAZ populations from Mexico have been undertaken at two locations, namely, in Karabalyk (Kazakhstan) and Omsk (Russia). KSBN jointly with Russian Shuttle Breeding Nurseries (RSBN) compiled after the studies were distributed to collaborators in Kazakhstan and Russia. Total number of collaborators amounted to 13 institutions in 2011.

The new shuttle breeding material F5-F6ME6KAZ (950 entries) was planted and evaluated in Quarantine Nursery, Karabalyk Experimental Station (Kazakhstan) and Omsk Agrarian University (Russia). The 10th KSBN consists of 179 entries, which were studied at 6 institutions in Kazakhstan, and the 10th RSBN, which consist of 175 entries, was evaluated at nine institutions in Russia. Obtained data demonstrated a high efficiency of the screenings. Efficiency of selection of hybrid populations in a number of institutions (Pavlodar, Novosibirsk, Tyumen and Omsk) reached up to 95-100%.

The adaptation of the shuttle breeding germplasm to high latitude environment is gradually improving. Some of the advanced shuttle lines were submitted to the 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.

Biofortification of Wheat by Zinc (Zn) and Iron (Fe)

New varieties and advance lines of the 10-11th KASIB Nurseries were analyzed on Zn and Fe content. The nurseries included 50 varieties of spring bread wheat from 14 breeding programs. The study of this germplasm of different country origin allows for identification of the varieties/genotypes characterized by a high micronutrient content and good adaptation capacity. It gives opportunity to identify the genotypes for crossing and develop the new breeding material with high micronutrient content. The trials on evaluation of genotype and technology interaction to define optimal agronomy practices and screening environments for high Fe and Zn content was continued at 4 locations of Kazakhstan: Aktobe (West); Karabalyk (North-West), Ust-Kamenogorsk (East) and Shortandy (North) to assess the effect of Zn and Fe fertilizers on the microelements accumulation in different soil and climate conditions. The iron grain concentration showed a non-significant treatment effect, indicating that the grain iron concentration depends on genotype mostly. Data obtained over 4 years allowed to make a general conclusion that for iron, the role of genotype in the overall variation is more important than the role of location. In case of zinc, location plays a higher role.

Winter Wheat Breeding

Winter wheat is cultivated in the South, South-East and South-West of Kazakhstan on the area of 800,000 hectares. Breeding of winter wheat is carried out within four breeding programs. In the South, it is undertaken both for irrigated and rainfed conditions, while in the North and East (Karabalyk, Ust-Kamenogorsk) of Kazakhstan, only for rainfed conditions. The limiting factors are extremely continental climate and cold winters, which determine the breeding aim of increasing frost resistance. In 2011, 760 entries were evaluated repeatedly. Assessment has been undertaken for 350 entries selected from the breeding process. About 40% of the entries have surpassed the check varieties in yield capacity by 0.4-1.9 t/ha. High resistance to stripe and leaf rusts characterizes most entries, which also showed good yield capacity. Disease severity of the majority of 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 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 North Kazakhstan. Such approach is of high importance because of the aggravation and frequency of drought summers during last decades. Testing of 11,144 entries of winter bread wheat has been undertaken in Karabalyk, Kazakhstan. In addition to local material, the study involved entries from CIMMYT, Russia (Krasnodar, Tatarstan), Ukraine (Kharkov), Bulgaria and Canada. The promising material was selected at all stages of breeding process. Forty-six lines (15 of them from Novosibirsk) 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 was also initiated to diversify crop production. Several nurseries were developed in 2011 at Kazakh Research Institute of Farming and Crop Production (South-East Kazakhstan), Karabalyk Station (South-West Kazakhstan), East-Kazakhstan Agricultural Research Institute, Krasnovodopad Station (South Kazakhstan), and Russian breeding programs in Samara, Novosibirsk and Kurgan.

Pathological Evaluation of Germplasm

Based on the international nurseries such as 1st SRRSN and 2nd SRRSN, the new nursery named 1st PSR, was developed. This nursery includes 73 entries adapted to local conditions, which were sent to breeders of KASIB Network.

As usual, many lines were late maturing and photosensitive. Therefore, it was considered appropriate to re-assess them to prove the resistance. In this respect, 60 lines, which proved to be resistant to Ug99 in previous years, were re-tested. The evaluation showed that the majority of lines are resistant to Ug 99. It should be noted that resistant genotypes represent mainly promising lines rather than commercial varieties. Resistant varieties among commercial ones are “Omskaya 37”, “Omskaya 38” and “Stepnaya 62”. They were released in the last 2-3 years. Based on the study of resistance of the breeding material to Ug99, a set of resistant varieties was prepared for distribution among the breeding programs of Kazakhstan and Siberia.

Evaluation of resistance of winter wheat varieties to stem rust showed that it varies from 15M to 50S. “Egemen” variety developed from the CIMMYT breeding material showed the highest resistance to Ug 99 (15M). Thirty KASIB varieties were also tested for resistance to leaf rust in collaboration with Moscow Institute of Phytopathology, Russia. Wheat varieties were tested through artificial inoculation of the pathogen population containing virulence genes. Test results showed 24 genotypes as susceptible to leaf rust with the intensity of infection between 25 and 80%, while 6 varieties of spring wheat “Sibakovskaya yubileynaya”, “Chelyaba yubileynaya”, “Chelyaba stepnaya”, “Chelyaba 75”, “Apasovka” and “Lutestsens 120-03” proved to be resistant to fungal populations. The assessment of the same set of genotypes for resistance to Septoriosis (*Septoria nodorum*) showed the varieties “Fitton 27” and “Apasovka” as resistant (on Saari and Prescott scale) and 4 genotypes (“Lutestsens 53-95-98-1”, “Erythrospermum 55-94-01-20”, “Line 776” and “Chelyaba yubileynaya”) as moderately susceptible.

Development of New Varieties based on CIMMYT Germplasm

In 2011, several varieties of winter wheat, triticale and barley were developed from the germplasm obtained from CIMMYT’s International Nurseries (**Annex 1**). Two winter wheat varieties “Alikhan” and “Azharly” were developed in Kazakh Research Institute of Farming and Crop Production, Almaty, based on the International CIMMYT germplasm and submitted for State Official Trial in 2011. The triticale variety “Vodopad 100” was developed in Krasnovodopad Agricultural Experimental Station and submitted for SVT in 2011. Winter wheat variety “Konditerskaya” and barley variety “Kuralay”, which have been developed from the CIMMYT-ICARDA breeding material, were released in South Kazakhstan.

Capacity building

In 2011, FAO, CIMMYT and National Centre for Biotechnology have jointly continued a project on “Strengthening the Plant Biotechnology Capacity for Sustainable Utilization of Plant Genetic Resources for Food and Agriculture in Kazakhstan”. As part of this project, CIMMYT-Kazakhstan organized a Travelling Seminar on Breeding, Plant Genetic Resources and Biotechnology (South -East, South, and South-West of Kazakhstan, altogether 1500 km) and three training-courses on “Plant Genetic Resources

Conservation, Characterization and Use Methods", "Modern Breeding Technologies and Practices for Crops Improvement" and "Biosafety, Regulations and Policy Issues in the Field of Biotechnology, PGR and Breeding".

CIMMYT is giving emphasis on capacity building. During the reporting period, it organized 28 training courses, meetings and workshops in the region for more than 800 participants, and supported the participation of young scientists in international symposiums and other scientific events.

Centers: CIMMYT
Donors: CGIAR Research Program "Wheat" sub-project "Developing Wheat Cultivars Adapted to High Latitudes"
Project period: 2012- 2014
Countries: Kazakhstan

Conservation Agriculture for Rainfed Cropping System of North and Central Kazakhstan

Aims and scope of work

In the beginning of the 2000s, CIMMYT assisted KazAgroInnovation and Ministry of Agriculture of the Republic of Kazakhstan (MoA) to initiate 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, and 1,600,000 ha in 2011, with continued rapid increases in area according to a recent assessment conducted by CIMMYT. The utilization of CA-based technologies has become official state policy in agriculture in Kazakhstan. Since 2008, the government of Kazakhstan has been subsidizing farmers in adopting CA-based technologies. With these results, Kazakhstan entered the list of 10 top world countries with largest areas under no-tillage. Presently CIMMYT activities on CA in Kazakhstan are focused on weed control, crop rotation/diversification, and fertilization strategies.

Study of no-till efficiency in grain production in the agricultural landscapes of Central Kazakhstan

Introduction of legume crops into the cereal-fallow crop rotation, especially under no-till technologies, can effectively contribute to diversification of crops produced and crops preceding the spring wheat. The highest grain yield was achieved on the trail involving mixed oat and pea followed by pea-involved one. The lowest grain yield was produced by lentil-involved trials. Replacement of cereals by legumes or by pea/oat is necessary to improve crop protection control reducing diseases and pests, raising incomes and profitability. The long-term use of no-till technology had a positive effect on the microbiological activity in the top layer of soil. In a trial where wheat was planted after the chemical fallow, the number of *Cladosporium fungi* and myxobacteria increased in the complex of cellulose-decomposing micro-organisms.

CIMMYT and Karabalyk Experimental Station joint research on conservation agriculture and crop diversification in North-West Kazakhstan

The weather conditions in 2011 facilitated the intensive development of agricultural crops and high yields. As negative outcomes, late maturity and high weeds' spread were observed. Zero tillage increased the yield due to the presence of plant residues that provided better moisture accumulation and conservation in the soil. Yield surplus of post-fallow crops, under conventional and zero tillage, was defined by content of N and P in fertilizers. Zero tillage treatments were also characterized by low weed level during the spring wheat vegetation. Pea and rape yield was higher under zero tillage. Wheat planted after rape gave the lowest yield under this year's conditions.

Conservation Agriculture for irrigated and rainfed cropping systems of South Kazakhstan

In recent years, CIMMYT started combining 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, and overall economic efficiency of the crop production. If the distance between beds is acceptable for other crops in the rotation, use of permanent beds can significantly reduce the time between harvesting the previous crop and sowing the next one (obtaining two crops in one year is the big challenge in the Region).

In 2011, based on the previous project "Sustainable Agriculture Program for Kazakhstan" (CIMMYT, Washington State University, JTI-Kazakhstan), activities continued for the extension of no-till technologies in Almaty province through established farm clubs. Three hundred hectares of rainfed and irrigated land were planted by use of no-till technologies. Research findings suggest that the winter wheat yield under irrigated permanent bed-planting was higher than the conventionally planted winter wheat by 0.38 t/ha. Conventional and no-till direct planted winter wheat demonstrated practically the same yields. Taking into consideration that the inputs (labour, fuel, etc.) in CA were rather lower in comparison with conventional methods, the data obtained confirm higher economic efficiency of CA technologies.

Introduction of high yielding and drought-resistant crops and advanced technologies for wide-scale feed and biofuel production

Climate change, soil degradation, desertification, water scarcity and frequent droughts decrease the natural primary energy resources that lead to food and energy security. Prompt introduction of high yielding and drought-resistant crops within all territory and climatic zones of the country, including the conservation agriculture and biotechnologies for production and processing, can be one of the most effective ways and solutions of this broader objective of food and energy security.

In 2011, CIMMYT-Kazakhstan, as part of its CA and crop diversification activities in the country, initiated introduction of sorghum into the crop rotation systems. This crop is known as one of the most drought resistant, high-yielding and low-input. Sorghum can provide sustainable bases for intensive livestock and biofuel production in short time, which are important pillars of the national food and energy security. Sorghum, as a crop with high content of sugar, also could be used for sugar production. CIMMYT-Kazakhstan established two experimental plots (in Akmola province, North Kazakhstan, and in Almaty province, South Kazakhstan) with sorghum varieties provided by ICARDA-CAC and ICBA-CAC.

Centers: CIMMYT
Donors: Ministry of Agriculture of Kazakhstan, National Budget Program No.042 "Applied Research in Agriculture", Project "Improvement of Crops' Genetic Yield Potential and Agricultural Technologies for Different Agro-ecological Zones of Kazakhstan"
Project period: 2012- 2014
Countries: Kazakhstan

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

Aims and scope of work

The expected long-term impact of the 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 program will be prepared for farmers in a broader geographic area.

Launching the project

During the reporting period, National Seminars were held in Azerbaijan and Kazakhstan. They brought together national consultants, different research institutes and private farms from the respective countries, providing 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.

Experiments on crop diversification, bed-planting and no-till technologies were set up on research stations and farmers' field in Azerbaijan (winter wheat, maize, and sugar beet), Kazakhstan (winter wheat and spring barley, kidney bean and mungbean) and Uzbekistan (cotton, soy bean, mungbean and maize). A baseline study was completed in the all three countries. The economics of double cropping growing mungbean after harvest of winter wheat was tested where mungbean planted on beds.

Crop diversification

Maize is double-cropped after the winter wheat harvest in Azerbaijan. The maize harvest provided 4.9 t ha/1 (91.25 %) yield advantage after no-till wheat, which is a very significant difference. New legume crop species were introduced as succeeding crop after winter wheat harvest in irrigated areas of South Kazakhstan province to improve the availability of legumes for crop production. Seed rates had a significant effect on kidney bean grain yield. The highest grain yield (0.86 t/ha) was recorded where seeding rate was 110 kg/ha while lowest grain yield (0.76 t/ha) was recorded with seeding rate 100 kg/ha.

The soy bean variety "Uzbek-6" was planted with eight different treatments using the bed planting method. Plant height, growth and grain yield were observed during the vegetation period. The maximum plant height was observed in the treatment where Rizobium+K60+P120 was applied, while the lowest plant height was observed in the control. Soybean grain yield varied among the treatments. The eighth treatment (Control+Rhizobium K60+P120) received the highest grain yield 2.23 t/ha and the control treatment got the lowest grain yield 1.62 t/ha.

Bed planting

The highest grain yield of 5.51 t/ha was recorded in Ehtibar Jumshudov's farm in bed-planted wheat while the lowest grain yield (2.51 t/ha) was recorded in Mehmon Babaev's field using the broadcasted planting method in Azerbaijan. According to the results obtained during the first project year, bed planting method improves yield, saves seed and water (an average of 36 % water).

For the first time in the irrigated conditions of South Kazakhstan province, spring barley was planted on beds. Low yields (1.7 t/ha), the main reason being unusual weather conditions in spring where temperatures reached 35 C during the tillering stage and temperatures were even higher during the grain filling period. Additionally, water shortages restricted the growth of spring barley. Field germination and grain yield of mungbean increased with bed planting in Karshi site, Uzbekistan. The maximum grain yield (2.24 t/ha) was obtained in bed planting and the minimum grain yield (1.85 t/ha) was obtained in broadcasted planting method.

No-till winter wheat

Winter wheat was planted at the end of October with an Indian no-till planter. For winter seeding of no-till wheat, the project team borrowed a Happy Seeder from the ZEF project in Urgench (Uzbekistan). No-till sowing had not been practiced at this site prior to the experiment. Seed was placed with 4 cm of soil cover while the seeding rate was 140 kg/ha while seed rate of conventional planting was 220 kg/ha. Field performance of no-till winter wheat was good.

Economics

In 2011, in Qashqadaryo province, economics of double cropping growing mash (mungbean) after harvest of winter wheat was tested where planted on beds. Winter wheat yield was 5.94 t/ha and that of mash was 1.73 t/ha. Average price across the year was: for wheat grain 650 uzs/kg, for mash 1750 uzs/kg. The net income amounted to 3,861,000 and 3,027,500 uzs/ha for wheat and mash, respectively. These data also indicate that farmers' incomes could be doubled easily through double cropping even under rather low market prices for alternative crops.

Field days

Six field days were organized, in Azerbaijan, Kazakhstan and Uzbekistan, to bring farmers, extension agents, and researchers to observe and discuss raised bed and no-till approaches in the project demonstration sites throughout the three countries. Farmers from the project demonstration site and adjacent areas participated and became acquainted with conservation agriculture practices. The capability of the ZT seeder to seed maize (Azerbaijan and Kazakhstan) and mungbean (Uzbekistan) directly behind the combining of wheat was demonstrated during the field days which were conducted in 2012. The participants clearly recognized the need for introducing conservation agriculture practices in the countries.

Training Courses

Three training courses were organized for some 40 participating farmers and specialists, researchers/technicians and policy makers at district level in each country (totally 120 participants). The main objective of the formal training courses was to create awareness about the conservation agriculture practices.

Center: ICARDA
Donors: FAO in the framework of the FAO-Turkey Partnership Program
Project period: 2011-2013
Countries: Azerbaijan, Kazakhstan, Uzbekistan

Germplasm Conservation and Enhancement in Potato

Aims and scope of work

Several research studies have been carried out on potato germplasm within the BMZ/GIZ project “Enhanced food and income security in South-West and Central Asia (SWCA) through potato varieties with improved tolerance to abiotic stress”, which was initiated in 2008 and completed in 2011. The project aimed at research of potato cultivars’ response to water stress before releasing appropriate cultivars/varieties in regions experiencing such abiotic stress conditions. Imported potato varieties are not adapted to local conditions because they are selected usually in the northern European environment, and therefore, under agro-ecological conditions where water supply is not an issue, and heat and salinity are no constraints. In general, those varieties have been grown for the European farmers who can afford to pay high prices for the regular replenishment of seeds. In Uzbekistan, it was estimated that only large farmer households can purchase imported seeds of European varieties and plant them on 15-20% of the whole potato cultivated area.

CIP advanced clones

Some CIP-bred advanced clones that were previously selected in the coastal, desert areas of Peru, revealed good tolerance to drought, heat and salinity in Central Asian environments. As far as soil salinity is concerned, potato is normally classified as a moderately salt-sensitive crop, having threshold salinity levels from 1.6 to 2.5 dS/m. However, in collaboration with the Institute of Vegetables, Melon and Potato, the Department of Bio-organic Chemistry of the National University and the Soil Agrochemistry Institute, CIP conducted trials in Syrdarya province, Uzbekistan, under moderate salinity levels and predominance of chloride-sulfate. Some CIP advanced clones, namely CIP 397077.16, out-yielded the other entries with marketable and total yield of 17.6 and 18.6 t/ha, respectively, which is significantly higher than those of the Dutch variety “Sante” (9.9 and 10.3 t/ha), the most popular potato variety in Uzbekistan and that was tested as a standard check. The dry matter of both ranged from 20.7 to 19.5%, respectively. In Uzbekistan, two CIP candidate varieties were released in 2011, both of them carry the noticeable traits of resistance to abiotic and biotic stress, CIP 397077.16 (“Sarnav”) and 390478.9 (“Pskem”). As a main result of the project in Uzbekistan, local government decided to finance (partly as a grant and partly as a loan) a seed potato production project taking as a departing point the varieties recently released. Investments in new laboratories, equipment and greenhouses are ongoing. The organization, which is in charge of the project, is the Academy of Sciences of Uzbekistan.

Results of trials

In the drought tolerance trial (with a strip plot design) carried out in Tashkent, the vertical factor was represented by the different irrigations regimes, one per each block (**I_1**=Control, representing current irrigation practices carried out locally during the whole growing season; **I_2**=Moderate water deficit, with water applied as in the control treatment up to 40 days after planting (DAP) and thereafter only at 60 and 80 DAP. In the trial, across entries, CIP-bred clones 388615.22, 397077.16 and 390478.9 showed highest significant mean tuber yield under the different irrigation regimes. In particular, clone 388615.22 had the highest significant tuber yield in the control and under moderate water deficit conditions (36.5 vs. 32.5 t/ha). The drought tolerant characteristics of 397077.16 and 388615.22 were confirmed by a high drought tolerance index (> 1.0) under moderate water deficit conditions. In particular, CIP-bred clone 388615.22, which was initially selected for traits of resistance to heat and viruses, had also a significant increase of dry matter content in the tubers under the water stress conditions, possibly associated with its lower osmotic potentials. More work is needed to quantify the effects of environment on dry matter concentration and to determine the degree at which stability of tuber dry matter concentration and of other traits differ between genotypes.

In the heat tolerance trial carried out in Tashkent in 2011, the Dutch variety “Sante” revealed to be extremely susceptible to high temperature with a lower percentage of emerging plants among all the entries during 45 days after planting (63.3 vs. 96.8%). At 70 DAP, plant canopy ranged from 55% of “Sante” to 87% of CIP clone 381381.13. Clone 393617.1 had the lowest mean wilting value (1.0) compared with CIP 395434.1 (3.5). The average marketable yield was 19.4 t/ha, with values ranging between 6.8 t/ha (CIP 395186.6) and 32.3 t/ha (CIP 393617.1). CIP 392820.1 (31.7 t/ha), 393708.31 (29.3 t/ha), 381381.13 (27.2 t/ha) and 396311.1 (26.4 t/ha) had a marketable yield, significantly higher than “Sante”, the Dutch variety used as a control (16.5 t/ha). It can be concluded that the above clones are highly tolerant to heat because the average maximum temperature recorded in July and August was 40°C, while the canopy temperature recorded in the second half of July was exceptionally and extremely high for the season, corresponding to 52°C. The average minimum temperature was 16°C during tuber initiation, therefore, acting as palliative to the high temperature recorded in August. The most promising clones will be introduced in multi-location trials in 2012, in order to confirm above-mentioned characteristics. The only critical aspect is the growing cycle that should be exactly 90 days from planting to harvesting in order to accommodate local needs. In the near future, bulking trials will be organized to detect the most suitable harvesting time for those clones.

Heat tolerance trials were also carried out in Muminabad and Faizabad, Tajikistan (**Annex 2**). In Muminabad, CIP 720189 was defined as the best performing clone (24.8 t/ha), followed by 397054.3 (21.9 t/ha), 302313.105 (21.4 t/ha), 720148, 302328.109 (21.2 t/ha) and 388611.22 (20.2 t/ha). In Faizabad, on the other hand, CIP 388611.22 was the best with 25.5 t/ha. The overall average yield was of 21.7 t/ha. Both in Faizabad and Muminabad, CIP 720149 had the highest average tuber weight of 91.7 and 76.9 g, respectively.

Based on the results of the project in terms of selected germplasm and applied techniques and methodologies, it will be possible to bring non-traditional potato growing areas under potato cultivation in near future, by introducing salt, drought and heat tolerant varieties, thus improving food security and livelihoods of resource-poor farmers in the temperate lowlands of Central Asia.

Mixing local and traditional practices with improved techniques

According to the IPCC (Intergovernmental Panel on Climate Change), Central Asia will experience a temperature increase of 1–2°C until 2030–2050. Glacier-melt runoffs have already increased by 15% in the period between 1959 and 1992, and by more than 30% in the last decade. To mitigate partially the effect of temperature change on the potato crop, farmers tend to anticipate planting in the lowlands of Termez, Uzbekistan to the month of January, in order to have plants harvested at the beginning of May when the temperature may already reach 40°C. On the other hand, to alleviate partially the crop from the high temperatures of the second cropping season in the lowlands (mid July to end of October) in Tashkent and Samarkand regions; Uzbekistan farmers provide water every 5 to 7 days in July and August, the hottest moments of the growing season. Furthermore, they plant seed potatoes with orientation southeast (to keep soil moisture), while in spring, planting is with direction east south (to favour soil heating). As the experiments have demonstrated in Tashkent region, Uzbekistan emergence rates of more than 90% have been recorded for CIP germplasm materials under the temperatures that in the second half of July (immediately after planting and before tuber initiation), may be over 50°C in the sun.

The development of early and heat tolerant potato varieties adapted to the long day conditions of Central Asia would allow farmers to invest in a profitable crop that would replace fallow between two consecutive wheat crops, thus contributing to better land use ratio and profits. The selected varieties have a growing cycle ranging from 95 to 110 days. Therefore, they are adapted to fill the gap between two consecutive wheat crops with planting in mid-July and harvesting towards mid-end of October.

Development of a farmer-based seed potato production system using True Potato Seed (TPS)

In Tajikistan, the informal seed sector was privileged. A group of 37 smallholders utilizing TPS seedling tubers from different generations were followed by a local agronomist in Garm district, while a group of fifteen seed growers multiplied each five hundred kilograms of seed potatoes belonging to some CIP candidate varieties (397077.16, 720189) at the rate of 1:2, that is per each kg of seed supplied by the local NGO “Tukhmiparvar”, two kg are given back by the seed growers.

The utilization of TPS shows an interesting potential especially in “niche” areas such as those in Zerafshan, Rasht Valleys, Pamir (Tajikistan), Badakhshan (North-Eastern Afghanistan), and the mountainous bordering districts of Uzbekistan.

Five TPS families were identified as the best performing under the 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 research organizations, NGOs (such as German Agro Action, Mercy Corps, Aga Khan Foundation, Global Partners), UNDP Project “Area-Based Development” (Kashkadarya, Uzbekistan) and smallholder farmers often operate as a surrogate for absent or inefficient national extension systems.

CIP tested two techniques, the direct seeding technique in nursery and the transplanting of rooted seedlings in the open field. 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 with the direct seeding method (7.3 and 4.6 kg/m2, respectively), at 137 and 132 days after sowing. The only drawback to the adoption of the transplanting method is the long duration of the growing cycle of the tested TPS families (151 days from sowing until harvesting), which would need to be shortened, requiring, additional research on new germplasm materials.

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

The collaborative research conducted at National University of Uzbekistan resulted in the establishment of a calendar of operations that can be of great use in the case of large-scale seed production activities. According to the results obtained, two types of planting materials can be used with success: in-vitro plants, transplanted at a high density (50 pl/m2, or 8 x 25 cm) in February and in-vitro microtubers planted at the same density in September, allowing, therefore, 2 cycles of minituber production under screen-house conditions per year. The research work led to the formulation of an appropriate media for the production of minitubers under screen- house conditions and consisting of 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 screen-houses, it was possible to avoid expensive operations like soil sterilization that always represents the main bottleneck in the minituber production stage. In the formal seed production system, the Uzbek Institute of Vegetables, Melon and Potato implements research trials with the objective of achieving a better Water Use Efficiency (WUE), which would allow important water savings and lead through Mother & Baby trials the uptake of new varieties and techniques among farmers.

Capacity Building

In Central Asia, the key need is strengthening of capacity building efforts by (i) establishing appropriate research infrastructures to allow local research institutions to conduct high-level research, and (ii) training of local young talented scientists to upgrade their knowledge. In addition, the absence of experiment stations (as in case of Tajikistan) makes it difficult to carry out trials because under farmers' field conditions it is not always possible to reach such conditions that would allow the replication of experiments.

In Uzbekistan, the staff of the National University of Uzbekistan together with the Institute of Vegetables, Melon and Potato have been continuously trained either in the field or through seminars and workshops. A continuous follow up process is needed because of the great task that was given to them by the government, namely the production of seed tubers for local needs. CIP is preparing a budget to cover costs for training and advisory services provided to the project. In particular, the staff of the Institute of Vegetables, Melon and Potato have been trained in the establishment of crossing blocks and hybridization for the development of new potato varieties in the research site of Pskem, Bostalnik district.

In Tajikistan, the local NGO Tukhmiparvar, established in 2005 under the agreement with FAO-funded project, received trained in breeding, selection, and seed multiplication for the highlands of Tajikistan. The potato breeder was trained at CPRI-Shimla, India, and pursued his observations on 39 F_1C_2 clones issued from crossings made in 2009, by using CIP clones as female parents and varieties "Picasso", "Zarina", "Kondor" and "Kufri Surya" as male parents. True Seeds were sown under screen-house conditions and data were recorded on the clonal selection. At harvest of F_1C_2, some of the most promising selected materials are provided in **Annex 2**. The best performing clones showed to have an average of 10 to 18 tubers per plant, an average tuber weight of 90 to 218 g and an average plant weight of 800-1000g.

Centers: CIP
Donors: CGIAR Research Program "Potato and Tubers"; BMZ/GIZ funded project "Enhanced food and income security in SWCA through potato varieties with improved tolerance to abiotic stress"
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

The UNEP-GEF/Bioversity International project “In Situ/On-Farm Conservation of Agricultural Biodiversity (Horticultural Crops and Wild Fruit Species) in Central Asia” has brought together five countries to address issues of conservation and sustainable use of local horticultural crops and genetic diversity of wild fruit species. Local varieties of horticultural crops and wild fruit species are conserved in situ/on-farm through enhanced capacity of stakeholder groups including policy-makers, researchers, agricultural extension workers, farmers and their associations, local communities, and NGOs. Knowledge about levels and distribution of fruit species genetic diversity, and the value of this diversity for sustainable agriculture and ecosystem health are used to strengthen policy and legislation. The project produces and distributes proven participatory management models that contribute to the conservation of this important global resource within and outside the five target countries. Key project objectives are: (i) to provide options to policy-makers for strengthening legal and policy frameworks for conservation and use of fruit genetic resources; (ii) to assess, document, and manage local varieties of horticultural crops and wild fruit species in a sustainable way; (iii) to promote broad stakeholder participation, representative decision making, and strong partnerships among them; and (iv) to strengthen the capacity to implement all aspects of fruit genetic diversity conservation at local, national and regional levels.

Conservation

In the reporting period, national partners in the five countries involved in the project conducted household surveys of farmers to assess the impact of the project activities on distribution and diversity level of target fruit crops and livelihoods. In total, 561 households were surveyed including 114 households in Kazakhstan, 102 in Kyrgyzstan, 47 in Tajikistan, 83 in Turkmenistan and 215 in Uzbekistan. The survey results demonstrated considerable increase of diversity of local varieties of fruit crops in the farmers’ orchards. It was found that 589 local varieties of fruit crops were maintained on farm, including 221 local varieties of apple, 116 apricot, 149 grape, 27 pear, 21 pomegranate, 18 almond, 15 mulberry, 12 walnut, 10 peach. Promising forms of wild apple (37), apricot (16), pear (14), cherry plum (13), walnut (29), pistachio (21), almond (12), and sea-buckthorn (13) were identified in forests throughout the Region and recommended for use in breeding as high-yielding, stress resistant varieties, or for direct use in establishment of commercial plantations of nut-bearing crops. Many of these varieties and forms possess useful traits such as drought and frost tolerance, resistance to pests and diseases, high yield and good taste quality. Fifty-five demonstration plots were established in farmers’ orchards, including 10 in Kazakhstan, 5 in Kyrgyzstan, 12 in Tajikistan, 8 in Turkmenistan and 20 in Uzbekistan. 480 local varieties and forms of apple, apricot, grape, pomegranate, pear and mulberry are maintained in those plots. Two demonstration plots were established in forest sites in each country, in total 10 sites with promising forms of wild walnut, pistachio, apple, apricot, sea-buckthorn, cherry plum and grape conserved. These plots are used for training of farmers on advanced techniques in fruit crops management, including traditional practices, demonstration of economically valuable features of local diversity to farmers. The established demonstration plots also serve as on-farm repository of this unique diversity and mother plantations for multiplication of local varieties of fruit and nut-bearing crops.

Fifty-three nurseries were strengthened to produce planting material of target fruit crops, including 11 in Kazakhstan, 7 in Kyrgyzstan, 9 in Tajikistan, 10 in Turkmenistan and 16 in Uzbekistan. A total of 974,600 saplings of 348 local varieties of fruit crops and 87,000 seedlings of 60 forms of wild fruit and nut species are produced in these nurseries annually and distributed to farmers.

Central database on diversity of target fruit crops is in the process of development. The database is hosted by Bioversity International according to the signed Agreement with national partners on access and information sharing. It contains data on morphological characterization of local varieties of target fruit crops, their geographical location, information about farmers, holders of these varieties and related socio-economic data on the households. National partners are provided with access to the database according to the terms of agreement on access and information exchange through the project's web-portal: http://centralasia.bioversity.asia/

Enabling legislation

In the reporting period, national partners have followed up with their proposals on strengthening legislative frameworks for support of in situ/on-farm conservation of fruit crops diversity in their countries. Lists of valuable tree species including wild fruit and nut species that need specific protection and conservation actions were developed for inclusion to the national Forest Codes in Kyrgyzstan, Turkmenistan and Uzbekistan. In Kazakhstan, a proposal to include fruit production to the list of compulsory insurance was developed and submitted to the Ministry of Agriculture. In Kyrgyzstan national partners participated in discussions of the draft Law "On specially protected natural areas" in the Committees of the Parliament of the Kyrgyz Republic and provided their proposals on inclusion of crop wild relatives into conservation actions in protected areas. The national project team in Kyrgyzstan participated in development of National Action Plan for Forestry Development of the Kyrgyz Republic for the period until 2015. In 2011, the project organized a round table meeting to discuss proposals on protection of traditional knowledge on plant genetic resources management. Staff of the National Academy of Sciences, the Ministry of Agriculture, State Agency for Environment Protection and Forestry, deputies of Zhogorky Kenesh (Parliament), experts from the Parliament Office, universities and NGOs in Kyrgyzstan participated in the round table.

Guidelines on "Access and benefit sharing (ABS) in research projects", which summarize model agreements on access and sharing information, transfer of germplasm and planting material for research, breeding, training and conservation purposes and prior informed consent (PIC) for individuals and communities were developed in English and Russian. The Guidelines also include possible benefit sharing provisions for transfer of germplasm for commercial purposes.

National Roster of local varieties of fruit and nut-bearing crops was published in Uzbekistan, which includes data on 422 local varieties of target fruit crops maintained by 185 farmers in the country, including 148 varieties and forms of apricot, 90 apple, 72 grape, 39 pomegranate, 32 pear, 21 almond, 18 walnut and two of pistachio. The Roster aims to protect framers' rights on the germplasm of fruit crops conserved and maintained in their fields. In Kazakhstan, a manual "For help to farmers-growers of fruit crops" was published in the reporting period. The manual assists farmers in realizing their rights stipulated in the existing national legislative framework.

It is worth noting that the changes observed in national agricultural policies in the Region started to bring about support to horticulture development along with wheat and cotton. Government's Decree on horticulture development in 2010-2012 was issued in Uzbekistan, which aims at establishment of 6,500 ha and 15,500 ha of new vineyards and orchards. In Kazakhstan, the government provided subsidies in amount of USD 25 million to farmers for establishment and maintenance of orchards and nurseries in 2011-2012.

Dissemination

Based on the results of the project, 19 guidelines and manuals on assessment of diversity of fruit crops, traditional knowledge on their management, cultivation and multiplication were produced by national partners in Russian and local languages for use by scientists and farmers.

To share the project's outcomes with a wider audience, the International Scientific and Practical Conference "Conservation and sustainable use of biodiversity of horticultural crops and their wild relatives" was organized in August 2011, in Tashkent, Uzbekistan. Over 80 participants from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, as well as Azerbaijan, Armenia, Italy, India, Czech Republic, China shared their knowledge and experience in fruit crops diversity research, conservation and use. Representatives of research institutes, scientists, universities, policy makers from Ministry of Agriculture, Ministry of Nature Protection, Parliament of Uzbekistan, and donor organizations (UNEP and UNDP), participated in the Conference.

During 2011-2012, three Diversity Fairs were organized in Kyrgyzstan, two fairs of farmers' achievements in Kazakhstan and two fairs demonstrating planting material of fruit crops in Tajikistan. Farmers, representatives of local self-governance bodies, consulting services, processing companies, scientific and educational institutions participated in the fairs. Lively information exchange took place among the farmers involved in the project and other stakeholders regarding characteristics of different varieties, acquisition of planting material of local varieties, disease and pest control, pruning techniques, etc. For conducting fairs, the project team prepared booklets about nurseries, demonstration sites, and brochures about local varieties.

Four video-films were developed for increasing public awareness about the value of target fruit crops: in Kazakhstan the video-film entitled "Pear – healthy dessert", in Uzbekistan –"Grape of Uzbekistan" and "Walnut diversity in Uzbekistan". In Kyrgyzstan, a video film on fruit tree nurseries and farmers' experience in multiplication of fruit trees was made.

Capacity building

Bioversity International organized a number of training workshops, scientific and practical conferences at regional and national levels for policy makers, researches, students, farmers, forest dwellers and local communities and also supported participation of national partners at significant international events dedicated to conservation of agricultural biodiversity:

- International Scientific Practical Conference "Conservation and sustainable use of biodiversity of horticultural crops and their wild relatives" (23-26 August 2011, Tashkent, Uzbekistan);
- Seventy-six M.Sc. and PhD students from research institutes and universities in Uzbekistan participated in the Scientific and Practical Conference for Young Scientists entitled "Issues of conservation of agrobiodiversity, its role in agricultural development, food security and environmental sustainability" organized jointly by Bioversity International, Uzbek Institute of Genetics and Plant Experimental Biology and Samarkand Agrarian University (18 May 2012 , Samarkand, Uzbekistan);
- Eight farmers and scientists from Kazakhstan, Kyrgyzstan and Uzbekistan participated in the Knowledge Share Fair 2012, held in March 2012, in Chiang Mai, Thailand and organized by the Department of Agriculture of Thailand in collaboration with Bioversity International/ UNEP-GEF project "Conservation and Sustainable Use of cultivated and wild tropical fruit diversity" where they shared lessons learnt with

the UNEP-GEF/Bioversity International regional project “In Situ/On-Farm Conservation of Agricultural Biodiversity (Horticultural Crops and Wild Fruit Species) in Central Asia”;

- Seven female scientists from Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan participated in the Global Conference “Women in Agriculture” organized by Indian Council of Agricultural Research (ICAR) and partners (13-15 March 2012, New Delhi, India). They shared the results of their research on the role of women in conservation of biological diversity of fruit crops in Central Asia;
- 13 farmers and scientists from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan were trained at the regional workshop on "Establishment of apricot orchards and local diversity of apricot in Zarafshan valley of Tajikistan" (18-22 July 2011, Khudjand, Tajikistan)
- 26 farmers and scientists from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan were trained at the regional workshop on "Natural regeneration and selection of economically valuable forms of walnut in the nut-fruit forests of Kyrgyzstan" (28 -31 July 2011, Bishkek, Kyrgyzstan);
- 16 young scientists from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan were trained at the regional workshop on "Application of molecular markers in study of plant genetic resources " (13-17 August 2011, Tashkent, Uzbekistan);
- 53 farmers and students were trained on new technologies for cultivation of fruit trees and grapevine, accounting in farms and key issues of conservation of fruit and forest crops at national training workshops organized in Uzbekistan;
- 142 farmers and staff of forestry farm enterprises were trained at 4 workshops on conservation and natural regeneration of wild fruit and nut species in Kyrgyzstan;
- 60 farmers and forest dwellers in Turkmenistan gained on job training in cultivation technology of fruit trees, establishment of nurseries and regeneration of wild relatives of fruit crops;
- 72 farmers from different parts of Kazakhstan attended the workshop "Ways of conservation and sustainable use of agrobiodiversity of horticultural crops and grapevine" (13 September 2011, Taldykorgan, Kazakhstan);
- 25 scientists were trained at the workshop on "Application of international descriptors and new technologies in study and characterization of diversity of wild fruit species "(30 November 2011, Talgar, Kazakhstan).

Centers: Bioversity International
Donors: UNEP/GEF
Project period: 2006-2012
Countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan

Sorghum and Pearl Millet for Crop Diversification in Central Asia

Aims and scope of work

The main goal of the three-year project launched in 2011 is to contribute to the improvement of livelihoods of farmers in salinity-affected and marginal environments of Central Asia through the development and dissemination of high-yielding, salinity-tolerant sorghum and pearl millet lines and cultivars, as well as crop management technologies for economic and sustainable crop-livestock production systems in these three countries. During the first year of the project, 12 accessions of sorghum and 7 improved lines of pearl millet derived from the ICBA/ICRISAT germplasm were evaluated in multi-location and on-farm trials in Central Asia. Local varieties were used as a control during the trials. Research conducted in 2011 till summer 2012 allowed to:

- Assess the high-yielding and salt-tolerant accessions and improved lines of sorghum and pearl millet in saline and waterlogged soils;
- Establish nurseries for the collection and selection of variety trials. The most adapted high-yielding accessions and improved genotypes (in terms of green biomass and quality of seed crop) were selected. Based on these accessions and genotypes, further breeding work and evaluation of productivity and profitability for forage and grain production are being conducted during the remaining years of the project;
- Identify high-yielding varieties of sorghum and millet as the second alternate crops after wheat harvest in Uzbekistan and Tajikistan, rice harvest in Kazakhstan, suitable for use by farmers;
- Develop and recommend common criteria for primary seed multiplication at the farm level.

Germplasm conservation and enhancement in sorghum and pearl millet

The measures included the establishment of a multi-location trial for open pollinated varieties (OPVs) and improved lines of dual-purpose (for forage and grain) sorghum and pearl millet, which were identified during a previous project (2007-2010). The 12 promising accessions and 7 improved lines of pearl millet additionally provided by ICRISAT (in 2011) were evaluated mostly for forage livestock feeding production. The plant material was evaluated on low saline soils at “Zangyota” Corn Station (Uzbekistan), “Ziroatkor” Production Farm, Institute of Plant Husbandry of Tajik Academy of Agricultural Sciences (Tajikistan) and Abay district, Chimkent region (South Kazakhstan), on moderately and high saline soils at Shortanbay Farm, Nukus region, Karakalpakstan (Uzbekistan) and at Institute of Rice Production, Kyzylorda (Kazakhstan). The same sorghum and pearl millet germplasm was also evaluated under rainfed conditions of Almaty region in Kazakhstan.

To assist the national research partners in their breeding programs and efforts on rehabilitation of salt affected and abandoned land, ICBA and ICRISAT supplied a set of improved lines and high-yielding accessions of sorghum and pearl millet. In spring 2011 and 2012, seeds of high yielding sorghum and pearl millet germplasm from ICRISAT were distributed to the national partners in each country. Screening of more than 52 improved lines of pearl millet through on-station and farmer-participatory on-farm trials under different field management practices identified “Sudan Pop III”, “Guerinian-4”, “Raj 171”, “IP 6107”, “IP 6112”, “IP 131150”, “IP 19586”, “HHVBC Tall”, “ICMV 7704” and “MC 94 C_2“ as the most salt/drought tolerant and highly productive varieties for food and forage production.

Sorghum varieties “ICSV 93046”, “ICSSH 58”, “SPV 1411”, “ICSR 93034”, “ICSV 25280”, “S 35”, “Sugar Graze”, “Pioneer 858” and “Uzbekistan 18” showed a high potential to increase forage production on saline prone soils in Central Asia. They demonstrated about 30% higher dry fodder and 25% higher seed yield than the local varieties. The high morphological diversity in grain size, color and number of grain/panicle were observed as distinctive features for majority of the screened varieties.

Development of sorghum and pearl millet varieties resistant to abiotic stress

Monitoring of irrigation water, ground water and soil salinity level (at different soil depth profile -15, 30, 45 cm) by using Direct Soil EC meter during sorghum and pearl millet vegetation season at Bayavut and Kyzylkesek Farms (Uzbekistan), Shortanbay farm (Karakalpakstan, Uzbekistan) and at experimental station of Kyzylorda Institute of Rice Production (Kazakhstan) demonstrated the trend of increasing salt tolerance.

Average threshold salinity levels for the sorghum varieties ranged from 2.60 to 8.5 dS/m; and from 2.4 up to 4.6 dS/m for pearl millet entries, respectively. The newly released variety “Hashaki 1” has an intermediate position. Thus, sorghum and pearl millet varieties derived from ICRISAT and ICBA germplasm can be classified as moderately salt-tolerant material. Pearl millet was more sensitive than sorghum to soil and water salinity under shallow (0, 5-1, 8 m) and saline water table (1, 5-3.8 dS/m), as it was demonstrated in a trial in Shortanbay farm, Karakalpakstan, Uzbekistan.

Under severe drought in the summer 2011, the pearl millet varieties especially “Hashaki1”, “IP 13150”, “HHVBC Tall” and “IP 19286” showed more significant drought tolerance than sorghum entries in target sites in all project countries. There was no precipitation during July-September, except at Tajikistan sites. The air temperature during the vegetation period was 3.8°C higher than average multi-annual data.

A pest *Ostrinia nubilalis* Hbn. that seriously affected maize industrial fields in Uzbekistan and partially sorghum entries at Bayavut Farm (Syrdarya region) in 2011 and Dos Farm (Saraguach district, Kazakhstan) in summer 2012 was not revealed on pearl millet fields. The disease pressure was very high and checks of maize in the vicinity of sorghum and pearl millet were almost dead in the plots. Thus, the tested lines of pearl millet and sorghum that appear to be resistant to salinity, drought and pest represent valuable materials for further testing as potential new varieties and/or use in crossing programs. Farmers are interested in the cultivation of pearl millet due to these features. Pearl millet with higher fodder yield can partially replace proso millet and occupy new niches leading to crop diversification and enhanced crop-livestock productivity in the Aral Sea Basin.

Evaluation of sorghum and pearl millet in participatory trials

Evaluation was carried out in the second decade of July 2011 after harvesting of winter wheat. Interspaces between rows were identical for all sites – 30cm, which differs from standard practice in the Region. Seed bedding was done manually. In 2012, a similar set of sorghum and pearl millet germplasm was planted in March-April as main crop and after wheat harvesting in July in Uzbekistan and Tajikistan and after barley and in rice crop rotation system in Kazakhstan. Evaluation of the material was based on biological and economically valuable traits studied in different ecological conditions. The statistical analysis of the data obtained during two years was made and the best cultivars were selected. They demonstrated advantages as compared with local varieties.

The multi-location testing of advanced lines of sorghum and pearl millet selected in 2011 showed that several lines produced high yield forage biomass. The yield levels could increase under better management. Forage yield levels of the best breeding lines were at least 15% higher than the best local checks. Sorghum accessions SPV 1411 (in Kazakhstan), ICSSH 28, ICSSH 58, ICSV 93046 (in Uzbekistan and Southern Tajikistan) exceeded the standard Korabosh variety in 14.32-23.66 kg/plot of green matter and 1.85-4.01 kg/plot of dry matter yield at standard height. Sorghum and pearl millet planted as second crop in mid-June to early July after wheat harvest and rice crop rotation showed promising results in each country. However, the appropriate maturity requirement will depend on the time of onset of the frost, when planted as a main crop in the Aral Sea Basin, Northern Tajikistan and rainfed areas of Kazakhstan. Sowing these two crops with 30 cm inter-rows space significantly increases the plant density and, consequently the fresh forage production at the end of harvesting of sorghum and pearl millet from the fields. Sorghum varieties maturing in 110–140 days can be taken only as a main crop as the frost starts early in this area. Pearl millet with 85 to 90 days maturity fits well as second crop in southern Kazakhstan. As a second crop, pearl millet with 65–70 days maturity such as "Hashaki 1" variety will have a good chance of fitting under the prevailing cropping system in all the eco-regions. The early seed bedding (mid-March at soil temperature +5-10°C), as was demonstrated in a trial in Kyzylkesek (Central Kyzylkum), would allow to obtain two cuts (7, 8-9.1 kg/plot green forage).

The increase of forage biomass for selected sorghum and pearl millet entries was primarily caused by the fact that the high precipitation (October 2011-April 2012) favored sorghum and pearl millet production in rainfed areas in Navoi region (Uzbekistan) and Almaty region (Kazakhstan), where they were introduced first. Dual-purpose, two-cut varieties can play significant role in filling gaps in the farm productivity and crop-livestock systems. In South Kazakhstan, the most viable option for their large-scale cultivation is to shift traditional production to alternative forage-livestock production system with dual-purpose crops, which can maintain farm productivity, diversify and improve income for farmers.

Progress in breeding activities

In 2011, "Hashaki 1" was recognized by the State Variety Testing Committee (SVTC) in Uzbekistan as promising pearl millet variety to be tested and released under different environmental conditions. As an early maturing variety, it has performed well in dryland saline environments and could be widely planted as main crop in early spring or as second crop after the wheat harvest or in rice rotation system. Four trials on seed production of this high-yielding variety is under development in order to provide high quality and certified seeds for increasing needs of biosaline agricultural production in Uzbekistan. The main objective of seed production of "Hashaki 1" is rapid multiplication by maintaining the varietal identity (with a spatial field isolation of about 700-1000m with periodic renovation from breeders' seeds) and genetic purity. Farmers in Uzbekistan and Kazakhstan showed interest to cultivate it mostly for forage as green biomass and silage.

Seed Multiplication Trials and identification of seed production facilities on sentinel sites to meet seed requirements for yield trials

Specialized on-farm seed multiplication trials with participatory involvement of farmers to address the issues of quality seed production, storage and supply of most promising germplasm were established in all three countries based on guidelines provided by ICRISAT. Progressive farmers with relatively larger size of low saline lands used these varieties in Abay district, South Kazakhstan to produce good quality seeds of sorghum "ICSSH 58" (C0 bulk) and "IP13150" pearl millet varieties; "ICSV 93046" sorghum and "HHVBC Tall" promising lines in Kyzylkesek and sorghum "SPV 1411", "ICSV 93046" and "MC94C_2", "IP 19586" pearl millet populations at Zaraotkor Farm in Southern Tajikistan. In 2012 vegetation season, "Hashaki 1" was distributed for evaluation and seed production at Zangyota Experimental Corn Station and Kyzylkesek sherkat Farm (Uzbekistan), Shortanbay farm (Karakalpakstan, Uzbekistan) and Abay Farm (South Kazakhstan). For small-scale on-farm seed production, after anthesis heads of selected rows, plants were protected by selfing bags or similar bags made of porous cotton textile.

Selected farmers produced the seeds under fish nets or by using selfing bags to protect from bird damage, and sold the seeds to other farmers on a remunerative price to recover the cost of seed production plus 30-50% profit. Farmers will be producing the seeds for an incentive, and hence can ensure adequate and timely supply of quality seeds. The International Centers and National Institutions in the target area of seed production are providing technical guidance for quality seed production.

Nutritional value of forage and livestock feeding system in selected populations and varieties

Research on chemical content of protein, lipids, sugar, carbohydrates, ash and mineral composition of sorghum and pearl millet forage were recently initiated by ICBA in collaboration with Institute of Chemistry of Plant Substances, Academy of Sciences of Uzbekistan and Kyzylorda Institute of Rice, Kazakhstan. Preliminarily results showed high content of crude protein (value based on air-dry matter) ranging between 16.0-24.5%. The content of protein in fresh forage of "ICSSH 28", "ICSSH 58", "SPV 1411", "ICSV 93046" were better compared to the control (local variety) and maize. Among pearl millet the content of crude protein of forage of "Hashaki 1" was higher than at similar stage for "HHVBC Tall" (parental line). Estimated mean values of crude protein content of green biomass (at the growth stage after first cut) is 1.4 times higher than in stove, collected at the grain maturation stage. Pearl millet may become a high nutritive-value forage crop, popular among farmers. Sorghum and pearl millet are regarded as a high quality feed for grazing, greenchop and hay. The forage is good for all kinds of livestock, when used at vegetative stages (first and second cuts).

Centers: ICBA, ICRISAT and ICARDA
Donors: Islamic Development Bank through ICBA; State Committee for Science and Technology of the Republic of Uzbekistan;
Project period: 2011-2014
Countries: Kazakhstan, Tajikistan and Uzbekistan

Improving Livelihoods of Rural Communities under Saline Desert Environments in Turkmenistan - Development of Sustainable Water, Rangelands and Livestock Management

Aims and scope of work

The bilateral project of ICBA and National Institute of Deserts, Flora and Fauna (NIDFF) under Ministry of Nature Protection of Turkmenistan targets the efficiency of non-conventional water use in agro-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 in the Aral Sea Basin. The research identified that a low productivity of sandy desert pastures in Karakum Desert is driven by (i) up-rooting and replacement of woody vegetation in the surveyed areas; (ii) depletion of seed bank of valuable rangeland species; increasing of non palatable species in areas close to settlements and watering points; (iii) severe droughts (unequal seasonal distribution of limited rainfall induced by severe 2010-2011 droughts; (iv) intensification of grazing load from irrigated agricultural zone towards virgin desert areas; (v) structure of household goat herds (mostly affects the rangeland productivity).

Agro-silvi-horticultural and silvi-pastoral biosaline technologies for crop diversification, efficient water (marginal quality) use, feed and livestock production and rangelands improvement were evaluated and adopted during 2011-2012 in Dashauz province (Northern Turkmenistan) and at Karakuly site, Central Karakum sandy desert (Southeastern Turkmenistan). Use of non-conventional water for establishment of artificial agro-ecosystem using *Pistachio vera*, *Haloxylon aphyllum*, *H. persicum*, *Salsola rigida*,, *S. arbuscula*, *S. Richteri, Ceratoides ewersmanniani, Kochia prostrate* and *Halothamnus subaphylla* is the key advantage for domestication of economically valuable native trees, shrubs and perennial halophytes. It increased by 1.3-1.5 times the productivity of saline prone sandy desert rangelands.

Water harvesting techniques on saline 'takyr' surfaces mixed with ground water were demonstrated in Karakum desert. At Karakuly Experimental Desert Station, this is a single source of water, which has been used for irrigation of industrial plantations of pistachio (*Pistachio vera*) during the project period. Preliminary studies on salt affected soils also indicated that tree plantations and shelterbelts with native drought and salt tolerant indigenous species showed adequate relative growth (1.2-1.4 m overall height for the last two years). They have a potential for increasing the soil organic matter due to the relatively rapid leaf litter decomposition. Greater demand and higher prices of pistachio would encourage the agro-pastoralists of Karakum Desert to expand areas under pistachio plantation inter-cropped with fodder halophytes. NIDFF staff supported by ICBA organized Field Demonstration Day for the local community, mostly sheepherders and agro-pastoralists. Farmers were trained on seedling preparation of wild forage shrubs (*Kochia prostrata, Haloxylon aphyllum, Atriplex* spp., *Robinia pseudoacacia, Halothamnus subaphylla, Salsola vermiculata*, etc.).

Productivity enhancement of fodder-based cropping systems through the use of saline drainage water

During the reporting period, experiments on utilization of drainage-mineralized water for establishment of multi-purpose wild and fruit trees were initiated with support of the

Institute of Agriculture in Dashauz. Agro-silvicultural trees (including salt tolerant fruit trees) inter-cropped with complementary crops, especially deep-rooted, early maturing and frost tolerant legumes and graminous crops were simultaneously evaluated on marginal lands at the Akdepe experimental site. The level of water table varied from 0.5 to 1.8 m below field level. Soil salinity at root zone was about 45 dS/m. The fast growing rate of survival was noted for local poplar species (about 91.3%), *Armeniaca vulgaris* (75.2%) and *Morus nigra* (54.8%), when these were cultivated in mixed stands with various salt tolerant crops. The shrub *Elaeagnus angustifolia* having an exceptional ion-translocation bioremediation mechanism can be an aggressive colonizer species, which tends to invade natural habitats and pushes out less salt tolerant species.

The optimal integrated agroforestry farming system (12-15% of tree cover, 58% alfalfa and 27-30% annual forage crops) provides satisfactory drainage control of saline environments preventing accumulation at the root zone area. It was found that the irrigation scheduling (rate and regime) is a critical point for the success of agroforestry practices. Herbaceous fodder crops planted within the inter-spaces of salt-tolerant plantations improve productivity of saline prone soils, solve the animal feed gaps in the lands degraded due to overgrazing and salinity, and increase the profits for farmers.

To generate additional income, two seed multiplication trials were established on abandoned lands in Akdepe Etrap, Dashauz region with participatory work of skilled farmers, women and schoolchildren. Dual-purpose salt tolerant crops (flax, pearl millet, sorghum, topinambur, alfalfa, holy clover, amaranthus, indigofera) were evaluated in pure stands or inter-cropped with salt-tolerant fodder shrubs, such as *Atriplex* and *Salsola*. Two groups of dual-purpose crops for the local community in this area were identified:

1- Fast maturing and short-lived crops, which might produce good quality seeds (some of the entries of sorghum, pearl millet, flax, chickpea, holy clover, sesame and saflor);
2- Medium-or late maturing crops (pearl millet, sorghum, indigofera, amaranthus, topinambur, alfalfa).

Three years evaluation of pearl millet, sorghum, indigofera, amaranthus, saflor and topinambur on their green biomass for forage demonstrated promising results. ICBA in collaboration with NIDFF and Institute of Agriculture in Dashauz region developed guidelines for seed multiplication of these valuable crops. Fodder yield data collected at the end of 2011 growing season indicated a considerable adaptability of these crops to grow saline lands affected by secondary salinization, when compared to local material.

Centers: ICBA
Donors: ICBA-Turkmenistan bilateral project “Improving Livelihoods of Rural Communities under Saline Desert Environments in Turkmenistan”
Project period: 2010-2012
Countries: Turkmenistan

Promotion of Biosaline Technologies for Utilization of Marginal Resources in Zarafshan River Basin

Aims and scope of work

A new initiative on "Web-based platforms of water quality in Zarafshan River Basin integrated with promotion of technologies of marginal resources as part of a climate change adaptation strategy" was launched to promote and adopt innovative biosaline agriculture technologies for sustainable development and conservation of agro-ecosystems. It is funded by the grant of the Government of Uzbekistan for the period of 2012-2015, and was initiated by ICBA jointy with Uzbek Research Institute of Karakul Sheep Breeding and Desert Ecology and Samarkand State University in Uzbekistan.

Web-based platform

This project focuses on water quality monitoring of the main streams, irrigation canals, and collector-drainage system of Zarafshan River Basin and on developing of platform for efficient data management, sharing datasets on water quality and hydrological information. These national institutions since 1997 carry out the water quality monitoring of 74 points along Zarafshan River. Collected water samples, hydrological, meteorological and economic data indicate that generally water in the downstream part of the basin has a low quality. In this project, the main attention is given to concentration of salts and heavy metals in water that could be dangerous for people. The water quality datasets are stored in a newly developed web-based geospatial database, coupled with hydrological, climatic, socio-economic appraisal data for the period of 2007-2012. The database integrates quantitative and qualitative datasets into spatially explicit maps. The web-based feature with online access to the visualized maps of hydrological and water quality datasets provides an interactive framework solution for collaboration among those involved in water resources management in Zarafshan River Basin. The GIS maps of irrigated agriculture area of the Basin were used as a template for further mapping of physical and chemical water parameters for visualized preview of results.

Water quality data integration

Each point on the map layers is assigned to the sampling site or gauging station and these points are attached with files of collected information. The platform automatically recognizes different data file types and shows the points with different marker icons corresponding to the data file types. One of the advantages of the database is an easy integration of unstructured, sparse and diverse datasets from different sources into a data repository with simple visualization. A wide variety of information and data resources from various sources with different background can be added to the database and will increase its potential for broader use. Currently water quality and hydrological data of Zarafshan River Basin are accessible to the users. The database will be helpful in finding solutions of a wide range of arising problems in planning water management through available information and datasets. It provides a simple tool to share collected information, which can be important in the poorly observed area. Providing the datasets through the web-based platform will help to build a centralized data repository for this basin. Visual representation of the datasets on maps will facilitate sharing them among interested local communities and researchers.

Centers: ICBA
Donors: State Committee for Science and Technology of the Republic of Uzbekistan, Yamanashi University and Kyoto University, Japan

Project period: 2010-2012
Countries: Uzbekistan

Improvement and Diversification of Vegetable Crops

Aims and scope of work

In 2011, the Regional Variety Trials supported by the World Vegetable Center - AVRDC were conducted in different soil and climatic conditions in all eight countries of the CAC Region: Armenia (Research Center of Vegetable, Melon and Industrial Crops), Azerbaijan (Azerbaijan Research Institute of Vegetable Growing), Georgia (Research Institute of Crop Husbandry), Kazakhstan (Kazakh Research Institute of Potato and Vegetable Crops), Kyrgyzstan (Research Institute of Crop Husbandry), Tajikistan (Research Institute of Horticulture and Vegetable Growing), Turkmenistan (Research Institute of Crop Husbandry) and Uzbekistan (Uzbek Research Institute of Plant Industry).

Regional Variety Trials

A total of 83 accessions of six vegetable species from AVRDC's international gene bank were introduced to the Region. They included tomato (6 lines in 5 countries), sweet pepper (5 lines in 6 countries), eggplant (3 lines in 2 countries), hot pepper (5), soybean (5) and cabbage (7). In addition, 111 accessions of 13 vegetable species were introduced at the request made by the CAC countries in 2011. All accessions were evaluated for biological, morphological and marketability traits under the different soil and climatic conditions. As a result, a number of promising lines (early maturing, higher yielding, resistant to diseases, good quality, etc.) were revealed in each country during 2011, including: tomato lines CLN3125A in Armenia, Georgia and Tajikistan; CLN-3078C in Georgia and Tajikistan; CLN-3125Q in Tajikistan and Uzbekistan; sweet pepper lines PP0737-7016 in Armenia, Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan; PP0437-7031 in Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan; and eggplant line VI041674 in Azerbaijan and Turkmenistan. Seeds of promising lines were multiplied in 2011 in order to conduct competitive trials in 2012.

In 2012, 78 accessions of five species were submitted for the regional variety trials and 106 accessions of ten species were introduced by the countries' requests. These varieties were passed for evaluation to the Research Institutes with results to be obtained at the end of the vegetation period.

Competitive variety trials of 38 promising lines of nine vegetable crops selected on the basis of previous research were continued in eight CAC countries in 2011-2012. Twenty-three varieties of eight species including tomato, sweet and hot pepper, eggplant, cucumber, vegetable soybean, mungbean, bean and cabbage were submitted for the State Variety Trials in Armenia, Azerbaijan, Kazakhstan, Tajikistan and Uzbekistan.

Released vegetable varieties

Four new varieties, including mungbean "Durdona", vegetable soybean "Sulton", yard long bean "Oltin soch" and leafy cabbage "Shark guzali" were released in Uzbekistan during the reporting period between 2011-2012. Mungbean variety "Turon" was released in 2012. In 2011, new tomato varieties "Narek" and "Janna", hot pepper variety "Kon" and sweet pepper variety "Emili" were released in Armenia. Three new varieties of tomato "Saadreo", vegetable soybean "Mtsvane Parkiani', "Sabostne 1" were registered in Georgia, also in 2011.

The seed multiplication of promising and released varieties was conducted to provide farmers with good quality seeds for out-scaling. The released varieties have a high potential to increase the production of vegetables, diversify the daily ration, increase the export potential of fresh and processed products and farmers' income (**Annex 3**).

Wider linkages

In 2011, AVRDC-CAC conducted several collaborative events on the component of ICARDA–MSU Project entitled "Development and Delivery of Ecologically-Based IPM Packages for Field and Vegetable Crop Systems in Central Asia", in particular the IPM Tomato Package. Within this component, several studies on tomato grafting methods, their introduction and evaluation, were conducted in collaboration with the Tashkent State Agrarian University. Using this biological method allows farmers to increase productivity and quality of tomato in greenhouses and open field conditions. Tomato grafting technology was presented at UZEXPOCENTER during the "Innovation projects and ideas" Fair in April 2011.

The joint project of AVRDC and the Uzbek Research Institute of Plant Industry on "Complex evaluation of vegetable germplasm with unique traits, promising lines selection and submission to the State Variety Trial" was completed in 2011. Based on the study of 102 lines in ten vegetable crop species, a number of promising lines was revealed. A competitive trial was conducted for promising lines of eggplant and summer squash and two new varieties, which were submitted to SVTC, including sweet pepper varieties "Sabo" and "Shodlik".

Research project "Study of the world gene fund of tomato and revealing of promising lines for processing" (2009-2011) was implemented by the Kyrgyz Agrarian University in Kyrgyzstan, in collaboration with AVRDC.

In 2011, AVRDC-CAC office also implemented the state grant "Creation of innovative training and experimentation farm at the Farmers' Association of Uzbekistan", which was a joint collaboration with the Farmers' Association of Uzbekistan.

Capacity Building

Several Ph.D. theses were successfully completed resulting from the collaborative research of AVRDC in Uzbekistan in 2011-2012.

AVRDC-CAC provided financial support for two young specialists working on vegetable research in Uzbekistan and one specialist in Kyrgyzstan to participate in English language courses in 2012.

The Workshop on "Integration of Education, Science and Production" was conducted in Tashkent region in May 2012, which brought together more then 80 participants. It was organized by ICARDA, AVRDC, the Farmers' Association of Uzbekistan in collaboration with other ecological organizations, local governments of Tashkent region and Bostanlyk district, Women Community, National University, Tashkent State Agrarian University, Uzbek Research Institute of Plant Industry and Bostanlyk Agricultural College.

Training on introduction of new varieties of vegetable crops was conducted in the piedmont region of Bostanlyk, Uzbekistan in June 2011, as a joint initiative of the AVRDC-CAC, Tashkent State Agrarian University, Bostanlyk Agricultural College and Khokimiyats (local governments) of the Tashkent region and Bostanlyk district. The main goal was to present new methods of cultivation and seed multiplication technologies. Twenty people, including 16 women participated in the training course. All trainees received seed kits of 7 early maturing varieties of various vegetable crops for cultivation and further multiplication.

The collaboration in the piedmont area will be continued and "The Education, Research and Production Integration Center" established by ICARDA/AVRDC, the National University and the Women Community was officially opened in the Bostanlyk Agricultural College. The aim of the Center is to develop common efforts on vegetable production, to diversify daily ration, increase income and livelihoods of a population living in the piedmont area.

AVRDC–CAC jointly with the Uzbek Research Institute of Vegetable, Melon Crops and Potato conducted the Training Course on “Evaluation of superior vegetable varieties” in Tashkent, Uzbekistan in July 2011, which was attended by 17 scientists from Uzbekistan.

Individual Training course on “Vegetable species gene conservation and use for breeding and seed production” was conducted by AVRDC-CAC for two specialists from Kazakh Research Institute of Potato and Vegetable Growing in Tashkent, Uzbekistan in September 2011.

AVRDC–CAC jointly with the Uzbek Research Institute of Vegetable, Melon Crops and Potato with the support of the Program Facilitation Unit (PFU) organized the Training Course on “Actual breeding methods and effective technologies in vegetable production” in Tashkent, Uzbekistan in March 2012 for 12 specialists working in Research Institutes and Universities of Kazakhstan and Uzbekistan.

The “Review and planning meeting on vegetable variety selection and adoption in Central Asia and the Caucasus” was conducted in October 2011, in Tashkent, Uzbekistan, where the AVRDC Regional Variety Trials, maintained by the partner institutes in each country were thoroughly reviewed and future collaboration on variety trials in the Region was discussed.

The Fourth Steering Committee Meeting of “Central Asia and the Caucasus vegetable system Research and Development Network (CACVEG)” was held in Tashkent, Uzbekistan in October 2011 to discuss the status, constrains and ways for further development of vegetable research in CAC Region, strengthening capacity in developing appropriate policy options that are critical for crop diversification, nutritional security, cool-season production, distribution channels, post-harvest technologies and market economy.

Information dissemination

In 2011-2012, more than 300 people (representatives of government, policy makers, farmers and farmers’ associations, scientists, private sector, mass media, etc.) participated in the Farmers’ Field Days conducted by AVRDC in all eight countries.

Center: AVRDC
Donors: AVRDC; State grants of Uzbekistan and Kyrgyzstan
Project period: ongoing
Countries: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, 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 integrated pest management (IPM) packages for key food security crops - wheat, tomato and potato. The IPM packages for these three crops are aimed to address key pest management problems in Kyrgyzstan, Tajikistan and Uzbekistan. The project places a strong emphasis on scholarships, publications and dissemination of research results through both electronic and print media.

Wheat IPM Package in Tajikistan

The objective of the research was to screen and select best lines that show resistance to cereal leaf beetle (CLB). Wheat seeds were received from ICARDA's Biodiversity and Integrated Gene Management Program. In November 2011, 36 wheat entries were planted with susceptible check of the local wheat variety. Out of the 36 experimental entries, five showed high and two moderate levels of CLB resistance. In 2011, the project developed a research and demonstration site for wheat in the Spitamen district of Sogd region, Northern Tajikistan. The research was focused on the management of Sunn pest (*Eurygaster integriceps)* and wheat rusts (yellow rust, *Puccinia striiformis*, and brown rust, *Puccinia recondite*). The following IPM package components were compared to the local farmers' practices in the same area. Seven local farmer households participated in the trial.

Potato IPM Package in Kyrgyzstan

The IPM activity in Kyrgyzstan was focused on the evaluation of the suitability of specific potato lines and cultivars. After completing the necessary international regulatory requirements, 31 potato-breeding lines/varieties were sent to Kyrgyzstan by Michigan State University. These lines/varieties were selected to represent a broad range of potato production characteristics, including resistance to key pests. Ten tubers of each line/cultivar were planted using the square-cluster method of 40–60 cm in three tiers; each plot was 4 m long with 0.60 m between the rows, including 1 m of protective strips.

Above-ground potato stem emergence ranged from 30 to 100%. Emergence was low (30%) for both "Saginaw Gold" and "MSJ 316-A". Tuber yields ranged from 2.1 to 18.8 metric tons per hectare, with a mean of 9.67 t/ha. "MSI 316-A", "MI purple", "Dakota Diamond", "MSE-149-5Y", "Beacon Chipper", and "MSM 182-1" were the highest yielding variety, representing round-white, round yellow, purple skin, chip-processor, and table stock lines. The lowest tuber yields were associated with "Saginaw Gold", "MSS 582-1SPL", and "MSJ 316-A". The two varieties ("Bolder" and "Missaukee") with genes of resistance to golden nematode had the average yield of 6.0 mt/ha in this trial in the absence of *G. rostochiensis*. The research demonstrated that some of the tested potato lines/varieties could grow and yield in a satisfactory manner under Central Asian conditions.

Role of soil amendments on the growth and development of potato plants

The potato research trial in 2011was conducted near Samarkand by using three inputs: (i) "Fosstim-3" (*B. subtilis* BS-26 applied to the potato seeds the day of planting); (ii) "Serhosil" (a bacterial and algae preparation sprayed on the potato leaves prior to flowering); and (iii) "Biokom" (compost developed at the Laboratory of Soil Microbiology). The bio-system was compared to normal fertilizer recommendations; it included a 0.50

rate of the normal potato NPK fertilization recommendation. The potato variety “Sante” was used in the trial. The soil amendments increased the number of ammonifying, bacterial colony forming units (CFUs), one order of magnitude (107 to 108), nitrogen fixing oligonitrophilic bacteria, 1.5 orders of magnitude, and phosphorus-mobilizing bacteria, 3 orders of magnitude compared with the conventional production system. The population density of actinomycetes was increased, while that of pathogenic soil fungi was reduced by three orders of magnitude. The bio-system resulted in an increase from 19.3 to 27.3 mg/kg of nitrate nitrogen in the soil compared with the conventional system. Mobilized phosphorus was increased from 26.6 to 30.9 mg/kg soil compared with the system without “Fosstim-3”, “Serhosil”, and “Biokom”. Humus degradation in the rhizosphere of cv. “Sante” roots was reduced 0.02–0.03% in the presence of the bio-system. Tuber yield was increased by 3.6 mt/ha with “Fosstim-3”, “Serhosil”, and “Biokom”. Tuber dry matter, starch, and ascorbic acid content were increased by using the bio-system, whereas, tuber nitrate concentration was reduced by 10.58 mg/kg or 67% compared to the conventional soil fertility system.

Tomato IPM Package in Uzbekistan

The purpose of the study in tomato greenhouse located in Zangiota distict, Tashkent region was introduction of biological control of leaf mould *Cladosporium fulvum* by using such effective microorganisms as Baikal EM 1 as a biological agent against diseases as well as an alternative source of fertilizers, growth stimulators and immune inductors. During the experiments, best results were obtained in option where tomato plant seedlings and soil were treated with Baikal EM 1. Besides obtained high yield there were no any diseases noticed in this option during the plant growth comparing to others where in some tomato leaves leaf mould disease occurred.
In treating with preparation Baikal EM 1 soil beneficial fermentations were performed including the breakdown of complex organic molecules into simple organic molecules and inorganic nutrients such as amino acids, vitamins and antioxidants (all of which contribute to enhanced plant growth). These soils were generally characterized by the pleasant fermentative odor and had favorable for plant growth physical soil properties. Moreover, there were few pathogenic fungi or bacteria and the production of methane, ammonia and carbon dioxide were minimized. Treated soils in tomato greenhouse contained significant populations of microorganisms that fix atmospheric nitrogen and carbon dioxide into amino acids, carbohydrates, and proteins.

It can be concluded that due to application of Baikal EM 1 in tomato greenhouse in Tashkent region the environmentally friendly control of leaf mould was performed, as well as soil amendment with nutrients that stimulate growth and induce immunity in plants.

Effect of antagonist bacteria *Bacillus subtilis* on tomato growth in laboratory condition

At the Institute of Microbiology, antagonistic bacteria present in the rhizosphere of tomato plants were screened against *fusarium* wilt. *Fusarium* wilt caused by *Fusarium oxysporum* f. sp. *lycopersici*, attacks the tomato root system, resulting in necrosis of stem tissues, yellowing of old leaves, wilting, and plant death. A soilborne disease is difficult to control. Two isolates from the soil, *B. subtilis* № 4 and *B. subtilis* № 9, were compared with *B. subtilis* № 26, taken from the collection of the Institute of Microbiology. Tomato seedlings infected with *F. oxysporum* were inoculated with three *B. subtilis* isolates. The results obtained during experiment showed that *B. subtilis* strains prevent infection diseases of tomato plant roots as protectors, promote plant growth with Rhizobacteria and act as bio-fertilizers.

Test of yellow sticky traps

Two types (commercial and made in the laboratory) of yellow sticky traps were tested against whiteflies (*Trialeroydes vaporariorum*) in tomato greenhouses at the University

Experimental Station. Yellow sticky traps are a non-toxic, integral part of any IPM program. They can be used indoors, in greenhouses, and outdoors against whiteflies, fruit flies, midges, and more.
The results obtained showed that commercial traps were more effective than those, which were made in the laboratory. In one hour, there were about 3,000 whiteflies captured on one commercial trap, but on the laboratory trap, it was only 500 whiteflies. Commercial traps slightly suppressed white fly numbers in the early stages of infestation, and they are not effective when the population of the pest increasing.

Evaluation of tomato rootstock for grafting

Sixteen tomato lines received from the World Vegetable Centre for use as rootstocks for the tomato variety "Gulkand" were evaluated. Grafting was done when plants reached a stem diameter of 1.6–1.8 mm in the 2–3 leaf phases. Grafted plants were compared with non-grafted plants for (i) vegetative period, (ii) morphological features, (iii) resistance to diseases and pests, (iv) yield; and (v) biochemical composition of fruits.

Capacity building

A training course on "Biomethods and innovative technologies usage in vegetable production" was held in "BioCenter" under the Tashkent State Agrarian University (TSAU) in April 2012. This training course was organized with the support of ICARDA, Michigan State University, SRSP-USAID project "Development of integrated protection of tomato in Central Asia conditions", with the participation of the AVRDC – the World Vegetable Center and TSAU. Twenty young specialists from TSAU, the Uzbek Research Institute of Vegetable, Melon Crops and Potato, as well as farmers from Tashkent region attended the training course. The purpose of this training course was to improve the qualifications and training of young specialists and farmers in biological plant protection methods, innovative technologies for their further work in vegetable production, including the grafting vegetable crops to improve their yield and quality.

Centers: Michigan State University, AVRDC
Donors: IPM Project, USAID
Project period: 2009-2012
Countries: Kyrgyzstan, Tajikistan, Uzbekistan

Transbounday Water Management

Aims and scope of work

The project aims at assisting the 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 the 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, Ashgabat, Kyzil Orda, Khojand, Bishkek and Osh. It is expected that the trained local specialists will be creating and updating following main thematic of 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. Copies of GPS manuals, draft maps were distributed among the regional partners.

Centers: IWMI
Donors: GIZ, Germany, Transboundary Water Management Project (TWMP)
Project period: 2009-2011
Countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

Integrated Water Resources Management in the Fergana Valley – phases 5 and 6

Aims and scope of work

The main goal of the "Integrated Water Resources Management in the Fergana Valley" project is to contribute to the security of livelihoods, increase environmental sustainability, and social harmony, through the improving of effectiveness of water resources management in the Fergana Valley.

For the Phase 5 of the project the following specific objectives were identified:

1. Improve the financial and economic viability of the IWRM institutions up to canal level, with a special focus on the WUA's within the project area, and exit from part of the past activities that are not anymore priorities.
2. Ensure the long-term sustainability of the project IWRM approach by defining with the respective governments, visions on ways and means to integrate the new IWRM structures, from the perspective of a possible replicating of the SDC approach at national level.

For the Phase 6:

1. Preservation of acquired technical and operational competencies, including its documentation at a level of an editorially agreed standard.
2. The average capacity of WUAs in the project zone should be enhanced in terms of financial viability and efficient provision of water services. For that a limited number of well-performing WUAs in the project areas will be provided with computers, simple software and pertinent IT training.
3. Continuation of ongoing transboundary consultations process for two pilot STTs (IWMI).
4. To complete all project activities for logical termination of the existing contractual arrangements with SDC related to fifth phase of the "IWRM-Fergana" Project.

Facilitation of the formalization of cooperation between riparian sides of two pilot STTs

Towards this objective before starting the 2-side consultation process, the positions and views of the key stakeholders of each riparian side on 2 STTs regarding the formalization of basin-wide transboundary cooperation were additionally verified through a number of meetings in April and May 2011 for the *Khojabakirgansai* and in December 2011 for *Shakhimardansai*. It was when the process of building system-wide IWRM institutions had been finally completed on both sides of each respective STT. The focus of these meetings was to assess: (i) options for water-related data sharing between countries, ii) perspectives of managing sub-basins independently versus packaging sub-basins into one management structure and iii) what are the needs, motivations, hindering factors and organizational options. Results of these meetings showed that there is mutual interest in basin-wide institutionalization of bilateral water relations both from downstream and from upstream representatives.

Following this preliminary assessment, 2 rounds of 2-side consultations were planned to be held for each STT at local and national levels. While for the *Khojabakirgansai* this has been fully achieved, for the *Shakhimardansai* only local level consultations have been be held so far with the national level consultations scheduled for May/June, 2012.

Overall, 3 out of 4 two-side consultations were conducted. The first round of joint 2-side consultations was held in August 2011 for the *Khojabakirgansai* and in February 2012 for

Shakhimardansai. The Board members of both co-riparian Water Committees comprising leaders of WMOs, USWUs, WUAs, local governments etc attended these meetings. Both sides confirmed about the need for a joint basin-wide institution to be functional on a regular basis and ensuring data exchange, trust building and strengthening further the development of this institution. At the same time, when asked about the scale of an ideal IRBO the participants favoured the one, which would set up for each individual STT basin in separate. The proceedings of conducted consultations were forwarded to all participants for their feedback and approval.

Following this, the next round of 2-side consultations for each river at the national level involving NCSGs of both countries was prepared, coordinated and agreed. The one for *Khojabakirgansai* was held in February 2012 in Bishkek. The Bishkek discussions helped to better clarify the following important points regarding the immediate future and the institutionalization of mechanism of joint transboundary water cooperation for the *Khojabakirgansai*:

- A separate agreement on the establishment of joint structure at the local level between the two sides of the river is not required because it is within the competence of the governments and parliaments of two countries
- Such joint river structure at the local level, as a rule, could be formalized through an intergovernmental agreement and/or relevant decisions of governments, with all the organizational details, tools and mechanisms attached in the form of individual attachments, protocols, or regulations
- Because there is no intergovernmental agreement between the two countries to date, as well as due to the fact that the relevant work on the conclusion of the agreement is being implemented under GIZ, it will take some time to make it happen

As for the 2nd round of 2-side consultations at national level for the *Shakhimardansai* the venue and the dates were discussed with the nation project coordinators of two countries and preliminarily agreed and held in Tashkent (June 05, 2012). Outcomes of group discussions during Tashkent meeting between Kyrgyz and Uzbek participants yielded almost in principle identical results, which stated that the special working groups should be established including representatives of other relevant ministries such as border services, foreign affairs and others. The ministry of agriculture and water resources should take the lead in this initiative, which has to study the issues in detail and draft the joint bi-lateral framework agreement based on the main principles of cooperation and mutual benefit sharing with appropriate proposal to the governments of both sides. At the end participants agreed on decision points, which recognized the existing transboundary water cooperation between Kyrgyzstan and Uzbekistan, which at present is ad-hoc, informal and complicated by border crossing and also participants noticed that local cooperation must continue to run until the conclusion of an framework agreement. For that, both sides proposed to initiate a special working group to draft and facilitate the inter-governmental agreement. The facilitation role was recommended to MAWR from both sides.

In the reporting period, project was able to streamline the basin wide arrangements for water cooperation through the number of workshops. First workshops was organized to facilitate joint basin-wide arrangements into action plans on key aspects of common & transboundary concern including joint discussion of water allocation/sharing where the frequency of meetings (or calls in case of *Shakhimardansai* due to tight border situation) increases during water stress periods (early spring and fall) and decreases with water abundance; cooperation before/during/after the extreme events such as floods and mudflows (to facilitate early warning system the stakeholders to be provided with radio and double-sim mobile phones); exchange of data/information on key water intake points including data on registered floods; and mutual help with maintenance of the transboundary infrastructure. Stakeholders accepted facilitation process as positive institutional building course.

Khojabakirgansai STT:
- 22/05/2012 – workshop with sub-basin water committees to develop action plan – in Tajik side;
- 12/06/2012 – riparian sides met to discuss the implementation of basin wide arrangements in Kyrgyz side;
- 17/07/2012 – a follow up/ operationalization meeting in Tajik side;
- *Shakhimardansai* STT:
- 06/05/2012 – workshop to develop joint action plan on water cooperation – in Tashkent;
- 10/07/2012 - riparian sides met to discuss the implementation of basin wide arrangements – in Uzbek side of STT;

As it was mentioned during the first meetings, stakeholders developed action plans, where the rest were dedicated on implementation of agreed procedures. On these, follow up meetings riparian sides started present the water management situation and problems in terms of technical as well as governance aspects where other side ask questions or propose decisions to get full basin wide picture/feeling and to talk on the same language. Riparians agreed to rotate the place of the meetings, where each time the accepting side introduces the guest new object/ WUA or management structure as well as cultural sites. The outcomes from these implementation meetings are assistance in terms of the machinery, consolidation of water reading tables, a side from exchange of daily flow information in key water diversion points – sides agreed to exchange the copies of bi-annual and annual water management reports and joint test-measurements of water discharges. 6 radio phones for *Khojabakirgansai* and 4 double-sim mobile phones for *Shakhimardansai* STTs are about to be provided to facilitate the communication, information exchange and early warning before/during the extreme weather events to prevent water control structures, especially located in downstream from being washed away during the floods.

Capacity building

The main thrust in phase V was on building awareness and skills among WUAs to start collecting, analyzing and maintaining their operational, management and governance data with further aggregation of it at higher system level. To facilitate this, 2 STT consultants were hired in 2011 for each riparian side. They were provided with detailed and clear instructions, checklists and materials regarding what historic and current management information and data each respective institution should have in place for regular monitoring, accountability, self-evaluation and communication purposes. To see how it works, in December 2011, IWMI undertook a field assessment. The assessment showed that most institutions are aware about the importance of keeping regular track of their operational and governance data for monitoring, self-improvement and accountability purposes they still fail to do this independently and in a consistent manner. So further project support will be required to strengthen and sustain more or less regular and consistent practice on the ground. Overall, skills and capacities of 19 WUAs were enhanced in 2011 in self-monitoring and self-evaluation. In 2012 up to 12 sub-basin/basin level IWRM institutions at 2 STTs will be provided with IT support and training with focus on monitoring and evaluation of irrigation performances at both sub-basin and basin-wide levels.

Centers: IWMI
Donors: Swiss Agency for Development and Cooperation
Project period: Phase 5: 03/2011 – 02/2012; Phase 6: 03/2012 – 12/2012
Countries: Kyrgyzstan, Tajikistan, Uzbekistan

Groundwater in Central Asia

Aims and scope of work

The objectives of the Phase IV of the IWMI project are the demonstration of groundwater irrigation practices suitable for small farms of the Fergana Valley, and testing of technologies for increasing water and soil productivity under groundwater irrigation.

Methods of groundwater management

In 2011, three demonstration sites of groundwater irrigation were established in the Fergana Valley with the involvement of farmers. The first site was selected at the orchard farm located in the upstream of the Isfara River Basin. The tested technology merges with the groundwater artificial recharge through the infiltration basin and pumping water stored underground for irrigation purposes. Pumped groundwater was used in conjunction with canal water for irrigation of the trees and the intercrops.

The second site was established at the vineyard farm located in the upstream of the Shahimardan River Basin. Farmers use deep wells – costly for installation and expensive for maintenance – for irrigation of orchards and vineyards. They face shortage of resources, especially in the first 2-3 years when young trees and vineyards are not fruiting. Intercropping of young vineyards with legumes was introduced in the Mirzamumin farm to increase efficiency of groundwater irrigation. It was hypothesized, that this way the farmer will gain profits to be able to cover expenses for maintaining and operating the pump at the initial stages of vineyards' growth.

The third site was established in a cotton and wheat farm located in the Kuva District of the Fergana Province. This area belongs to the tail end of the commands of the southern Fergana Canal and farmers have access only to drainage water and groundwater for irrigation of crops. Farmers produce cotton and wheat under the state quota system. The dominating soil is sand with a low FC. Because the yields of cotton and wheat are low, the state subsidizes the operation and maintenance (O&M) costs of the wells. Under such conditions, double cropping after winter wheat harvesting was suggested to increase the income of farmers using groundwater. Bentonite was applied under the second crop at the Dilnavoz Juraev farm to improve the properties of the soils and increase the yield of the crops.

Outcomes

Results of the studies carried out in 2011 allow making the following recommendations to small farmers planning or using groundwater for irrigation:

- Apply groundwater for irrigation in conjunction with canal water, wherever it is available.
- If irrigation water, after mixing groundwater and canal water, has a high turbidity, bentonite could be added to the shallow soils to increase soil FC and cation exchange capacity.
- If clarified pumped water is applied for irrigation, a mixture of sediments (50%) and bentonite (50%) could be added to the topsoil before the irrigation season to increase soil FC and cation exchange capacity.
- Grow legume crops between young saplings of orchards and vineyards using pumped water to increase farm income and improve soil physical and chemical properties
- Grow second crops after winter wheat harvesting to increase productivity of soils under groundwater irrigation.

Capacity building

Two M.Sc. and one Ph.D. student of the Tashkent Institute of Irrigation and Melioration were involved in the project activities.

Centre: IWMI
Donors: 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 at 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.

The project objective is to strengthen the capacity (in terms of knowledge, extension material and methods) of the different actors in the agricultural innovation system through strategic alliances for conveying solid and adapted extension messages relating to water productivity improvement at plot level. It is expected 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.

Currently, WPI-PL project runs its third phase. Priority objective of the phase period include generalizing and systemizing of the produced research, training and dissemination of materials over the last phases of the project.

Innovation cycle developed and adopted by water users

Over the past period, the IWMI and SIC-ICWC identified main ways of solving the problems hindering improvement of land and water productivity at field level. The project strengthened the capacity (in terms of knowledge generation and dissemination) of the different actors in the agricultural innovation system through strategic partnerships for dissemination of sound and adapted extension messages relating to water productivity improvement at plot level to farmers. The project developed strategic alliances with national partners in the three countries that are interested in generating, translating and disseminating agro-technical and hydro-technical knowledge and experience. Project activities followed the different steps of the innovation cycle for developing and disseminating relevant technologies, by constantly improving and adapting technologies and extension materials according to the systematically collected feedback from the end-users, the farmers.

Over the past period, from 2008 to 2011, the WPI-PL project has achieved apparent successes. The WPI-PL project was able to identify the 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 operative assessment of the situation in irrigated agriculture and transfer of innovative solutions through the relationship of different institutions. 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.

Dissemination

IWMI and SIC-ICWC work with 16 partners in three countries, including the Research Institutes, Information and Training Centers and 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.

WPI-PL project has covered 713 farmers (816 ha) in Kyrgyzstan, 96 farmers (4547 ha) in Tajikistan and 155 farmers (7784 ha) in Uzbekistan. Project prepared training materials broadly disseminated in the form of guideline, brochure, article, poster, etc. The outputs of the project are being scaled up. All the extension materials of WPI-PL project are being used currently in the project area of RESP-2 project, World Bank-SDC. In addition, the WPI-PL project partners in Uzbekistan are involved in capacity building of disseminators in the RESP-2 project area.

In Kyrgyzstan, the WPI-PL technologies have the biggest outreach because of the complementing project of Helvetas: 16 partners (8 NGOs and 8 WUAs) of SEP Project (Efficient Use of Water) are using WPI project materials in their activities in the Southern regions of Kyrgyzstan. The project has reached up to now approximately 10’000 farmers. In addition, the government supported WUA Support Units use materials of WPI when training other WUAs who are not involved in activities of the project. These two ‘distribution channels’ allow a wide dissemination of WPI project ideas, knowledge and technologies outside of the project area.
The information center and disseminators in Tajikistan are NGOs who are specialized in agriculture; they are broadly using materials of WPI-PL for training of other farmers. By this, they contribute to the development of the agricultural sector of Tajikistan.

Technical and institutional interventions and impact

To improve water distribution and water use efficiency at WUA and farm level, it was decided to equip all WUAs with water flume meters and regulating structures within the base WUAs covered by WPI-PL project. In addition, drip irrigation systems were introduced in water shortage areas on farmers’ fields that grow orchard. Six WUAs were fully equipped with water flume meters and 40 hectares of orchard fields with drip irrigation system, and demonstrated to farmers the water accounting at field level and efficiency of drip irrigation systems. Moreover, 19 water saving technologies and new varieties of cotton, which were drought tolerant, were demonstrated to farmers. As the result of technical interventions, water productivity increased in project areas and conflicts on water use among farmers decreased after introduction of water flume meters. These positive results were highlighted in the reports of two independent external reviewers. Besides, farmers have tremendously benefited within and outside the project area. For example, average income in the area was USD 362.5/ha in 2008 and now the average income increased up to USD704/ha.

Centers: IWMI
Donors: Swiss Agency for Development and Cooperation
Project period: Phase I: 04/2008 – 02/2009; Phase II: 03/2009 – 02/2012; Phase III: 03/2012-12/2012
Countries: Kyrgyzstan, Tajikistan and Uzbekistan

Increasing Knowledge on Climate Change: Potential Impact and Adaptation Strategies

Aims and scope of work

In 2012, ICARDA and IFPRI in partnership with scientists from the national agricultural research systems of China, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan successfully completed the multi-disciplinary project "Adaptation to Climate Change in Central Asia and People's Republic of China" funded by the Asian Development Bank for a period of 3 years. The overall objective of the Project was to increase knowledge on climate change (CC) and its potential impact in Central Asia. The project was implemented through three major research components, including GIS mapping, crop modeling and socio-economic assessment.

Biophysical simulation of the impact of climate change

Crop growth, water and N uptake, total aboveground biomass and yield of 14 wheat varieties grown on 18 sites in key agro-ecological zones of Kazakhstan, Kyrgyzstan, Uzbekistan and Tajikistan in response to CC were assessed. Three future periods affected by the two projections on CC, the IPCC emission scenarios A1B and A2, were considered, and the impact on wheat simulated with the CropSyst model distinguishing three levels of agronomic management. Averaged across the two emission scenarios and three futures, yields increased in response to the projected CC at 14 of the 18 sites. The overall increase, averaged across all sites and futures and management scenarios, was 12 %. This is higher than the predicted rate. An overall shorter life cycle did not negatively affect biomass accrual and yield. Often a short(er)-season variety is lower yielding than a long-season variety, because the crop has less time for photosynthesis and biomass build-up. In Central Asia however, simulations revealed that a potentially negative effect of a shorter life cycles in a CC-affected future was more than counter balanced by more favorable growth conditions in spring. The moderate increase in precipitation, a projected consequence of CC for almost all sites, had only a minor, insignificant, positive impact on crop yields under rainfed conditions, because of the increasing evaporative demand of the crop under future higher temperatures. IFPRI scientists studied impact of CC on productivity of cotton and potato using DSSAT Crop Simulation Model. Various CC scenarios were considered on the base of detailed site specific data provided by ICARDA and compiled from different experimental stations in Central Asia for model calibration. The key findings from all the simulated sites suggest that cotton will gain from future carbon dioxide fertilization effects. This will mitigate future CC negative effects on cotton yields. Although, CC effects on cotton in Central Asia are not alarming in the immediate future (2011-2040) they can become severely alarming in the far future (2071-2100). Tajikistan will be most negatively affected in the near future while the other countries of the region appear to be somewhat better off in this same period. However, in the long term CC is a key concern for all countries. The simulations of CC impact on potato show that production in Central Asia will gain substantially from future carbon dioxide fertilization effects, which will mitigate future negative effects on potato yields. Moreover, simulation results demonstrate that CC does not appear to be a big threat on potato production in Central Asia both in the near future and far future except in Kazakhstan, where the results show mild negative effects.

Farming systems, productivity and efficiencies in Central Asia

Ten different farming systems were examined in Central Asia using the data collected from household surveys in the scope of the study. The detailed characteristics of agricultural production in these farming systems were demonstrated in case of representative regions for these ten farming systems. Farm characteristics such as main actives, farm size, machinery availability and input use vary from region to region, as well as yields and production efficiencies. The important factors in achieving high productivity in agricultural production as a strategy for enhancing resilience of farms to climate shocks were investigated. The analyses confirm the importance of establishing government policies for creating better access to fertilizers as one of the key production factors in agriculture. Low fertilizer application rates are found in Kazakhstan and Kyrgyzstan, which explains the low yields in these countries when compared to Uzbekistan and Tajikistan. The resource use efficiency in these countries was analyzed as one of the important factors of sustainable agriculture, especially under climate change conditions.

The analysis showed that machinery availability, farm size and access to extension services are the main factors influencing technical efficiencies of wheat and cotton production in Central Asia countries. The results show that large-scale farms could have higher technical efficiency in case of wheat production. Therefore, large farms with high number of machinery in Northern Kazakhstan have shown highest technical efficiency in the analysis. Agricultural production in Tajikistan and Kyrgyzstan are based on small-scale farms, with limited machinery availability and have lower efficiency when compared with Uzbekistan and Kazakhstan. Thus, the analysis demonstrates the vulnerability of small-scale farmers to climate change due to high resource losses during the production process. Therefore, improving the resource use efficiency of small scale farmers enables their adaptation to climate change. This calls for action to improve delivery of farm advisory services including extension and weather information, and access to credit to acquire needed inputs and machinery.

Access to extension services was identified as one of the important aspects in terms of production efficiency especially in cotton production. High resource use efficiency in cotton production in Uzbekistan was mainly explained by high access to extension services. Policies for improving the access of farmers to agricultural extension services are needed in order to improve the production efficiency in other Central Asia countries. This is not only important for improving the production efficiency but also for improving yields. Moreover, low yield in some regions (Kyrgyzstan, Kazakhstan) is also caused due to input access constraints. Therefore, special policy reforms improving the input availability in these countries are needed. Improving the yields and agricultural efficiencies in Central Asia is not only important for increasing farm income and food security but also for enhancing the climate coping capacity of farms. Farmers, who are operating at sub-optimal levels, in terms of input use and access to farm inputs and technologies, will be most affected by climate shocks and are most vulnerable. This vulnerability can be reduced by taking action now to improve extension and input delivery services that are necessary for improving farm productivity and improving efficiency.

Dissemination

The final workshop of the Project was held in February 2012 in Tashkent, Uzbekistan. About 40 project partners and experts from national and international research institutions, as well as from development and donor agencies attended the final workshop. The purpose of the workshop was (i) to summarize the project results on CC impact research, (ii) to review the recommendations in light of comments and discussions during the workshop; and (iii) to identify the policies that support farmers' resilience to CC. Based on the outcomes of the research activities, the participants made conclusions and presented recommendations, which can be found in the final project report available from ICARDA.

Centers: ICARDA, IFPRI
Donors: Asian Development Bank
Project period: 2009-2011
Countries: Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan

Strategic Dual Purpose crops and Mobilization of Underutilized Plants as Part of a Climate Change Adaptation Strategy

Aims and scope of work

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 the dual purpose crops alternate by fruit trees and forage shrubs in strip-alley-system as adaptation measures. The objective of the Project was 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.

Outcomes

Most important outcome of this finalized project is the local climate change adaptation strategy, developed by the villagers of Kadok within the socio-economic research. Villagers created a holistic approach including strategic measures against desertification and alternative livelihoods, as the region is extremely and successively prone to water scarcity. Rehabilitation of eroded foothills to prevent mudflows, to increase forage and receive benefit from this ecosystem was identified as the main priority. This includes prohibited free grazing in this area. Second priority was the enhancement of water supply by additional collective water reservoir, which was established within collective action meantime. Third priority was a development of alternative livelihoods (income options besides agriculture), which do not require much water.

Villagers' strategy is valuable for much larger areas in the CA region including semi-desert parts of Uzbekistan, Southern Kazakhstan and parts of Turkmenistan. The Kadok strategy has high potential for significant improvement of livelihoods facing extremely severe climate change threats. Villagers and ICARDA spent the last half year of the project on clarifying options to realize this strategy to become a model for climate change adaptation in foothill regions. This resulted in a proposal including entire Mahalla Kadok as model region. Project is meantime approved by donor and shall start in September 2012

Centers: ICARDA, ICBA
Donors: Federal Ministry for the Environment, Nature Protection and Nuclear Safety, Germany
Project period: 2010-2011
Countries: Uzbekistan

Improving Local Institutions (through Pastoral User Groups) for Better Coordination of Common Rangeland Use and Management: An Environmental Governance Approach

Aims and scope of work

This pilot project is realized in semi-arid Khokimiat of Qiziltepa (Navoi district, Uzbekistan) in cooperation with Samarkand Division of Academy of Sciences of Uzbekistan and Uzbek Research Institute of Karakul Sheep Breeding and Desert Ecology, villages, entrepreneurs and shirkat farm. Due to rangeland degradation livestock production specifically of villagers shifted from small ruminants to cattle, based on irrigated forage. As the area relies on Zarafshan River, irrigation water is terminated in consequence of glacier melt-off in Zarafshan range. Shift back to production of small ruminants requires immediate and long-term rehabilitation of rangelands to restore diversity of forage shrubs and to increase amount of such rain-fed forages. The new environmental governance approach creates a "win-win" situation for pastoralists under climate stress, for biodiversity and vegetation cover on degraded rangelands.

Progress

Based on participatory development of local climate change scenarios and identification of adaptation options, villages developed a common principle to rehabilitate rangelands through collective governance systems with enforcement of rules and management tools. They established pastoral user groups (PUGs) and different kinds of fenced seed isles to ensure seeding of forage shrubs and facilitate seasonal grazing. The project started to develop different models for rangeland rehabilitation by local land users within this environmental governance approach.

Center: ICARDA
Donor: Federal Ministry for the Environment, Nature Protection and Nuclear Safety, Germany, within the International Climate Change Initiative
Project period: 2011-2012
Countries: Uzbekistan

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

Aims and scope of work

IFAD/ ICARDA project entitled “Improving Livelihoods of Smallholders and Rural Women through Value-Added Processing and Export of Cashmere, Wool and Mohair” is being implemented on the pilot sites in Kyrgyzstan, Tajikistan, and Iran. The overall goal of the project is to enhance living standards of small-scale livestock producers and rural women through improved production, processing and export of value-added fiber. Hence, the project aims at setting up value chains focused on fiber production, processing and marketing at the project sites. The project continued to build capacities of sheep and goat producers and women’s groups in fiber production, processing and marketing.

Progress in breeding activities

In North Tajikistan, the project team succeeded in importing frozen semen from the United States. This was a very demanding process with multiple logistical hurdles, which were successfully resolved. With a professional assistance from the project partner from Iran, the team in Tajikistan inseminated 237 goats owned by 5 farmers.

In Badakhshan (Tajikistan), the project team organized community breeding with imported Altai bucks from Russia. Organizing community-breeding nuclei was also a major accomplishment that will improve the productivity of local flocks. The team selected 482 female goats from 6 villages for the nucleus breeding in 2011. The new crosses of local and Altai goats are expected to produce more meat and fiber than the existing goats and thus contribute to increases in income and improvements in livelihoods of the village households. The crosses will produce more cashmere and cashgora fiber for local processing, allowing the production of yarn and knitted products to expand. The community breeding system developed in the pilot region can be applied in other livestock sectors and replicated in other regions.

In Kyrgyzstan, the project team is working with household sheep farmers to improve homogeneity and productivity of their flocks. The farmers were provided with high-quality rams, and trained to apply selection strategies for their breeding animals that will improve quality of semi-fine wool and allow them to produce more and better lambs. The semi-fine wool produced in the flocks can be used for traditional felt products. At the same time, the team continued working with large Merino sheep farmers to establish a source of steady supply of high quality Merino wool for the women groups that is essential for luxury products.

Progress in fiber processing and marketing

The major accomplishment in fiber processing was organizing first large-scale fiber processing in Asht region, North Tajikistan. The project team started to work with women to dehair, scour, card and spin 400 kg of fiber that was purchased in April 2011. This was the first attempt at scaling up the project outputs and moving from producing small batches of yarn by individual spinners to producing much larger batches (around 100 kg of fine yarn for the US market, over 200 kg of coarser yarn for the Russian market) by organized spinner’s groups. The knitting group that started to produce sophisticated, luxury clothing is expected to be able to successfully compete on international markets. Secondly, the project started to work on producing woven blankets from adult mohair on a new loom imported from Canada. Products of this design and quality are being produced in Tajikistan for the first time.

In Badakhshan, the project was able to test cashgora and cashmere spinning. The preliminary results show that the cashgora fiber will be excellent for spinning yarn and making luxury knitwear for export. This is a very positive result for women at the pilot sites who produce mostly cashgora goats. The women will be able to add value to fiber harvested from their own goats by making yarn and products. They will also learn how to improve fiber quality and volume through the community-breeding program.

In the process of working with households and farmers on breeding, animal husbandry, fiber harvesting and processing, the project team developed collaborative ties with hundreds of women and men in the pilot villages and was able to build mutual trust and understanding that is essential for delivering on the project objectives. The project was also able to establish productive collaboration with other organizations such as Cesvi and Aga Khan Foundation (AKF). It plans to collaborate with AKF on several activities, including the production of spinning wheels and assistance with fiber dehairing in Afghanistan.

In terms of marketing, the project developed new contacts with buyers of fair-trade yarn and products such as ClothRoads that want to purchase yarn and other handicrafts made by the groups. The project website “adventureyarns.com” also helped in promoting interest in the project and the products among potential customers and the public.

In Kyrgyzstan, the development of new products (chairmats, slippers) helped the women groups compete on the regional and international market and increase sales and income. Institutional capacity, access to raw materials and markets, and skill sets of the women’s groups were increased, also contributing to increases in their revenues and incomes.

Capacity building

In Kyrgyzstan, institutional development of 4 pilot groups continued in 2011. The groups began to market new products and used the initial marketing experience to focus on increasing product sales and strengthening their position on the market. All pilot groups learned the basics of record keeping, accounting and reporting on the amount of products made, the volume and revenues from sales, labor costs, administrative expenses and income distribution. In the course of the project, all pilot groups developed different forms of internal organization and management that affect the production process and the results. The project team works with each group to improve mechanisms of internal governance when necessary.

In North Tajikistan, the project team conducted extension training with farmers on how to select and replenish the nucleus groups with the best bucks and does and how to identify and cull inferior goats. Activities on culling and replenishing of the nucleus flocks were organized in the spring and fall 2011. The animals were evaluated based on mohair productivity and quality, body size and condition, and age. During the training, farmers learned to consider multiple factors that affect the productivity of their flock and how to evaluate their goats based on qualitative traits of mohair. They also learned how to clarify their breeding objectives and how to optimize their flock structure depending on specific breeding objectives. Farmers also received information on preliminary preparation of doe flocks for mating. An experienced weaver from Kyrgyzstan trained women from Taboshar and Dulana villages, North Tajikistan, in total 12 artisans, in August 2011. This training was a contribution of CACSARC-kg to the project development in North Tajikistan with additional funding support from FAO.

Fourteen successful artisans who intend to produce slippers in the future were invited to participate in a practical fellowship organized by CACSARC-kg in Bishkek, Kyrgyzstan, on 21 – 23 November 2011. The designers made 6 pairs of sample slippers that were used as models during the fellowship. The objective of the fellowship was to teach the artisans how to produce felt slippers using the new templates and felt stitching technique and how to finish them by felting on a shoetree.

In 2011, the Min-Bulak and Lakhol groups were provided with merino wool and trained to use the wool to produce fine silk and felt scarves. The trainings were conducted on 22-25 September 2011. Eleven women from the Naryn district produced scarves during the three-day workshop at CACSARC-kg office using patterns and designs prepared by the trainer. Practical work under the supervision of a designer led to a considerable improvement of the artisans' scarf-felting skills. After the trainings, all workshop participants mastered different scarf-making techniques.

Center: ICARDA
Donors: International Fund for Agricultural Development
Project period: 2009-2013
Countries: Kyrgyzstan, Tajikistan

Tables/ Figures

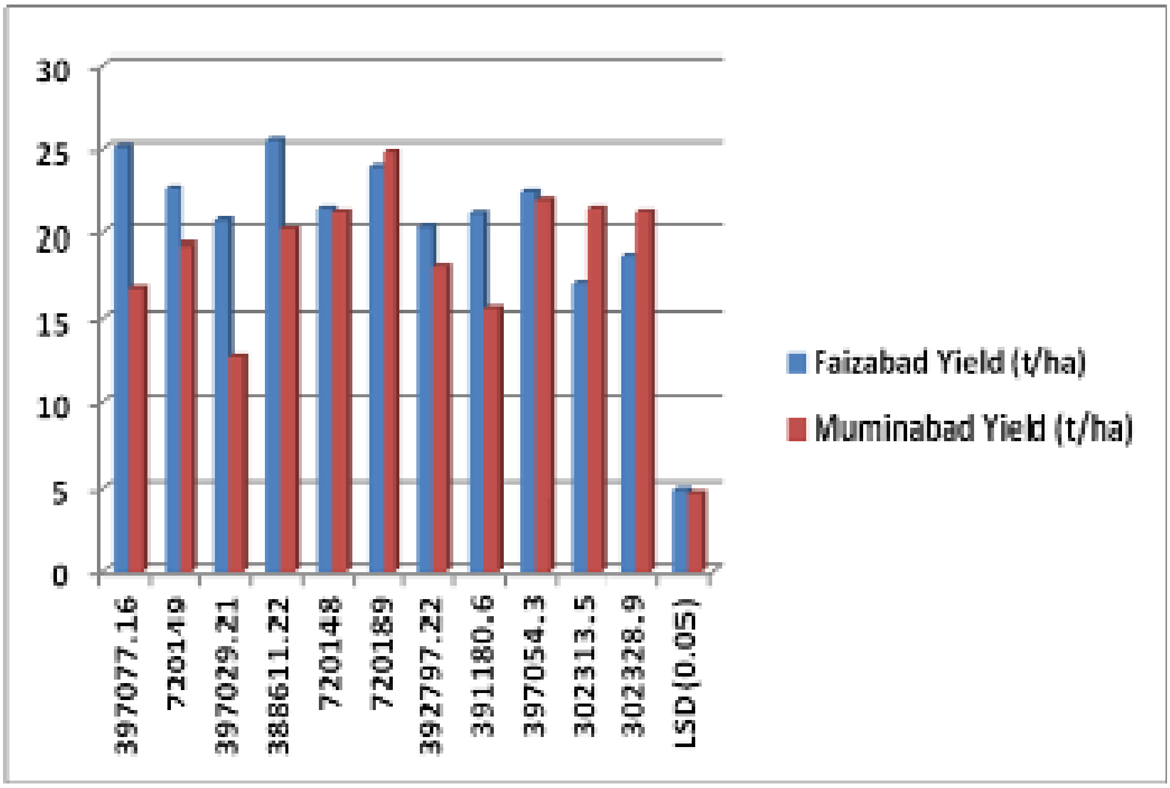
ANNEX 1

Table 1. Cereal crops varieties developed from CIMMYT germplasm, officially tested and released in Kazakhstan (2011)

Variety	Crop	Research Institutions	Year		Estimated area, ha
			Submitted	Released	
Egemen	WBW	Kazakh Research Institute of Farming	2001	2007	500
Konditerskaya	WBW	Krasnovodopad Experimental Station	2006	2011	100
Stepnaya 60	SBW	Aktobe Experimental Station	2006	2010	100
Orda	TCL	Krasnovodopad Experimental Station	2004	2009	400
Kuralay	BRL	Kazakh Research Institute of Farming	2007	2011	100
CIMKAR 20	SBW	Karabalyk Experimental Station	2011	-	-
Alikhan	WBW	Kazakh Research Institute of Farming	2011	-	-
Azharly	WBW	Kazakh Research Institute of Farming	2011	-	-
Vodopad 100	TCL	Krasnovodopad Experimental Station	2011	-	-

ANNEX 2

Total yield of potato (t/ha) in Tajikistan (June-October, 2011)



ANNEX 3

Table 1. AVRDC' promising lines revealed in CAC countries in 2011

Country	**Regional Varieatal Trial 2011**	**Selected AVRDC lines in RVT 2011**	**Revealed germplasm provided on countries requests**
Armenia	Tomato Hot pepper	CLN 3125A PP 0837-7613	Sweet pepper - PP 0437-7031, PP 0737-7016 Eggplant – TS 00325 Cucumber - TOT 2517, TOT 4434, TOT 2371
Azerbaijan	Sweet pepper Eggplant	PP 0737-7016 VI 041674	
Georgia	Tomato	CLN-3125A, CLN-3070 J CLN-3078C	Snap bean- TOT 5976 Pisum pea-TOT 2475, TOT 2939, TOT 3048
Kazakhstan	Soybean Cabbage	G 00042 AVCCS1103	Soybean- AGS437 Lettuce- TOT3598 Sweet pepper – PP 0437-7031, PP 0737-7016 Mungbean - VC 6372(45-8-1) Cucumber- 08TWFC 32 Bulk C-06
Kyrgyzstan	Sweet pepper	PP 0437-7031 PP 0042-68	
Tajikistan	Tomato Sweet pepper	CLN-3125 Q CLN-3078 C CLN-3125 A PP 0437-7031	
Turkmenistan	Sweet pepper Eggplant	PP 0437-7031 PP 0737-7016 VI 041674 VI 046096	
	Tomato Sweet pepper	CLN 3125E CLN 3125Q PP 0537-7032 PP 0737-7016	Squash -09WVC-S-3, 09WVC-S-2, 09WVC-S-4.

Table 2. Released new varieties in CAC countries in 2011

Crop	From AVRDC acc./line	Variety name	Country	Released year
Tomato	L01569	Narek	Armenia	2011
Tomato	CLN2413D	Janna	Armenia	2011
Hot pepper	C05670 or Prapadaeng or PBC613	Kon	Armenia	2011
Sweet pepper	0137-7041	Emili	Armenia	2011
Soybean	AGS 423	Sulton	Uzbekistan	2011
Mungbean	NM-94	Durdona	Uzbekistan	2011
Yard long bean	White Silk	Oltin soch	Uzbekistan	2011
Chinese leafy cabbage	Selected from a population	Sharq guzali	Uzbekistan	2011
Mungbean	VC6153B-20G	Turon	Uzbekistan	2012
Tomato	CLN 2026D	Saadreo	Georgia	2011
Soybean	AGS 292	Mtsvane Parkiani	Georgia	2011
Soybean	Jasuto-75	Sabostne 1	Georgia	2011

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