CGIAR

Программа по Устойчивому Развитию Сельского Хозяйства в Центральной Азии и Закавказье

САС ЦАЗ

Program for Sustainable Agriculture in Central Asia and the Caucasus

ANNUAL REPORT 2008-2009

CGIAR PROGRAM
FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT
IN CENTRAL ASIA AND THE CAUCASUS

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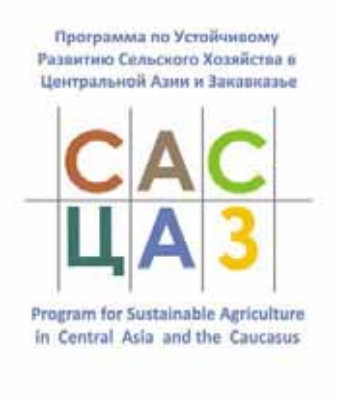

ANNUAL REPORT

2008-2009

Program Facilitation Unit

Tashkent, Uzbekistan

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Contents

Abbreviations

ACIAR	Australian Center for International Agricultural Research
APAARI	Asia-Pacific Association of Agricultural Research Institutions
ARD	Agricultural Research for Development
ARI	Advanced Research Institute
AVRDC	The World Vegetable Center
CA	Conservation Agriculture
CAC	Central Asia and the Caucasus
CACAARI	Central Asia and the Caucasus Association of Agricultural Research Institutions
CATCN-PGR	Central Asian and Trans-Caucasian Network for Plant Genetic Resources
CCER	Consortium Commissioned External Review
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
CIP	International Potato Center
GFAR	Global Forum for Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas
ICBA	International Center for Biosaline Agriculture
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
MTP	Medium Term Plan
NARS	National Agricultural Research System
PFU	Program Facilitation Unit
PGR	Plant Genetic Resources
PGRFA	Plant Genetic Resources for Food and Agriculture
PSC	Program Steering Committee
RCT	Resource Conserving Technology
SVTC	State Variety Testing Commission
SWEP	System-Wide Eco-regional Program
TAC	Technical Advisory Committee
TRRC	Temperate Rice Research Consortium
UNESE	United Nations Economic Commission for Europe
USDA	United States Department of Agriculture
UNEP-GEF	United Nations Environment Program-Global Environment Facility
WUA	Water Users Association
ZEF	Center for Development Research, University of Bonn, Germany

Introduction

The *Central Asian and the Caucasus Regional Program for Sustainable Agriculture in Central Asia and the Caucasus* (CAC Program, for short) of the *Consultative Group on International Agricultural Research* (CGIAR) works for improvements of food security, reduction of poverty and climate change adaptation and mitigation in the countries of

- Central Asia
    - Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan
- and the Caucasus
    - Armenia, Azerbaijan and Georgia.

Under this umbrella,

- eight CGIAR centers
    - Bioversity International
    - International Maize and Wheat Improvement Center (CIMMYT)
    - International Potato Center (CIP)
    - International Center for Agricultural Research in the Dry Areas (ICARDA)
    - International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
    - International Food Policy Research Institute (IFPRI)
    - International Livestock Research Institute (ILRI)
    - International Center for Water Management (IWMI),
- two other International Centers
    - AVRDC - the World Vegetable Center
    - International Center for Biosaline Agriculture (ICBA),
- and
    - Michigan State University (MSU)

collaborate in a consortium that is financed as a so-called System-Wide Ecoregional Program (SWEP). This program is convened by ICARDA.

The program was established in 1998. The *Program Facilitation Unit* (PFU), a regional office that supports the CAC Program, is located in Tashkent, Uzbekistan. In 2007, a sub-regional office for the Caucasus was opened in Tbilisi, Georgia, to facilitate collaboration in the countries of the Southern Caucasus.

Since its inception, the *National Agricultural Research Systems* (NARS) and the CAC Program have established strong research collaboration that contributed to the development of agriculture and agricultural research in the region. The joint program covers a wide range of areas such as plant genetic resources, germplasm enhancement and seed production, integrated pest management, crop diversification, land and water management, livestock and fodder production, socioeconomic and policy research, human resource development and information dissemination.

The region of Central Asia and the Caucasus is huge – it covers 418 million hectares, and is thus 30% larger than India or about half the size of the USA or China[1]. It is very diverse in ecosystems, and hence, also diverse in agro-ecological production systems. Even though the countries are now, 18 years after independence from the Soviet Union, moving into different policy directions, the fundamental issues of sustainable agricultural development remain common for all countries of the region. Since the research problems are inter-related, developing solutions needs a research program that integrates genetic and natural resource management for crops and livestock with economic assessments and the necessary 'supportive' policies. These issues nowadays require a double-pronged approach – developing a regional perspective for common strategic issues in agriculture, and country-distinctive action plans for implementation at national levels.

During the last ten years, the CAC Program has achieved considerable progress in three areas of research and development activities, namely conservation of genetic resources, germplasm enhancement and crop diversification, and efficient soil and water management, and in one more supportive area of activities, the strengthening of the NARS. The United Nations Economic Commission for Europe (UNECE) used the expertise of several of the above mentioned international centers, to develop the Environmental Performance Review 2008 on Uzbekistan.

During the reporting period, between August 2008 and August 2009, work in these areas has continued and was supported by all the partners of the Program. This report highlights, in brief, major activities undertaken by the Consortium partners in the year 2008/2009.

The Eco-regional Program for CAC is organized under broad themes, with each theme sub-divided into activities, as follows, and which correspond to the outputs of the program.

1. Productivity of Agricultural Systems
    - 1.1 Germplasm Enhancement
    - 1.2 Strengthening National Seed Supply Systems
    - 1.3 Cropping Systems Management and Agricultural Diversification
    - 1.4 Livestock Production Systems and Integrated Feed/ Livestock Management
2. Natural Resource Conservation and Management
    - 2.1 Irrigation, Drainage, and Water Basin Analysis
    - 2.2 On-Farm Soil and Water Management
    - 2.3 Rangeland Rehabilitation and Management
3. Conservation and Evaluation of Genetic Resources
    - 3.1 Plant Genetic Resources
    - 3.2 Animal Genetic Resources
4. Socioeconomic and Public Policy Research
5. Strengthening the National Programs (Capacity Building)

Within the framework of these themes, specific projects are developed and implemented by the Programs Member Centers (CGIAR and ARIs) in partnership with NARS.

[1] The area of the CAC countries corresponds to 43% of the area of the USA and 44% of the area of China. The area of Kazakhstan accounts for 65% of the total area in CAC.

Achievements in 2008/2009

Conservation of plant genetic resources

Central Asia and the Caucasus is a region extremely rich in *plant genetic resources* (PGR). Therefore, it also has a very rich genetic diversity of crops. In all, more than 8.100 plant species are recorded in the region, of which 890 are endemic (unique to the region). The wild relatives of many crops have their evolutionary origin in this region. Hence, there are many wild relatives of today's crops. The region is the center of origin of many economically important crop species. The region is also blessed with some of the world's best collections of fruits, nuts, and melons.

After the breakdown of the Soviet Union, the links from the world-famous Vavilov Research Institute - the leading Russian institution on plant genetic resources - to its sister institutes in the Republics, which had now become independent states, were severed. Collection, conservation and documentation of plant genetic resources in the region almost came to a complete halt. Given the critical importance of conservation of plant genetic resources in the region, the CAC program partners were able to make a significant contribution to this effort since 1998. The establishment of genebanks in all countries was supported, more than twenty collection missions were organized by and with the partners, and several thousand valuable accessions were collected.

In 2007 and 2008, strategies were developed for the conservation of plant genetic resources in food and agriculture (PGRFA) for two countries in the Caucasus, Georgia and Armenia, under the lead authorship of two renowned international consultants, and in cooperation with FAO. National consultation workshops were organized to develop those strategies together with national stakeholders in these countries, and an international workshop is being organized for September 2009, in which the strategies will be discussed with partners of all CAC countries. These strategy papers (McGuire 2009, Qualset 2009) were published on-line and in print versions in 2009.

The documentation of *ex situ* and *in situ* collections of plant genetic resources is being continued. It is encouraging to note that national partners more and more make use of the national funding possibilities, e.g. in Georgia and Kazakhstan, becoming more and more independent from immediate CGIAR support. The role of the CGIAR institutes is therefore slowly changing from a 'fire-fighting" and "emergency donor role" into one of being eye-level partners that provide bridges to the outside world and international science community.

The UNEP-GEF supported project *In situ/on farm Conservation and Use of Agricultural Biodiversity (Horticultural Crops and Wild Fruit Species) in Central Asia* brings together five Central Asian countries namely Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan with Bioversity International[2] as international executing agency to address the problems of inadequate information, coordination and knowledge, thereby contributing to the elimination of the other major barriers to conserving fruit genetic resources (unsustainable use of wild fruit species and loss of traditional diversity-based farming systems). Its immediate objective is conservation of the high diversity of

[2] As of December 1, 2006 the International Plant Genetic Resources Institute (IPGRI) has been operating under the name Bioversity International

horticultural crops and wild fruit species found in the Central Asian countries, the valuable genetic stocks important to plant breeders, researchers, and local populations who depend on them for their livelihoods.

Five Regional and eight National Training Centers are established to improve skills and knowledge of farmers and local communities in sustainable management of local fruit crops diversity. 63 key farmers, who maintained nurseries, are identified for multiplication of planting material of target fruit crops and promising forms of wild fruit species, including 16 farmers in Kazakhstan, 12 farmers in Kyrgyzstan, 8 in Tajikistan, 8 in Turkmenistan, 19 farmers in Uzbekistan. Forty-seven demonstration plots on target fruit crops and wild fruit species are established in existing farmers' orchards and forest lands in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan to exchange knowledge and experience among farmers and researchers.

A number of important conservation actions on crops such as *Triticum boeoticum, Triticum araraticum, Triticum urartu, Aegilops tauschii; Vavilovia formosa, Beta lomatogona; Pyrus caucasica* in Armenia and onion (*Allium*), apple (*Malus*), walnut (*Juglans*), pistachio (*Pistacia*), almond (*Amygdalus*), and barley (*Hordeum*) in Uzbekistan have been carried out in the framework of Bioversity International's project *In-situ conservation of crop wild relatives through enhanced information management and field application*, an important and large project that is supported by UNEP-GEF (2004-2009). Conservation actions have included Red Listing, analysis of the legal and policy framework for wild relatives of crops (crop wild relatives, CWRs), benefit sharing aspects, identifying protected and unprotected areas for conservation actions and the development of management plans.

The Red Listing of all 100 taxa identified for conservation has been completed in Armenia. Three of those taxa were assessed as being critically endangered, 25 endangered, 12 vulnerable, 14 near threatened, 3 data deficient and the remaining 43 were classified as of 'least concern'. In Uzbekistan, an evaluation of plant status according to IUCN international criteria was carried out in 2009 and a Red List of species prepared. The list includes 15 vascular and grass species of CWR. Forty-eight species of woody plants and shrubs (used for medicinal, nutritional and technical purposes) are included in the Red List; 18 of them had already been evaluated according to IUCN criteria. In Armenia, the National CWR Conservation Action Plan was finalized and is now available on the web (*Armenia CWR Information System*; at: http://www.cwr.am). It is based on the inventory of CWRs, including 2518 taxa (this represents a large share, about 70%, of the flora of Armenia).

In Armenia, the management plan for wild wheat populations (*Triticum araraticum, T. boeoticum, T. urartu* and *Aegilops tauschii*) and for the Erebuni Nature Reserve has been completed.

An important project, *Reviving biocultural heritage: Strengthening the socioeconomic and cultural basis of agrobiodiversity management for development in Kyrgyzstan and Tajikistan* that was supported by the Christensen Fund and coordinated by Bioversity International was successfully completed in 2008, after having been carried out in two phases. The scientists working in this project studied the diversity of traditional varieties of fruit and nut crops directly in the field of the Pamir mountains of Tajikistan and in Kyrgyzstan. An important focus of the work was to address the question how this diversity is being shaped and maintained by farmers as the 'natural custodians' of diversity.

A number of methods was developed, tested and implemented to strengthen the social, economic and cultural basis of communities to manage agricultural biodiversity. The most significant of these revolved around the identification of 'custodian' farmers and aimed (through community organization and development) at strengthening the roles they play in their respective communities in spreading knowledge about the benefit that community members can obtain from cultivating fruit trees. So-called *Diversity Fairs* proved to be a particularly powerful tool in strengthening the pride people take in local agrobiodiversity and in stimulating the exchange of seeds and planting material (for example, more than 4500 people attended and over 20,000 samples were exchanged during one such fair in Khorog, Tajikistan).

Fruit tree diversity and related farmers' knowledge was documented in over forty villages using focus group discussions and individual interviews. This work made apparent that there is a need for structured collection of information both on agrobiodiversity and on the farmer's knowledge associated with it. To address this need, a *Descriptor list for farmers' knowledge of plants* was developed in collaboration with experts worldwide[3].

Twenty eight farmer custodians were identified and invited to form a network. A beginning was made through training workshops, information and seed exchanges, and biodiversity celebrations, to establish such a network, which connects these custodians and their communities to each other, to scientists and to germplasm institutes. A preliminary set of environmental, economic and socio-cultural determinants of fruit and nut tree diversity was identified and approaches derived which the custodians can apply to contribute to conservation. These determinants (and approaches) include harsh and heterogeneous environments (maintain a diversity of important and useful traits), active (cultural) use (maintain the demand for those traits), appropriate market mechanisms (create additional livelihood options), and social networks (connecting farmers, communities and formal as well as informal institutions). On the basis of the work and the findings of the research, an approach to crop genetic research conservation has been formulated that is human-centered, grassroots-based, and that relies for a large part on the knowledge, skills, and needs of farmers.

The project received funding from the Christensen Fund for an additional year of work (2009), during which the approach that was tested in the first two project phases will now be applied in new areas of Kyrgyzstan and in the Pamirs of Afghanistan. It will also allow partners to develop and implement innovative tools that are either economic and market-based (in collaboration with the *Aga Khan Foundation's Mountain Societies and Development Support Programme*) or cultural (together with *Slow Food International*) and which will strengthen the important community management of agrobiodiversity.

In Uzbekistan, a preliminary draft version of the *National Strategy and Plan* for CWR Conservation has been developed and delivered to experts for revision. This strategy covers almost all fields of CWR conservation. The action plan will be finalized in the second half of 2009. Project partners in Uzbekistan have also prepared inputs about conservation and sustainable use of CWR for the new

[3] Bioversity and The Christensen Fund, 2009. Descriptors for farmers' knowledge of plants. Bioversity International, Rome, Italy and The Christensen Fund, Palo Alto, California, USA. Available at: http://www.bioversityinternational.org/fileadmin/bioversity/publications/pdfs/1321.pdf?cache=1250621800

edition of the *National Strategy and Action Plan for Biodiversity Conservation* for 2008 -2017. In Uzbekistan the species management plan for wild almond has been published and delivered to the Ugam-Chatkal National Park and Chatkal Biospheric Reserve authorities for implementation.

Germplasm enhancement

Wheat, Legumes, Wild pepper

Scientists of the CAC Program have been closely working with NARS on breeding of new varieties resistant to both biotic and abiotic stresses. Under this collaborative program, new promising varieties of winter wheat, triticale, barley, chickpea, lentil, lathyrus, soybean, mung bean and groundnut have been released in the region. These varieties have recorded consistently higher yield with superior quality and disease resistance over the local checks. Some of them are now covering large areas and becoming popular with farmers. However, uptake of new varieties remains a problem, also because there are gaps in seed provision, a sector which in some countries is run by the state, while in others an incipient private seed industry is coming up but not yet fully functional. Here, more work needs to be done also on harmonization of regulations.

To promote winter wheat varieties, a new initiative was launched in different countries for the targeted promotion of the key varieties of wheat. These include the wheat varieties 'Armcim' in Armenia, 'Tale 38' in Azerbaijan, 'Tale' in Azerbaijan, 'Lomtagora-09' and 'Lomtagora-23' in Georgia 'Norman', 'Alex' 'Orien' 'Zeroat-70', 'Sadoqat', 'Somoni', 'Iqbal' Tacica' and 'Ormon' in Tajikistan, and 'Dostlik' in Uzbekistan. Similarly, seed increase for varietal promotion of chickpea and barley was undertaken in Kazakhstan. The promising varieties have been bred in the south of Kazakhstan in collaboration of CIMMYT with the national breeding system. The most promising varieties Akdan, Tungish, Egemen and Orda and one variety of them, Egemen was released in Kazakhstan.

To determine ecological flexibility under the conditions of Northern Kazakhstan, more than 500 varieties and breeding lines of winter wheat originating from 18 countries around the world were tested in the period of 2005-2008. Material delivered from Novosibirsk, Russia demonstrated good frost resistance followed by materials from Ukraine and Kazakhstan.

The winter crop season 2008-2009 was better than the average year for the productivity of cereals and legumes. In general, the CAC region received higher precipitation during late winter and early spring. The winter conditions were less harsh than the average winter, and spring months remained cooler for a longer period than normal. The wet weather conditions, however, favored pathogens such as yellow rusts and powdery mildew in a severity that was much higher than normal. There was a serious outbreak of yellow rust in Uzbekistan and leaf rust in Tajikistan in spring 2009. Since the weather condition was unusually wet during spring yellow rust problem was also experienced in several other parts of the CAC region.

The serious wheat yellow rust epidemic in Uzbekistan showed that all, except one, of the 24 released and recommended cultivars were susceptible to the disease. An evaluation of advanced winter/facultative wheat breeding lines in the international nurseries showed that 92 out of 191 (48%) of the advanced breeding lines were resistant to yellow rust in the epidemic zone. A large number (58%) of the experimental lines were also resistant to leaf rust. Forty nine (26%) lines were

resistant to both yellow and leaf rusts, whereas 17 (9%) lines were resistant to yellow and leaf rusts and powdery mildew. These lines with resistance to multiple diseases are valuable materials both for further testing as potential new varieties and/or use them as parents in crossing program.

However, despite these disease epidemics, the CAC region harvested higher production of winter cereal, the increase coming primarily due to the fact that the high precipitation favored cereals production in rainfed areas; winter crop productivity was much higher on rainfed lands in 2009 compared to an average year.

Testing advanced breeding lines and working towards the adoption of new improved crop varieties continued to be key activities of ICARDA staff in the 2008-2009 crop season. Eight varieties of cereals and legumes, originating from the international nurseries, were released by different national partners in CAC. These include winter wheat (1), barley (1), chickpea (2), lentil (2) and triticale (2). Multi-location testing of advanced lines of wheat selected in 2007-2008 international nurseries showed that several lines produced high yields (6-7 t/ha) and also were resistant to yellow leaf rust. These yield levels could increase under better management. Grain yield levels of the best breeding lines were at least 15% higher than the best local checks; all local checks were susceptible to yellow rust. Like in previous years, ICARDA's regional program coordinated distribution of cereals and food legumes nurseries to the national partners in different countries in the region. More than 2000 entries of bread wheat, durum, barley, and food legumes were distributed to different collaborators in the region.

In Armenia, within Bioversity International's project *In situ Conservation of Crop Wild Relatives Through Enhanced Information Management and Field Application,* the evaluation of biotic and abiotic stresses (salt and cold tolerance, resistance to fungal diseases) was concluded and within-population genetic variances were assessed for wild einkorn wheat (*Triticum boeoticum* Boiss.), and wild pear (*Pyrus caucasica* Fed.) using molecular biology. Plant tissue culture techniques continued during 2008 and 2009. In Uzbekistan, evaluation and breeding programmes for Barley continued in 2008-2009.

CWANA Wheat Strategy Regional Sub-Meetings in Tashkent

ICARDA organized a partial wheat strategy meeting for *Central and West Asia and North Africa* (CWANA) on 6-7 July 2009 in Tashkent with participation of wheat breeders, genetic resources and seed specialists, pathologist, agronomist and senior managers from ICARDA, NARS heads and wheat breeders from the CAC countries and CIMMYT's winter wheat breeder from IWWIP participated. The meeting was a follow up to a similar strategy meeting that took place earlier in the year in Aleppo. Syria. The meeting forwarded wheat improvement in the CAC region as NARS partners together with ICARDA and CIMMYT agreed upon several focused activities for the region. These include collaboration on the *International Winter Wheat Program* (IWWIP-CAC) activities and capacity building targeted at CAC countries. In future, the IWWIP-CAC could have components such as regional (CAC) screening nurseries for wheat rusts, foliar blights, soil salinity, and frost and cold tolerance; the NARS partners agreed to provide specified testing sites for these CAC-targeted nurseries. It is hoped that IWWIP formally adopts these recommendations in its program and allocate budget to undertake these CAC focused regional activities. The CWANA Wheat Strategy Meetings in Tashkent also identified CAC regional priority research areas, the major ones being high yield

potential, resistance to rusts and Sunn pests, tolerance to drought, heat and salinity and improved end-use quality.

Wheat rust monitoring

ICARDA, FAO and CIMMYT have stepped up their efforts on preventing the possible spread and impact of Ug99, a highly virulent strain of wheat stem rust which drastically reduces wheat yield, into Central Asia and the Caucasus. Preliminary testing has shown that although the rust is presently not detected in the region, the region is lying on the rust's traveling route, and it may only be a matter of time for the rust to gain foothold. This is a dramatic risk, as this disease might affect 95% of all currently planted cereal grain varieties in CAC. In 2009, wheat rust monitoring activities were accomplished in different regions of Uzbekistan and Azerbaijan in the 1st and 2nd week of June, respectively. The national partners from respective countries and experts from FAO, ICARDA and CIMMYT participated in the monitoring trips.

Tajikistan and Kyrgyzstan are dependent on grain importations from abroad to complement their domestic production; however, lately a combination of bad weather conditions and the impact of several years of neglect in agriculture have drastically worsened the food security in these countries. Responding to a request of the *United States Agency for International Development* (USAID) and together with its development partners in Tajikistan (Save the Children) and Kyrgyzstan (International Center for Soil Fertility and Agricultural Development; IFDC), ICARDA organized in 2008 an emergency supply operation of winter wheat seeds to Tajikistan and Kyrgyzstan. USAID funded the operation. ICARDA, working together with numerous partners, facilitated the purchase of adapted seed varieties from Krasnodar, and their transport to the development partners.

Fruits

Within Bioversity International's project *In situ Conservation of Crop Wild Relatives Through Enhanced Information Management and Field Application* some preliminary work has also been carried out on the use of wild relatives in crop improvement programmes. In Uzbekistan, evaluation and breeding programmes for Pistachio were continued in 2008-2009.

Vegetables

Between June 2008 and July 2009, major activities of the *Network for Vegetable Systems Research & Development* (CACVEG) were collaborative research with partner institutes on topics such as introduction of germplasm, including non-traditional crops, testing of improved varieties/lines, segregating and adoption of lines, workshops, capacity building, information exchange, collection and establishment of baseline data on vegetables.

In total, 87 varieties/lines of four vegetable crop species were trialed in 2008, including sweet pepper (8 lines in seven countries); cucumber (6 lines in four countries); eggplant (5 lines in two countries); and tomato (5 lines in three countries). Also new trials were initiated in four CAC countries and total 80 accessions of 9 vegetable crops were evaluated in 2008. A number of promising accessions (early maturing, higher yielding, resistant to diseases, fruit quality, etc.) were selected in each country and seeds of the promising varieties were multiplied.

The project *Complex evaluation of valuable-marketable traits of vegetable soybean accessions and selection of promising varieties for submission to the SVTC[4] of Uzbekistan*, initiated by AVRDC- The World Vegetable Center together with the Uzbek Research Institute of Plant Industry was finished in 2008. The project counted on a grant given by the Government of Uzbekistan. As a results of the project, the cultural practice of using vegetable soybean as a non-traditional crop for Central Asia was elaborated and two promising varieties "Parvoz" and "Ilgor" were submitted to the SVTC; subsequently, the variety "Universal' was released in Uzbekistan in 2008.

AVRDC' regional varietal trials were continued in 2009. A total of 95 accessions of four vegetable crops (tomato, sweet pepper, eggplant and cucumber) are under regional varietal trials in eight CAC countries, and additionally, 92 varieties/lines of nine vegetable crops have been involved in new trials in five countries.

A new joint project of AVRDC - The World Vegetable Center and the Uzbek *Research Institute of Plant Industry* is being conducted in Uzbekistan and funded from a grant of the Government of Uzbekistan. The project title is *Complex evaluation of vegetable germplasm with unique traits, promising lines revealing and submission to the state varietal trial* (2009-2011).

Another project, *Study of the world gene fund of tomato and revealing of promising lines for processing*, (2009-2011) is receiving a grant from Kyrgyzstan's government and being implemented in the Kyrgyz Agrarian University in Bishkek. Allocation of state funds for variety trials emphasizes the efficiency of the network activities facilitated by AVRDC's CAC Program.

A range of AVRDC's lines of vegetable soybean and mung bean were studied last year. As a result, new varieties adapted to the local agro-ecologies, which meet the farmer needs were submitted to the SVTC in Uzbekistan. Two mung bean varieties, "Zilola" and "Marjon", and the vegetable soybean variety "Universal" were released in 2008 in Uzbekistan. These varieties are early maturing (90-95 days), with higher yield, resistant to diseases, have a larger seed size with a good taste.

The hot pepper variety "Uchkun", high yielding and mid-maturing, with a big fruit size, has been included in the State Register in Uzbekistan since 2009. Multiplication of the released variety seeds is underway for distribution to farmers. These new varieties will allow higher yields and increase the vegetable production and farmers' income in CAC countries.

Fifty promising lines of ten vegetable crops selected in previous years in eight CAC countries are in competitive variety trials of 2009. In total, 28 varieties of six crops including tomato, sweet and hot pepper, eggplant, vegetable soybean, mung bean and long yard bean were under state variety trials in Armenia, Kazakhstan, Tajikistan and Uzbekistan in 2009.

Five *International Potato Center* (CIP) advanced potato clones with the highest available Fe and Zn content were tested under different environmental conditions and growing seasons in Tajikistan and Uzbekistan. At harvest, all of them showed good tuberization with a yield ranging from 25.0 (397099.6) to 61.0 t/ha (397054.3). Further to organoleptic tests clone 388611.22 (Reiche) was considered very suitable for French fries.

[4] SVTC - State Variety Testing Commission

Due to their qualities and available tuber number, Uzbek NARS decided to deliver clones 390478.9, 397073.16 and 397077.16 to the State Committee for Variety Testing for further variety release. Also in Tajikistan clone 397077.16, together with True Potato Seed (TPS) family LT-8 x TS-15, were delivered to local State Committee for Variety Testing for further variety release.

In 2008, the multi-disciplinary project *Enhanced food and income security in South, West and Central Asia through potato varieties with improved tolerance to abiotic stress*, funded by GTZ started in Tajikistan, Uzbekistan, Bangladesh and India. In a split-plot experiment with 15 entries and carried out in Tashkent from July to October, we could observe that yield was influenced by different irrigation regimes since the interaction (entries x irrigation treatments) was significant at 5% level. Under severe drought clone 390478.9 yielded better (33.3 t/ha) compared with 41.7 t/ha in the control treatment with normal irrigation regimes. As a matter of comparison, Sante, a Dutch variety chosen as a check, yielded 11% (29.6 t/ha) and 3% (40.4 t/ha) less than the previous clone under severe drought and control conditions, respectively. Yield under reduced irrigation was highly correlated with yield potential under well watered conditions (P= 0.67), in contrast, yield under extended drought was much less proportional to yield potential (P= 0.23), indicating the presence of specific drought tolerance traits in the experimental clone set. Canopy size had high correlation with yield maintenance under control conditions (P= 0.80 and P= 0.84, at 70 and 88 days after planting, respectively), but this correlation decreased strongly under drought, indicating that other mechanisms than maintained canopy size determine yield under drought. As it was expected, average specific gravity of tubers increased by decreasing the water regime (control: 1.07729; partial irrigation: 1.07853; severe drought: 1.08195).

Crop diversification

The CAC region is known for mono-cropping of a few crops, in irrigated areas mainly wheat and cotton, maize and some rice. Therefore, crop diversification is a key activity for increased cropping intensity, sustainability as well as increased income for the farmers. The Program took major initiatives to test and demonstrate the potential of crop diversification in the region.

Sorghum

The main focus of ICBA activities in 2008-2009 was to introduce and evaluate native wild halophytes and conventional and non-conventional sorghum and pearl millet varieties, technical and fodder crops for their ability to grow and produce economic yields under saline environments. Special attention was paid to the development and adoption of innovative management options in order to increase productivity and income generation on salt-affected, marginal lands.

Among the sorghum varieties/improved lines from ICBA germplasm, Speed Feed, Sugar Graze, Super Dan, Pioneer 858, SP 40516, SP 47105, SP 39105 and SP 39269 showed a good adaptability to the high salinity in irrigated land and on degraded desert rangelands of all three target countries (Uzbekistan, Kazakhstan and Tajikistan). They proved to be highly productive, fast growing, thin-stemmed, tall and early maturing (98-118 days) compared to local varieties. The ability to produce grain, stover and total dry matter on the different salt affected soils differed significantly among evaluated improved lines and cultivars were noted and documented. The high biomass and early-maturing sorghum varieties produce 67.0- 94.3 t ha^{-1} of fresh forage biomass, equivalent to 2.0-30.21

t ha^{-1} dry matter at the plant density of 42.0-90.0 thousand ha^{-1}. Similarly, top-yielding populations/lines of sorghum were identified that exhibited 2.0-2.5 times increase in grain yield over the local varieties. The average grain production of top yielding accessions varied from 5.8-7.4 t ha^{-1}.

The effect of soil salinity on biomass, stover and grain yield in the top yielding dual-purpose sorghum varieties occurred during tillering and flowering stages. Screening of pearl millet germplasm by using 12-agro-biological traits suggest that IP6110, Gurenian -4, Dauro genepool, Sudan pop III, IP 3616, IP 6112 , IP 3616, ISMS 7704 ,MC 94C2, and HHVBC have elevated plant survival (89-92%) percentages and seasonal relative growth (250-296 cm) rates; good accumulation of green biomass per season (green of fresh biomass at 50% of plant stage varied from 6.2 up to 10.4 kg m^{-2} with a plant density of about 64-114 plants m^{-2} and number of basal tillers 4.9-6.8, respectively). Improved lines that include dual purpose Raj 171 (W), HHVBC tall, IP 19586, IP 13150, Wraj Pop, Gurenian-4 and Sudan Pop III, varieties showed excellent re-growth ability, with full maturation and good seed quality during September-October.

A range of trials for large-scale evaluation of promising dual-purpose salt tolerant sorghum and pearl millet crops were established in different eco-agroclimatic zones in Uzbekistan, Kazakhstan and Tajikistan that significantly differ in soil salinity level. Salt tolerant Raj171 and IP 13150 among evaluated pearl millet lines and thin-stmed tall Sugar Graze and Speed Feed and dwarf ICSV 172 and ICSV 745 sorghum lines were found to be most promising for both forage and grain production at the abandoned farmer lands at the Yangiobod site, Asht district (North Tajikistan), when irrigated with drainage highly mineralized water (2.5 -8.3 dS m^{-1}). These promising varieties of pearl millet and sorghum were evaluated during 2008-2009, as a main crops and seeds of them are multiplied. A significant decreasing of total soluble salts in the upper soil profiles during vegetation period (from April to late September) was observed under pearl millet trial. Statistically it was shown that fertilizers use efficiency is better at N30P150K30 under sulfate-chloride soil salinity with a variation of SAR value as 2.27-3.98 at the soil depth 0.0-0.50cm.

Forage crops

After three years of evaluation, ICBA scientists introduced two salt tolerant varieties of alfalfa (*Medicago sativa*), Eureka and Skeptre, which were performed the local varieties Khivinskii (used in Karakalpakstan and Turkmenistan) and Vakhsh (Tajikistan), while the Kyzylkesekskaya variety (Uzbekistan) showed almost similar salt tolerance, green biomass and grain yield comparing to the new introduced alfalfa cultivars. In all countries, the introduced salt-tolerant alfalfa germplasm showed rapid germination, high seed production and excellent regenerative capacity. Additionally, these two varieties were superior to local by length of generative sprouts, number of flowering buds, size and number of pods and seeds per one pod, which, in combination, demonstrate higher seed productivity of introduced germplasm. Fresh biomass production at the third year varied from 23 t ha^{-1} for Eureka variety and 20 t ha^{-1} for Skeptre, respectively. These levels of biomass production under saline soils (EC range of soil varied 1.6-9.1 dS m^{-1} and ground water 5.6-21.1 dS m^{-1}, respectively) were 1.5-2.5 times higher when compared to local varieties, such as Khivinsky (in Turkmenistan) and Vakhsh (Tajikistan). In addition, introduced alfalfa varieties have excellent re-growth capacity (at least 2-3 cuts throughout vegetation season).

In the last two years, for good quality seeds of salt tolerant alfalfa high demand has been observed among farmers. Therefore, seed multiplication trials of alfalfa were established at the Kyzylkesek site (Uzbekistan) and Yangiobod farm (Tajikistan). In 2008, 200 kg of alfalfa were produced at Kyzylkesek. Seeds were distributed to farmers both in Uzbekistan and Tajikistan.

Research in 2008-2009 has also demonstrated that, when alley-cropped barley, triticale and alfalfa are grown together, they yielded 20% higher green biomass than barley alone in the traditional barley-fallow system.

Growing salt-tolerant, high-yielding legumes in combination with cereals, alternated by strips aboriginal halophytes, such as *Atriplex undulata, A. nitens, Ceratoides ewersmanniana, Climacoptera lanata, Kochia scoparia, Salsola orientalis* and *Halothamnus subaphylla,* was found to have great potential for producing more of highly nutritional fodder (both fresh and as hay).

Licorice (*Glycyrryza glabra*) and *Alhagi pseudoalhagi,* both forage species from Fabaceae family, can be planted on salt-affected and degraded rangelands for soil bio-remediation and creation of highly palatable, pure or multi-component pastures by increasing its productivity 2.5 times over degraded, overgrazed pastoral lands. Planting these two valuable forage crops is recommendable along saline water bodies, for example ponds and drainage channels. Even during the remediation period, they have the potential to generate income for farmers, since their biomass can be used as a high quality forage additive for livestock. Their root material is well known to have very high marketability in many industries, especially in pharmaceutics. *Alhagi peseudoalhagi* young stems, leaves and fruits are considering a fattening feed for all kinds of animals and can be stored as hay, feed blocs or silage for winter feed. This pant is extensively collected by pastoralists during the flowering stage. Measures should be taken for the domestication of these plants for the improvement of pastures. Uncontrolled collection and increased soil salinity is treatening the wild genetic resources of this species.

Stable isotope composition (^{13}C) and water use efficiency of different ecological groups of plants, including perennial legumes, are being studied to determine the relationship of biomass production of the plants with soil salinity. Field investigations in collaboration between ICBA (International Center for Biosaline Agriculture), University of Yamanashi, Japan, and the Plant Physiology Institute of the Academy of Sciences of the Russian Federation have been initiated in 2008. First results were already published (Shyuiskaya et al, 2008, 2009 ; Toderich et al., 2009).

Triticale

Results of research since 2006 on salt-resistant varieties for dual purpose (grain and forage) *Triticale* are highly promising, and at the Galaba Farm, Syrdarya province and at the Kyzylkesek Experimental site of the Institute of Karakul Sheep Breeding, Uzbekistan, four varieties were selected for further testing.

In the rainfed areas of Southern Kazakhstan (Abylay, Jambul region), triticale was planted and compared with the performance of winter wheat. Triticale plants were not only 17 cm taller than the wheat plants, but the triticale spikes were also 1.5 cm longer, and the number of kernels per spike was 37 for wheat and 50 for triticale. The protein content of triticale was around 2 % higher (15.1 %),

but the methionine content was 0.8 % lower (1.3 %) than in wheat. Total yield data will be available in the final SLMR report. Currently, the farmer will sell the grain as fodder. If the yield would increase to 3 tons per hectare, the farmer has signaled that he would extend the triticale area to 10 ha. Moreover, as soon as the seed multiplication holding will be established, he would launch the triticale seed production for elite seeds as he can sell the seeds at a higher price (0.33 USD kg^{-1}) than if produced for fodder (0.20 USD kg^{-1}).

Triticale grain yields (2.6 t ha^{-1}) in 2008 were also higher in the Kyzlkum desert of Uzbekistan in comparison to winter wheat (1.7 t ha^{-1}), winter barley (2.3 t ha^{-1}) or rye (1.9 t ha^{-1}).

Sweet-stem sorghum (*Sorghum bicolor*)

Sweet-stem sorghum is a source of reneweable energy that can be converted into bio-ethanol. Renewables are currently not used in Central Asia, but Uzbekistan has demonstrated interest in establishing plantations on marginal lands, where food crops cannot be grown due to the high soil salinity.

In 2008-2009, two demonstration trials within the framework of the collaborative ICARDA/ICBA/ICRISAT and PFU project were established and 28 varieties of sugar sorghum, 16 of which were received from ICRISAT (India), were evaluated for suitability to be produced on saline soils in the Kegeyli rayon of Karakalpakstan with PFU funds, and at the Zangyota site, Corn Center, Tashkent province, with ICBA funds.

Evaluated sweet sorghum local breeds and ICBA/ICRISAT improved lines attained full milky stage between 81-128 days with limited irrigation (2-3 times per season) of 700-800 m^3 over the season and a plant density of 90-102 thousand ha^{-1}. Mineralization/salinity of irrigation water was around 0.619%. Measurement of plants' height showed that the most intensive growth of the stem started on the 40th day after planting and continued up to the 121st to 145th day after planting irrespective of soil salinity level and variety of sorghum. The first varieties to be harvested were SP-47513, ICSV-112, ICSR-93034, ICSV-707, and GD-65195 as they are considered the fast-ripening varieties among all the tested varieties of sorghum. The study results are presented in a publication (Begdullaeva et al. 2009).

Local varieties of sweet sorghum (Uzbekistan-18, Safar 3 and Karakalpakskiy) were promising, as they produced about 49.9-87.3 t ha^{-1} with an average 65.1 - 77.7 % extractable juice. Sugar juice content and total sugar production calculated per hectare ranges between 5.7 - 13.1 % and 1.8-8.4 t ha^{-1} (Toderich et al., 2008, 2009).

Salt tolerant varieties of *Helianthus tuberosus* L.

In 2009, ICBA in partnership with NARS initiated the evaluation of salt tolerant local varieties of topinambur – Haet Baraka and Novinka - showed good performance and accumulation of green biomass under highly saline environments in Takhtakupur, Karakalpakstan. Investigation on salt tolerance and impact of irrigation with marginal quality water on the growth and tubercle yields and quality of topinambur varieties are also started at the Kyzylkesek site, Uzbekistan. These salt tolerant varieties are economically useful for feeding livestock and a source for renewable energy production.

Agro-silvipastoral model for improvement productivity of marginal salt affected lands

An agro-silvicultural model of trees intercropped with complementary crops especially deep-rooting, early-maturing and frost tolerant legumes and graminous crops continued to be evaluated on marginal lands under arid climate in Uzbekistan (Central Kyzylkum) and northern Tajikistan (Yangiobod Farm). Herbaceous fodder crops planted within the inter-spaces of salt-tolerant trees/shrubs plantations improve productivity of saline prone soils, solve the animal feed gaps in the lands degraded both by overgrazing and salinity, and increase the profits for farmers. Wild halophytes planted in widely spaced patterns allows for easy mechanical cultivation and harvesting of forage grass and legumes. Our findings from the screening of 12 multipurpose tree species showed high survival rate, quick relative growth rate, high adaptive features and utility value of firewood and/or foliage. The most promising were *Haloxylon aphyllum, Populus euphratica, P.pruinosus, P.nigra var.pyramidalis, Elaeagnus angustifolia, Robinia pseudoacacia, Tamarix hispida, T. androsowii, Salix babylonica, Acacia ampliceps* and the shrubs *Atriplex canescens, A. nitens*, *A. undulata, Hippophae ramnoides* and *Ribes niger,* including stands of native rangeland halophytes grown alone, or mixed with various traditional salt tolerant fodder crops.

Experiments on the utilization of saline drainage water and its effects on the establishment of multipurpose wild and fruit trees were initiated at the Yangiobod farm (north Tajikistan). Trees/shrub plantations were deeply planting (sticks tap into the water table) through seedlings transplanting in early February, 2008 and 2009. Limited irrigation with low quality water was required during the initial stage of growth before sole reliance on drainage water (higher salinity; EC 2.5 -8.3 dS m^{-1}), the more freely available water resource, becomes possible. The groundwater level varied between 1.5-3.0 m below surface. Soil salinity in the root zone was about 45 dS/m. Fast growth and a high rate of survival were noted for local poplar species (about 91.3%), apricot (*Armeniaca vulgaris;* 75.2%I and *Dyospyros virginiana (*54.8%), when cultivated in mixed stands with various salt tolerant crops. *Elaeagnus angustifolia,* a plant that has an exceptional ion-translocation/bioremediation mechanism, can be seen as an aggressive colonizer, since it tends to invade natural habitats and dominate the less salt-tolerant species.

An optimal integrated agroforestry-farming system might comprise 12-15% of tree cover, 58% of alfalfa and 27-30% of annual forage crops, a mixture which provides satisfactory drainage control of saline environments preventing high salt accumulation in the root zone. Irrigation scheduling (rate and regime) is critical for the success of agroforestry.

Mapping of halophytic vegetation and domestication of economic valuable halophytes

In this mapping it was found that the soil salinity types, moisture and sodium ion content were the major factors responsible in the cover vegetation changes. Vegetation richness, botanic species diversity, plant biomass were well integrated with soil salinity calculated for sodium ion accumulation. A significant drop in soil salinity and the concentration of different ions was detected in winter-spring seasons, which was attributed to the diluting effect of snow and rain water. Research is continued and a scientific-based concept for the domestication of aboriginal tree/shrubs and perennial halophytes into a biosaline agriculture system for Central Asia will be developed.

Chickpea

From 29 chickpea cultivars, which had been screened for early vigor and high yield potential at the Tashkent State Agrarian University last year, the 6 most promising had been planted in November, 2008 (FLIP 01-50C, FLIP 03-63C, FLIP 04-18C, FLIP 04-31C, FLIP 04-35C, Uzbekistanskyi 32). Plant height and density, as well as NDVI readings were collected throughout the growing season. Maximum yield in 2009 was observed for FLIP 04-35C (1.50 t ha^{-1}), followed by Uzbekistanskyi 32 (1.37 t ha^{-1}), FLIP 04-31C (1.28 t ha-*1*), FLIP 04-18 C (1.25 t ha^{-1}), FLIP 03-63 (1.02 t ha^{-1}) and FLIP 01-50C (0.58 t ha^{-1}).

Four Russian rice cultivars and three Kazakh cultivars were evaluated in a field trial in Kaptagay, Kazakhstan. In comparison with the local improved variety Marjan (3.8 t ha^{-1}), the Russian cultivars Lider and Amber gave higher yield (5.2 and 5.1 t ha^{-1}, respectively). Results indicated that the rice productivity can be improved up to more than one ton by changing the traditional rice cultivar Marjan.

Survival results of different trees planted in the frame of the SLMR project in the Kyzlkum desert of Uzbekistan suggest that apricot (*Armeniaca vulgaris*, 50 %), ailanto (*Ailanthus aitissima*, 61 %), and poplar (*Populus puramidalis*, 40 %) may prove promising in this environment. On the other hand, cherry (*Cerasus vulgaris*) and peach (*Persica vulgaris*) had very low survival rates (<20 %), although peach showed good growth rates after planting. These tree species need to be planted again in a larger area to validate the results during the cold winter season when temperatures fall below -15°C for several weeks.

Mung bean

Using a raised-bed seeder in Uzbekistan available in the framework of the SLMR project, the plain cotton and maize cropping geometry was changed, and both crops were intercropped with mung bean. While the control yields of cotton (5.4 t ha^{-1}) and maize (3.5 t ha^{-1}) did not differ significantly from those yields, where cotton and maize were intercropped (4.8 t ha^{-1} and 3.9 t ha^{-1}, respectively), an additional 1.4 and 1.3 t ha^{-1} of mung bean was harvested. This increased the net profit of the farmers from about 700 USD ha^{-1} to more than 1500 USD ha^{-1}. Thus, a change in cropping geometry opens new opportunities for diversification of cotton-wheat systems in Central Asia and hence improved livelihoods.

Potato

A strategy for the promotion and diffusion of new potato varieties was implemented in Uzbekistan by the International Potato Institute (CIP) with its partners. As a result of the second year of multi-location trials carried out in Termez, Tashkent, Pskem and in the SyrDarya region during three growing seasons (February/March-May/June, July-October and May-September), seven promising clones (390478.9, 388676.1, 397073.16, 391180.6, 397077.16, 388615.22 and 392797.22) with multi-location adaptability were classified by maturing period. Two clones (388615.22 and 392797.22) showed the best performance in the lowlands during the first and second growing season, respectively. Storability was also assessed under traditional and controlled atmospheric conditions. The clone 397073.16 had the most noticeable apical dominance and the longest sprout length in both storage methods. A positive correlation existed between weight loss and the length of the

longest sprout for all the clones under the traditional storage method. The highest weight losses were reported for clone 397069.11 (8.84%) under controlled storage conditions and 397073.16 (8.03%) under traditional store conditions at 53 and 45 days from dormancy release, respectively.

Work on TPS (True Potato Seed) was mainly carried out in Pskem, Uzbekistan. After 130 days (sowing till harvest) of growing cycle in the nursery according to the direct seeding technique, LT-8 x TPS-13 had the highest yield (7.9 kg/m^2), although not significantly higher than other six hybrid TPS families. Only FLS-17 x TPS-67 had a number of seedling tubers higher than 500/m^2 (518). In another trial, seven TPS seedling tubers (F_1C_1) were compared with a CIP clone (397077.16). At harvest carried out 122 days after planting, CIP clone 397077.16 significantly out-yielded (5.8 kg/m^2) all the other TPS families. In terms of mean tuber weight, however, TPS seedling tubers of LT-8 x TS-15 had the highest mean tuber weight (84.3 g), thus confirming our results from 2007.

A strategy for promotion and diffusion of new potato varieties was implemented in Kazakhstan, Tajikistan and Uzbekistan by the International Potato Institute (CIP). Ten families of true potato seeds (TPS) with adaptation to long days and resistance to late blight are available for testing from CIP. Four elite clones combining virus resistance and high micronutrient content adapted to long days are identified in CAC for evaluation under farmers conditions (with HarvestPlus). The strategy for improving farmer-based seed potato systems was developed and validated for Georgia, Kyrgyzstan and Tajikistan. A feasibility study of introducing the parasitoid *Edovum puttleri* was conducted and dossiers were prepared according to the FAO Code of Conduct for its introduction to CAC.

CIP has cooperated with potato scientists of Georgia to contribute in development of potato breeding and selection in the country. It has provided Georgian Institute of Farming with late blight and virus resistant potato germplasm, and assisted in development of clones from in-vitro plants, which were further tested under farmer field's conditions in Dmanisi. CIP has also cooperated with local NGOs and private companies to develop a methodology for seed quality management through the implementation of positive and negative selection at farmer level and the application of a virus detection technique (DAS-ELISA). In particular, CIP has assisted Mercy Corps and a local NGO called IAAD in the training of more than 100 seed potato multipliers, who are now associated in 11 cooperatives established in three districts of the Southern Georgia (Akhalkalaki, Aspindza and Akhaltsikhe).

Alternative crops for West Georgia

In a desk study funded by PFU and carried out by Tbilisi sub-office with researchers from Georgia, we looked into the alternatives for growing crops in West Georgia and their potential and risks for exportation to the European markets. This study resulted in the publication of a detailed report (*Alternative crops for the subtropical zone of West Georgia and their sales opportunities and risks on the European market*) available on the CAC Program's webpage under http://www.icarda.org/cac/files/sacac/SACAC_06_Alternative_Crops_West_Georgia.pdf.

Integrated pest management

The distribution and importance of potato pests and their natural enemies were assessed and documented in the main potato production areas of Uzbekistan by CIP with the help of specialists of

Entomology Department of the Agrarian University of Tashkent. Surveys were carried out in large potato fields selected in three districts of Tashkent region (Kibray, Mid-Chirchik and Tashkent) and in five districts of Samarkand region (Ishtikhan, Pastdargam, Jambay, Taylak and Urgut), twice a month from April to September 2008, in order to identify major pest constraints and associated beneficial insects. Additionally, phenological observations were made to study stage development of Colorado beetle (*Leptinotarsa decemlineata*), turnip moth (*Agrotis segetum*) and other potato pests. The Colorado Potato Beetle (CPB) was the most important potato pest identified. Its presence is not reported in the highlands (>2,200 m asl) or in the southern part of Uzbekistan (Termez, Surkhandarya region) because the environment is less favorable for its survival (harsh winters or very hot summers). Natural enemies were found only in small numbers; no specific CPB entomophages could be identified, but this was not unexpected as CPB is an invasive pest species.

A study of the effect *Amblyseius cucumeris* on whitefly and aphids development in greenhouses in vegetable crops (carried out in May, 2009) showed that the average number of whiteflies per plant at release ratios of 3:1, 1:1, and 1:2 were reduced relative to the no release control in both the laboratory and field studies for the 35 day post release period. However, whitefly egg densities continued to increase following the release at all release ratios and in the no release control. The 3:1 release ratio provided the best control in both the laboratory and field study.

In the field experiment we tested effectiveness of Indian pheromone traps in comparison to triangular Uzbekistan pheromone traps, which traditionally farmers used in cotton area and rare in tomato crop in all Central Asian countries. Standard Indian traps for *Helicoverpa armigera* (10 traps) and 10 triangular traps made at the Tashkent Institute of Bioorganic Chemistry. These latter traps are made from cardboard, on the inside of which paper with sticky glue is inserted where caught male butterflies are fixed to the glue. Most of butterflies were caught with Indian traps. The average number for the first day was 56 individuals per trap, whereas Uzbekistan traps' attractiveness was in average 3 butterflies per day and per trap. However, the active period of Indian pheromone traps was only 5-6 days, while the traps made in Tashkent lasted for 20-23 days. Nevertheless, the total number of butterflies caught in Namangan, Uzbekistan region with import traps was in average 232 individuals, and with local traps were 23 individuals.

Natural resource management

In the field of conservation agriculture (CA), various steps have been developed to shift from conventional tillage to CA. The start is made by deep-ploughing to break up the compacted soil layer. Next, a fodder crop (e.g., maize) should be planted for mulch production followed by another plowing and the cultivation of winter wheat and then a nitrogen-fixing crop (e.g., mung bean). After plowing, the land is to be laser-leveled and permanent beds will be prepared. In the case of cotton production, the rotation would include cotton-wheat-3rd crop. A present focus of the long-term experiments is on an optimal fertility management within two crop rotations: cotton-wheat-3rd crop and rice-wheat. At present, three Ph.D students collect their data for their thesis supervised by staff from PFU/ICARDA and ZEF from Bonn University. A major output of the collaborative research with PFU/ICARDFA will be the development of two crop-soil simulation models by the use of CropSyst (for the crop rotation cotton-wheat) and APSIM (for the crop rotation rice wheat). With the use of quantitative, system-dynamic modeling tools, such as crop-soil simulation models, on-going and

needed research will be complemented, in particular for integrating key variables or assessing the impact of various variables on production and productivity. Research may, thus, advance with relative modest means. These models will be available within 8-12 months from now.

During the *Sustainable Land Management Research Project* (SLMR), 5 Indian raised-bed seeders and 3 laser-leveling equipments, as well as 5 optical sensors (Greenseekers) were imported and distributed to the national research organizations. Also, plastic chutes for irrigation, which had been developed by the Tashkent Institute of Irrigation and Melioration (TIIM) were tested in the sloped areas of Kyrgyzstan.

Using the new laser-leveling technology prior to leaching and seeding of the new crop, water savings of up to 25-35 % (500-600 m^3 ha^{-1} per irrigation) could be achieved along with even crop germination and soil moisture distribution. The laser leveler has proven to be suitable for small tractors (MTZ-80-10), which are available at most of the medium-scale farms.

Introducing the Indian raised-bed planter for different crops in Uzbekistan, Kazakhstan and Kyrgyzstan, the seeding rate of winter wheat and rice was up to 40% reduced; crop yields increased by 7-22%; irrigation water savings of 15-20% could be achieved; fuel and production costs significantly decreased by around 23 %; the net profit doubled; and intercropping and other cropping geometries could be introduced.

Keeping residues on raised beds yielded 6.9 t ha^{-1} winter wheat in Uzbekistan as compared to the control (bed-furrow system, no residues: 6.0 t ha^{-1}), and increased the net profit by around 200%.

Zero-till (direct seeding) advances the sowing of winter wheat by 10 days in Kyrgyzstan. The optimal window for planting winter wheat in Turkmenistan was found to be from October 6-22. Earlier or later planting dates reduced wheat yields by up to 2.5 t ha^{-1}.

Controlled-irrigation in sloping lands using plastic portable chutes saves water, improve water application and minimize irrigation-induced soil erosion.

Low initial soil salinity, slow salinization rates and high final soil salinity permit was found as the best strategy for use of saline drainage water in crop production in Uzbekistan. Then, saline drainage water (EC of 1-3 dS m^{-1}) can be used to meet crop water demands in later growth stages of wheat and cotton and for leaching the fields prior to planting cotton and wheat. Especially saline irrigation followed by fresh water saved canal supplies and improved leaching efficiency and increased crop yields.

Inward-sloping terraces covered with mulch on sloped land in the mountain regions in Tajikistan helped catching snowmelt and improve grape production. The residue retention increased soil moisture. Particularly grapevine mulch proved better than wheat straw mulch and increased soil moisture by 18-21% compared to the wheat straw, which increased soil moisture only by 6-8 % compared to the control. Furthermore, the mulch was a useful measure against soil erosion during spring time. Soil erosion on sloping land can be also reduced by maximizing the surface cover with extra-short duration pigeon pea.

Studies on developing winter wheat yield prediction functions and improving the nitrogen use efficiency in cotton and wheat using the Greenseeker Optical Sensor in five Central Asian countries are underway. Top-dress nitrogen rates at booting stage for Uzbek and Kyrgyz winter wheat were estimated based functions developed in the previous year. NDVI data were collected throughout the winter wheat growing period in Uzbekistan, Tajikistan, Kyrgyzstan, Kazakhstan and Turkmenistan to also develop the in-season nitrogen and yield calculator (INSEY).

Functional IWRM structures, including hydrographic management, participation, division of governance and management functions, as well as integration of all water users at its target areas in Uzbekistan, Kyrgyzstan and Tajikistan have been put in place by IWMI within "*Integrated Water Resource Management in Ferghana Valley*" project. Additionally, innovative and efficient mechanisms of dissemination of IWRM principles through educational curricula, extension services, knowledge sharing, informal networks, etc were developed.

A clear IWRM structure integrating both vertical (linkages between different hierarchy levels – canal, WUA or other non-agricultural primary water users, water user groups and farmers) and horizontal (incorporation of inter-sectoral linkages such as industrial, water supply, energy, environment etc.) interests and separating governance and management functions were also developed. A pioneering step towards Irrigation Management Transfer has been made in all three countries. All three countries have signed agreements with water user representing organizations for joint management of pilot canals, as they have experienced the benefits in terms of water saving, improved distribution, improved production and saving finances. Currently, World Bank and ADB have accepted to adopt the approaches developed under IWRM project in their rehabilitation projects. Already many NGOs and research projects in the region are adopting in their day to day operations the approaches developed in this project.

IWMI has completed the second phase of the project on "*Groundwater Banking*" in Fergana valley. This project has looked at the potential underground water storages for storing winter flows of Syr-Darya River and utilizing them to cover water shortages during the summer times. OPEC has now approved the third phase of the project, which will focus on economic, water quality and policy aspects of groundwater storage utilization.

Livestock and feed production

The IFAD-funded project *Community Action in Integrated and Market Oriented Feed-Livestock Production in Central and South Asia* is directed at increasing range and forage productivity. Experiments on pasture management showed that viable options exist for increasing the productivity of hayfields. An Increase in dry biomass production can be reached on the second year by hayfields over-sowing with sainfoin at a seeding rate of 50 or 70 kg per hectare, together with application of ammonium nitrate fertilizer.

To study the impact of different planting dates on maize performance under irrigated conditions; scientists in the project tested an improved maize hybrid with four different planting dates. The results demonstrated that the highest average biomass (12.6 t per hectare) and grain yields (6.8 t per hectare) could be obtained with an early sowing date (30 April in the experiment) in both farms and the yield produced from late sowing date (15 May) differed insignificantly (11.7 and 6.3 t per

hectare). Other experiment on application of ammophous fertilizer on alfalfa biomass in the first year of harvest allowed to collect green fodder mass with yield of 21.2 and 23.4 t per hectare with 40 and 60 kg/ha ammophous application, respectively. Four cuts were done during the vegetation period.

To address livestock productivity, trials were conducted on early lambing and weaning that were successfully finished in Kazakhstan. Due to scientific approaches of sheep maintenance (such as balanced rations, additional feeding during preparation of animals to mating and in the last period of gestation, appropriate veterinary care) good progeny was obtained during experiments in 2008-2009. The results of experiments with 346 ewes showed that farmers may obtain income from sheep breeding during the whole year.

In Shymkent, Kazakhstan, the project activities focused on end-product diversification, including technology on preparing Brynza (a brined white low-fat sheep's-milk cheese), Kurut (hard dried balls of fermented milk or milk curds), dried fruits, Chechil (dried'brynza) and home-made sausage.

Feeding the experimental groups of Gissar sheep with concentrated food (barley, cotton cake, corn) resulted in increase of ewes' conception rate and prolificacy. Additional feeding was organized in the experimental farms using an optimized ratio of available forage. Simplified systems for individual estimation (grading) of goats and for flock circulation among pasture sites were developed and introduced to farms in Khujand, Tajikistan. Briquettes with mineral supplements were developed by the project team and helped breeders of Angora goats to increase their disease resistance and obtain more mohair wool of better quality. Research activities in Tajikistan focusing on value addition and the local processing of goat fibers by women are focusing on establishing a market chain for mohair yarn, which is one of the key export commodities produced by women in the pilot region. During the last project year, research was conducted on the production and marketing of Tajik mohair and mohair yarn, and a promising new market for handspun kid mohair yarn in the United States was identified and is being developed. As access to this growing US market will allow the Tajik women to earn much higher incomes, than by producing coarse, low quality yarns for the Russian market - currently their main outlet.

Increasing demand for mutton in the region encourages farmers to breed meat sheep flocks. Furthermore, a possibility of producing milk by introducing Awassi milk breed to this region is being studied in Kyrgyzstan. Promising results are that the progeny of local ewes and improved rams is larger and that they have much higher body weight than the control traditional group. This would provide a source of additional income to farmers. Also, we have introduced veterinary supervision to each household and farm involved in the project experiments, and this has resulted in increased animal productivity and survival.

Since September 2008, the processing and analysis of the data of an extended livestock survey (conducted since the onset of 2008 among 60 livestock farmers and 100 households involved in livestock production), has started in the ZEF/UNESCO Project on landscape restructuring. A preliminary analysis showed the large differences in milk production of dairy cows at households and livestock farms and between winter and summer periods. In households the average milk production per cow is ca. 5.2 liters per day in summer, but only 4.2 liters in the winter period. This is marginally better for livestock farms with 6.9 liters in summer and 5.5 liters in winter. The average production per cow per year is 4.7 liters in households and 6.2 liters per cow per day in livestock farms.

The land allocations per cattle at households and livestock farms are quite different. The average land area used by households to satisfy feed needs is slightly less than 2000 m2 and people on average hold 4 cattle, or an availability of less than 500 m2 land per cattle. In contrast, the average size of livestock farms is 28.1 ha for holding in average 44 cattle thus ca 6300 m2 land is available per cattle, which is thus about 13 times more compared to households farms. The former have thus much more options for increasing performance if the feed is available.

Due to the limited presence of pastureland in the study region Khorezm, grazing was conduct by only 25% of the interviewees, whereas a small percentage of farmers regularly sent the animal for roaming the sides of canal and collectors or at some fields after collecting the harvest and most stated to have the animals graze on the stubbles.

Zero-till (direct broadcasting seeding) advances the improvement of degraded, salt-affected rangelands in the Kyzylkum desert. Investigations by scientists of ICBA in collaboration with ICARDA and the Institute of Karakul Sheep Breeding show that this re-seeding technology increased the grazing capacity of pasture by about 1.5-2.0 times. An effective and simple method of rehabilitation of overgrazed rangelands is the use of mixed of seeds of valuable shrubs and perennial species in a planting ratio of 25% shrubs, 45% dwarf shrubs and 25-30% annual forage species. This mixture, when well established, produced up to 1.2-3.9 tons of forage (dry matter) per hectare more than the original vegetation, reducing the need for extra feed storage and the possibility to increase the stocking rate for cattle on this land. The optimum period for the rangeland seeding is from November to February. Sometimes after a light snowfall, the seed germinated quickly.

Experiments of the last three years on the establishment of irrigated halophytic rangelands (in pure stands or intercropped with different salt tolerant crops) at the Kyzylkesek site with the use of underground artesian water showed that increased fodder availability near desert settlements will improve survival of the livestock, consequently the income of agropastoralists. Summer cypress (burning bush, or ragweed, Kochia scoparia), highly tolerant to drought and salt stress, was planted in the Kyzylkum desert in Uzbekistan. Planted in spring 2008, the green biomass of summer cypress was 14.0 t ha-1, while Climacoptera lanata yielded 7.0 t ha-1, and hoary orache (Atriplex nitens) yielded 27.0 t ha-1 green biomass. The study results are also given in ICBA publications (Toderich et al., 2008, 2009).

Also licorice (*Glizerriza glabra*), known to be very salt tolerant also proved quite promising under Kyzylkum saline desert conditions with a yield of 9.0 t ha^{-1}. Kyzylkum sandy soils promoted the development of a vigorous root system and rapid self-replication of licorice. Three years after the beginning of the experiment, the cumulative yield of licorice was 23.6 t ha^{-1}.

Cutting the alfalfa (*Medicago sativa*) variety Tashkentskaya five times during the crop season 2008 in the Kyzlkum desert, Uzbekistan, gave a biomass yield of around 2.3-3.0 t ha^{-1} per cut, or a total of 14.5 t biomass ha^{-1}. Seed production was initiated to multiply seed and distribute them to other farmers located in the deserts of Kyzylkum and to Tajikistan.

The seven millet cultivars received from the ICBA and ICRISAT office in Hyderabad and planted in the Kyzlkum desert, Uzbekistan, produced between 38 and 96 t ha^{-1} of green biomass, of which the cultivars Raj 171 (90.0 t ha^{-1}), Aip 19586 (91.6 t ha^{-1}), and Aip 22269 (96.7 t ha^{-1}) performed best. If

these cultivars are grown near the watering points in the vicinity of the herds (size of 2000 units) on 10 hectare area, the survival ration could easily be doubled from 2 kg to 4 kg day^{-1} per animal during the severe winter season.

The percentage of edibility (%) by gelded rams of the halophytes hoary orache (*Atriplex nitens*), *Climacoptera lanata* and summer cypress/burningbush/ragweed (*Kochia scoparia*) varied from 65-85 %, with *Atriplex nitens* being the preferred halophytic fodder (85 %). Fodder rations including 30-50 % halophytes only, however, were most willingly consumed by the animals as compared to other halophyte-mixtures with a higher halophyte share. In comparison, the edibility of the 30% halophyte-hay mixture was 84 % that of the 50 % halophyte-hay mixture 80 %, and the ration consisting of 100% halophyte-hay was 75 %.

Fifteen winter wheat varieties received from the CIMMYT-ICARDA office in Turkey were tested for their potential for dual-purpose (fodder and feed) i.e. cut for fresh biomass before and after winter. Those plots cut in March gave more biomass in comparison to those cut in November. From those varieties cut after winter BDMT06SK (23.36 t ha^{-1}), Karma (23.27 t ha^{-1}) and Izgi (18.57 t ha^{-1}) yielded highest fresh biomass, while minimum green fodder was harvested from Bagchi cultivar (11.07 t ha^{-1}).

Furthermore, local varieties of winter wheat, barley, and triticale were planted in Uzbekistan as dual-purpose crops to be cut before and after winter for fodder. Maximum fresh biomass was obtained for triticale (13.01 t ha^{-1}), followed by winter wheat (11.85 t ha^{-1}) and barley (4.40 t ha^{-1}), when cut in March. The respective kernel yield data for the 15 wheat varieties as well as the local varieties of wheat, barley and triticale will be available in the final SLMR report.

Socioeconomic and policy research

Under the IFAD-funded integrated feed and livestock project led by ICARDA, a multi-theme survey of livestock producing households was conducted in 2008 at four project sites located in Kazakhstan, Kyrgyzstan and Tajikistan. At each site, 150 smallholders were interviewed. The collected survey data indicating characteristics and income structure of households; their land endowments; sheep/goat production practices and livestock flock size of smallholders, marketing strategies of households were entered into the electronic database to be used for further statistical analysis. Initial survey results confirm the importance of livestock production for the livelihoods of households contributing 35-39% to the total households' income at each site.

In Sogd province, Tajikistan, goat mohair traders' survey was completed by June 2009. Data collected from 100 middlemen will be a basis for analysis of the existing mohair market in Tajikistan and elaboration of recommendations on enhancement of the market efficiency.

A cost-benefit analysis of fattening of the early weaned lambs was completed in Kazakhstan. Results show that this technology helps to increase the profit from sales of each lamb by up to 76% for Karakul sheep and up to 15% for fat-tailed sheep.

Weekly livestock price data collection started in June 2008 at rural and urban livestock markets in three above mentioned republics of Central Asia was completed in June 2009. These data will be used for analysis of the spatial price differences and assessment of the degree of market integration.

The collection of monthly data on prices for livestock products, feed / forage, and staple food is going on in Kazakhstan, Kyrgyzstan, and Tajikistan. This information will be used to address the impact of price fluctuations on livelihoods of the rural households.

Activities on value addition and local processing of goat fibers by women in research sites in Tajikistan are focused on establishing a market chain for mohair yarn which is one of the key export commodities produced by women in the pilot region. During the last project year research was conducted on the production and marketing of Tajik mohair and mohair yarn and a promising new market for handspun kid mohair yarn in the United States was identified. An access to the this growing US market would allow the Tajik women to earn much higher incomes than by producing coarse, low quality yarns for the Russian market which is currently their main outlet.

A study, funded by FAO, on assessing the Information and Communication Technology (ICT) needs in the agricultural sector in Kyrgyzstan has been completed and the final report prepared. One of the recommendations of the study was to launch a project for a pilot level implementation of the study's recommendations. The study is available for download under http://www.icarda.org/cac/files/sacac/SACAC_05_ICT_in_Kyrgyzstan.pdf.

A financial analysis of afforesting marginal lands in the Khorezm region of Uzbekistan was analyzed. The twenty-year established growth functions for *E.angustifolia*, *U. pumila*, and *P.euphratica* and their fractions, allowed analyzing the benefits for capital investment in small-scale plantations by considering annual fuelwood, fodder and fruit production, plus the stumpage value after 20 years. The results demonstrated afforesting of marginal lands is a feasible land use option, which does not compete with food crop production. Moreover, after year 1, the gross margin of all tree species exceeded those of all crops, owing to the annually recurring benefits from firewood and fodder and the low crop yields. A change in land use policies of marginal land would thus provide direct economic benefits to rural farmers, provide income for the government via taxes, and lead to an overall improvement in ecological conditions in the region.

During a three year study on the amount of greenhouse gas (GHG) emissions, the findings showed that irrigated farming in the Aral Sea basin represents a significant source of GHGs. It produced high emissions of N_2O from cotton and wheat fields, and even higher emissions of CH_4 from flooded rice fields. The good news is that a mix of optimal cropping systems including tree plantations would reduce such GHG emissions, and at the same time such as mix would improve carbon sequestration, increase soil fertility, prevent soil degradation, and increase farm incomes.

Information on bio-fuel characteristics of local tree species of the Aral Sea Basin were collected to support species selection for afforesting such marginal land patches. Quantitative fuelwood properties such as wood density, ash content, calorific value (constituting the Firewood Value Index (FVI)), the biomass-to-ash ratio, moisture, C and N contents in wood of *Elaeagnus angustifolia* L., *Ulmus pumila* L. and *Populus euphratica* Oliv. were examined over four years. The results show these

trees hold potential of earning tangible from sale of timber and certified carbon emissions and serve as fodder.

Within the "*Economic analysis of sustainable land management options in CA*" project, agricultural development domains for SLM practices in Central Asian countries identified using three factors: agricultural potential, access to markets and infrastructure, and rural population density. Livelihood and land management options in different domains were identified. Available and relevant data inputs for DSSAT (Decision Support System for Agrotechnology Transfer) crop modeling software were collected. Data collection efforts on this are being continued.

Capacity building

The program has been actively working on capacity building of NARS, students, farmers and national staff since its establishment in the region. Several trainings, workshops and filed days were organized during the reporting period for strengthening the NARS and dissemination of the best practices accumulated in projects.

Supporting projects

To support the development of information management and systems, and conservation actions in both Armenia and Uzbekistan, The Global Crop Diversity Trust and Bioversity International together are supporting a three-year project on *Regeneration of Sorghum Collections in Uzbekistan*, which was successfully started by the Uzbek Research Institute of Plant Industry (UzRIPI) in 2008. This project allows preserving the valuable collection material of sorghum for future generations. Eighty-six accessions of sorghum were regenerated through self-pollination in 2008. Methodologies of VIR (Vavilov Institute) and crop descriptors, developed by Bioversity International were used for regeneration, evaluation and documentation of regenerated accessions. The accessions have been evaluated morphologically, biologically and economic-valuable traits were assessed in the field and laboratory. The regenerated seeds of 86 accessions were put in UzRIPI genebank for middle-term conservation and will be transferred to Svalbard Genebank. By inquiries of breeders these accessions will be studied for development of the new highly productive and high-qualitative varieties of sorghum in the future.

Bioversity International is supporting a two-year research project of Mr. Ormon Sultangaziev, a young forest engineer from Kyrgyzstan, on "Characterization of genetic structure and reproductive biology of Juniperus seravschanica Kom in Kyrgyzstan" (2008-2009) at the Austrian Research and Training Centre for Forests, Natural Hazards and Landscape (BFW).

Armenia, Azerbaijan and Georgia were fully involved as member countries in the activities of the European Cooperative Programme for Plant Genetic Resources (www.ecpgr.cgiar.org) during active cooperation with Bioversity International. A number of scientists, researchers, genebank managers and documentation specialists attended network meetings and workshops. They contributed to the implementation of common workplans, methodologies, documentation systems as well as to the development of a European genebank integrated system. Some specialists from the Caucasus countries also participated as observers in the European Forest Genetic Resources Programme (www.euforgen.org).

A new joint project on "*Integrated approaches for sustainable use of marginal lands in Priaralie and Kyzylkum desert through the introduction of biosaline technologies and promoting renewable energy production*", funded from a grant of the Government of Uzbekistan for the period 2009-2011 was initiated by the International Center for Biosaline Agriculture (ICBA), the Research Institute of Regional Problems, Samarkand Division of the Academy of Science and, the Uzbek Research Institute of Karakul Sheep Breeding and Desert Ecology in Uzbekistan.

In Georgia, the International Potato Center (CIP) with the help of local scientists and advisors working for a local NGO, called IAAD, operated for improving the informal seed potato system in the country. As it was recommended by the Seed Group at the last Steering Commitee Meeting of the CAC Program held in Astana in 2008, a quality control system that is based on DAS-ELISA[5] kits supplied by CIP-Lima was tested under local conditions to check the level of viruses in the seed potatoes produced by an Association of seed potato growers in Akhalkalaki plateau. As a result of the tests conducted in twelve seed potato fields, the most spread virus, PVY, was present in ten out of 12 samples, followed by PVX, PVA and PVS. PLRV and PVM were absent in all the tested samples. This was the first attempt to establish a quality control mechanism that would give more guarantees to potato growers that the seed purchased from informal seed producers is of reasonably quality. However, to be effective such a system must be enforced by the Ministry of Agriculture that should select informal seed potato growers based on the quality of seed regularly commercialized.

Trainings

ICARDA-CAC started collaboration with a newly established research institute, Kashkadarya Scientific Research Institute for Breeding and Seed Production, in Uzbekistan. ICARDA-CAC provided a number of nurseries of different crops for 2008-2009, and initiated informal training of young researchers. ICARDA-CAC has planned extensive collaboration with this institute in coming years; this institute is likely to serve as focal partner for IWWIP activities in the region.

Bioversity International carries various training sessions were at regional and national levels for policy makers, research and conservation officers, extension workers, educators and local communities. Three Regional Workshops on PA Materials Development, on Market Research and on Policy Issues related to Agrobiodiversity Conservation and Use were organized from July, 2008 till July, 2009. Moreover, National Training Workshop on Issues of Biodiversity Conservation and Biosafety was organized for policy makers in Turkmenistan. This all were resulting in gained knowledge and improved skills in assessment of diversity level of target fruit crops and wild fruit species, documentation of gathered data, conducting household survey and market research, development of public awareness materials of the National partners from Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

In the frame of the *Sustainable Land Management Research* (SLMR) project, 7 Traveling Seminars for farmer and experts on SLM research topics were conducted between July 2008 and July 2009 in all 5 participating Central Asian countries (an additional 2 in Uzbekistan) in close collaboration with the national research partners and NARS. Around 180 participants attended the seminars.

[5] Double-Antibody Sandwich (DAS) method of the Enzyme-Linked Immunosorbent Assay (ELISA).

In the course of the Sustainable Land Management Research (SLMR) project, 2 training courses (one in partnership with the Center for Development Research (ZEF) and CIMMYT) were conducted on the use and handling of the Greenseeker and the analysis of the obtained data. In each of the two trainings, around 15-20 scientists attended.

IWMI-Tashkent has organized a School Children's festival on "Integrated Water Resources Management (IWRM) in Central Asia" in Osh, with the Ministry of Agriculture, Water Resources and Processing Industry of Kyrgyzstan, on 25th May 2009. Children were very creative in various activities and had a great impacted on their parents and other adults, on the value of water saving.

All three country national steering committee groups of IWRM *Ferghana* project were actively persuading policy makers and donors operating in Central Asian countries, as well as representatives of international organizations to pursue common approach towards water management in the region. In this regards several meetings were conducted in all three countries at different levels. Over 3500 persons from the project pilot areas and TSR basins were trained through training workshops, seminars, combined group meetings and round tables on various aspects of IWRM and modern approaches to water management.

The International Potato Center, through its liaison office based in Tashkent, has conducted national training courses on seed potato production and TPS technology in the Institute of Vegetables, Melons and Potato, Tashkent, and in the Institute of Plant Physiology and Genetics, Dushanbe, during 17-18 March and 25-26 March, 2009, respectively. In total 50 participants attended the national training courses in Tashkent and Dushanbe.

The International Center for Biosaline Agriculture, jointly with the Ministry of Agriculture of Turkmenistan and the Institute of Desert, Flora and Fauna at the Ministry of nature Protection of Turkmenistan conducted a seminar on "Utilization of Marginal Quality Water for Agriculture with Reference to Central Asia", from 30 May to 1 June, 2009. The meeting was attended by the representative of the Islamic Development Bank, Mr Fawzi Al Sultan, Chair of ICBA Board of Directors, ICBA staffs, administrative leaders from the ministries, scientists, teaching staffs and students of the different institutions of Turkmenistan.

In order to introduce technologies developed during realization of the project "*Community Action in Integrated and Market Oriented Feed-Livestock Production in Central and South Asia*", funded by IFAD, three trainings were conducted in which farmers could learn how to process milk products and prepare homemade sausages.

The "Second Vegetable R&D Network Steering Committee Meeting for Central Asia and the Caucasus" was held from 27 November, 2008 in Tashkent, Uzbekistan. The meeting focused on collaborative research agendas to tackle major regional issues, prioritize research problems, build capacity, and develop CACVEG funding strategies.

The "Review and Planning Meeting in Vegetable Variety Selection and Adoption in Central Asia and the Caucasus" was held from 25-27 November, 2008 in Tashkent, Uzbekistan. Participants discussed achieved results, current constrains and perspectives of regional varietal trials in CAC. Lectures on special topics to improve specialists' skills were conducted during workshop also.

A Farmers' Field Day was conducted by ICBA on 19 August, 2009 in Asht district, northern Tajikistan, where achievements and future plans for up-scaling of biosaline agroforestry production on marginal farmer abandoned lands were analyzed.

Individual training on "Breeding, Seed Growing and Vegetable Production" has been conducted in 13-18 July, 2009 for a specialist from the partner Kyrgyz Agrarian University.

A statistics training course was organized in early 2009 for local staff of CG Centers in Tashkent. The course, delivered by trainers from Syria and India, served to train ten researchers from ICARDA, IWMI and CIP at Tashkent. The biometrics course topics included: basic statistical concepts, introduction to GenStat, tests of significance, correlation and regression, experiment design and analysis principles, design and analysis of randomized complete blocks (RCB), design and analysis of two-factor factorials and split-plot experiments in RCBD, analysis of covariance and in complete block designs (alpha designs).

Academic capacity building

The CAC Program puts emphasis on student's capacity building. Mr. Kobiljon Soliev became a PhD student at Tajik Institute of Agricultural Economics of Tajik Academy of Agricultural Sciences for the period 2009-2012. Earlier, for his Master's thesis, Mr. Soliev used the materials collected during his work in ICARDA / IFAD Project "*Community Action in Integrated and Market Oriented Feed-Livestock Production in Central and South Asia*". He will continue this practice in his PhD research.

Recently, Mr. Alisher Mirzabaev, a socioeconomist from the ICARDA-Tashkent office, has been awarded a scholarship by the IPSWAT Program (International Postgraduate Studies in Water Technologies) of the German Federal Ministry for Education and Research. Mr. Mirzabaev will pursue his postgraduate studies at the Center for Development Research (ZEF), University of Bonn, and conduct his field research under ICARDA's new project on "Climate Change and Drought Management in Central Asia and China".

Two Master students from Kazakhstan, Ms. Alima Aymyrzaeva and Ms. Khalida Mamanova, have successfully defended their Master's theses and obtained their degree of Master of Economic Sciences at International Kazakh-Turkish University in Turkistan, Kazakhstan. Ms. Aymyrzaeva's thesis is on "Improvement of the social and economic conditions of live for rural households in South Kazakhstan", while Ms. Mamanova's research was conducted on enhancement of the pricing system for livestock products in Kazakhstan. Both students are involved in the research activities of the project *Community Action in Integrated and Market Oriented Feed-Livestock Production in Central and South Asia* funded by IFAD and implemented by ICARDA. IPM project has been supporting and supervising 3 PhD students in Kyrgyzstan, Tajikistan and Uzbekistan on field research.

Mr.Hasan Boboev and Mrs Lilia Gismatullina, PhD students supervised by ICBA-CAC, received a PhD research scholarships from the Ministry of Science and Education of Japan to study at the Tsukuba University, and from Russian Fund to study at the Institute of Plant Physiology, Russia, respectively.

Two PhD students are at the second year of their research on AVRDC' promising varieties, including vegetable soybean and hot pepper and one more postgraduate student has started a research work on long yard bean in Uzbekistan since 2009.

Mrs. Sri Wahyuini had completed her Ph.D on "Developing a Lake Water Balance Model for Groundwater Conservation in Arid/Semi Arid Area of Uzbekistan" under a joint supervision of Prof Satori Oishi (University of Yamanashi) and Dr Kristina Toderich (ICBA). This is the first result of ICBA's efforts for capacity building in the CAC region.

Awards and recognitions

During the Annual General Meeting 2008 of the Consultative Group on International Agricultural Research (CGIAR), held in Maputo, Mozambique, the CGIAR Program for Sustainable Agriculture in Central Asia and the Caucasus (in short, CAC Program) has been awarded the CGIAR King Baudouin "Science Award for Outstanding Partnership". The Prize illustrates close collaboration and regional scientific integration of the National Agricultural Research Systems, CGIAR and Donors for development of sustainable and more profitable agriculture in the highly degraded lands of Central Asia and the Caucasus.

Dr Kristina Toderich, ICBA Tashkent, has been awarded with a Ph.D. Degree from the University of Agriculture and Technology of Tokyo, Japan in September 2008.

Information dissemination

Both Armenia and Uzbekistan have developed their own crop wild relatives (CWR) National Information Systems and select data from these systems have been linked and integrated to Bioversity's CWR Global Portal. In Armenia, the national information system is currently online. Data available on the national web site (www.cwr.am) include 104 species, 7,438 records and about 6,000 coordinates. During the current twelve month period additional information was added to the system including local and global distribution of selected taxa, threats, conservation status and use data. In Uzbekistan, it is planned that the national information system will be available online early in the 2nd half of 2009. In the meantime, significant information was added to the national information system covering ecogeographical, methodological manuals for monitoring on reserves' territories, maps with pinpointed pilot plots, taxonomy data, information about threats, phenology of studied species (according to literature), biological description of plants (according to literature), adaptivity of the studied species (according to literature) and so forth. Data of eco-geographical surveys of walnut for 2006, data on onion and apple for 2007 and on apple for 2008 were input into data base. At present time data base includes information on 757 species for 366 pilot plots for the period from 2005 to 2008.

Much attention was paid to the dissemination of research findings. The Sustainable Agriculture in Central Asia and the Caucasus series of publications were placed at www.icarda.org/cac. So far, the SACAC series were enriched by 6 publications on different directions of the program: A vision for sustainable land management research in Central Asia; Rangelands of the Ravnina region in the

Karakum Desert (Turkmenistan): Current condition and utilization; Elements of a National Strategy for Management and Use of Plant Genetic Resources in Armenia; Elements of a National Strategy for Management and Use of Plant Genetic Resources in Georgia; Kyrgyzstan's National Agricultural Research and Extension system: An assessment of information and communication needs; and Alternative Crops for Subtropical Zone of West Georgia and their Sales Opportunities as well as Risks on the European Market.

The ZEF UNESCO project has commenced with the elaboration of project science briefs ZUR, which stands for ZEF-UNESCO Rivojlanishlari, (Uzbek for ZEF-UNESCO Developments). These highlight salient research results in a nutshell (see http://www.zef.de/khorezm.0.html), thus addressing a variety of research clients and end-users. Together with ICARDA/PFU research staff, ZURS have been elaborated in simple language, which aimed at different audiences, including practitioners and decision-makers while addressing a wide variety of topics such as laser-guided land leveling for water saving, reduction of greenhouse gas emissions for ecological improvement, renewable energy production and others for rural improvement and combating land degradation.

Demonstrational days of promising vegetable varieties were organized by AVRDC's jointly with Farmers' Association of Uzbekistan in 2009. New released mung bean variety Marjon was selected by the State Scientific Committee and presented on the State Innovation Ideas Fair in EXPOCENTER of Uzbekistan in 2008 and three promising varieties (mung bean variety Durdona, vegetable soybean Parvoz and long yard bean Oltin soch) were selected as innovation and presented in April 2009.

During two last years, AVRDC-CAC office has been paying more attention to vegetables nutritional value for a diet diversification and human health, especially of non-traditional crops (vegetable soybean, pai-tsai) and a number recipes were elaborated and disseminated.

A number of publications were published by AVRDC-CAC office in this period, including articles, number booklets and posters on AVRDC activities in CAC, "Vegetable soybean Parvoz", "Mung bean Durdona", "Leafy cabbage" and "Daikon".

A movie clip on "Conservation Agriculture Practices in Uzbekistan" was prepared by Dr Aziz Nurbekov under FAO TCP project in Uzbekistan. The film well received by Dr Fawzi Taher, crop production and protection specialist, FAO/SEC during his visit to Uzbekistan. The film was placed in ICARDA-CAC web-site (www.icarda/cac) for public awareness about issues related to conservation agriculture practices in Uzbekistan.

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Программа по Устойчивому Развитию Сельского Хозяйства в Центральной Азии и Закавказье

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