

## **Ecoregional Program: Collaborative Research Program for Sustainable Agricultural Development in Central Asia and the Caucasus**

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### **Rationale**

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The Central Asia and Caucasus (CAC) region consists of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan in Central Asia, and Armenia, Azerbaijan and Georgia in the Caucasus. The background information on the CAC region, the CGIAR Systemwide Ecoregional Program for the CAC region has been provided in detail in the earlier Program MTP for 2007-2009, however, as a brief overview, it can be mentioned that CAC Ecoregional Program operates in a complex environment with newly independent countries of Central Asia and the Caucasus undergoing a painful transition from a single planned economy to market-oriented national economies. The collapse of the Soviet Union has disrupted links between research and producers, production and trade resulting in negative impact on agricultural research and sustainable use of natural resources. Although newly independent republics inherited a wealth of national research experience from the Soviet era, yet most republics are ill equipped to respond adequately to fast changing market economies and emerging new challenges. Lack of contact with the international scientific community has caused a technology lag and has prevented scientists from keeping abreast with scientific advances. Links for dissemination of technologies are very weak and investment in agricultural research is quite low. Thus, the Ecoregional program plays a critical role in:

- (1) Development and application of cost effective and income generating appropriate technologies;
- (2) Generating an enabling policy environment together with supporting rural institutions;
- (3) Strengthening the capacity of NARS

The Ecoregional Program for CAC is organized under broad themes, with each theme sub-divided into activities, as follows.

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 National Programs

These themes provide the overall framework in which specific projects are developed and implemented by CGIAR Centers in partnership with NARS.

Out of twenty CGIAR priorities, the CAC Program is currently addressing thirteen, including (i) conservation of plant genetic resources for food and agriculture; (ii) maintaining and enhancing yield of staples; (iii) tolerance to abiotic stresses; (iv) income increases from fruit and vegetables; (v) income increases from livestock; (vi) improving water productivity; (vii) improving research and development options to reduce rural poverty and vulnerability, (viii) science and technology policy and institutions, ix) promoting conservation and characterization of underutilized plant genetic resources, x) promoting conservation of indigenous livestock, xi) genetically enhancing selected high-value species, xii) promoting sustainable agro-ecological intensification in low- and high- potential areas, xiii) improving rural institutions and their governance.

The project goal, purpose, outputs, output targets and associated expected outcomes and impacts are provided in the attached Project Logframe. This Logframe includes specification of which Center/Partner bears primary responsibility for the achievement of outputs and the associated outcomes and impacts.

Each Center finances its own projects and the details of the component projects are reported within the MTPs of the Centers implementing those projects. Some new initiatives of inter-Center partnership through new projects are taking place. Key assumptions in achieving research outputs remain the same as in the MTP for 2007-2009.

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## Outputs

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The attached Project Logframe contains detailed information on output targets and the Centers responsible for each output target. Below, we describe for each output: (a) Relation to SP goals, (b) the impact pathway, (c) the research approach to developing international public goods (IPG), and (d) the role of partner organizations, where and if there has been some change from the previous MTP 2007-2009.

### **Output 1: Germplasm for improved productivity and sustainability of key cereals and legumes that is important for food security (ICARDA, CIMMYT).**

#### **2.13 Relation to SP goals**

The output targets under this theme contribute to achievement of the goals of System Priorities 2A, 2B and 2D through selection of about 10-12 improved varieties of facultative/winter wheat, barley, food and forage legumes, and spring barley for their subsequent release for wide adoption.

**2.14 Description of Impact Pathways:** See the description in the previous MTP 2007-2009

**2.15 Research Approach to Develop International Public Goods:** See the description in MTP 2007-2009

**2.16 Partners' Roles:** See the description in the previous MTP 2007-2009

### **Output 2: Options for diversification of agricultural production systems (ICRISAT, CIP, IRRI, AVRDC, ICBA, ICARDA)**

#### **2.1 Relation to SP goals**

The output targets contribute to the goals of System Priorities 2A, 2B, 2D and 3A through the identification of promising germplasm and improved varieties of alternative crops such as rice, potato, vegetables, groundnut, halophytes, sorghum and pearl millet etc, as well as disseminating technologies for crop diversification. In addition, ICARDA has recently commissioned a project contributing to the goals of System Priorities 1C and 3B through livestock management.

#### **2.2 Description of Impact Pathways**

Impact pathways remain basically the same as in MTP 2007-2009. The change from the previous MTP 2007-2009 consists in ICBA's active involvement in crop diversification in saline areas using halophyte crops, as well as the new ICRISAT/ICARDA/ICBA initiative on on-farm evaluation of sorghum and pearl millet in Central Asia. Impact pathways for these specified output targets are given below.

**ICBA:** Agriculture in CAC seriously suffers from soil salinity and water logging problems. As a consequence productivity of several crops including cotton and wheat are declining. There is a need for introduction of salt tolerant crops in the production systems under marginal environments to benefit the farmers. ICBA has introduced salt tolerant conventional and non-conventional germplasm that adapts well in different regions of Central Asia. Preliminary results indicate to the potential of sorghum, pearl millet, fodder beet, alfalfa as conventional forages, and of *Atriplex* spp, and *Acacia ampliceps* as non-conventional species for the saline environment. Diversification of the existing production systems by inclusion of these crops will improve farmers' livelihood in stressed environments. Kyzylkum Desert in Uzbekistan is known to have several halophytic species that can be included in saline agriculture for enhanced biomass production and fodder availability for livestock. Studies on halophyte fodder quality (palatability and digestibility) as animal fodder and feed is likely to bridge the presently missing link for significantly improving the livelihoods of even the landless farmers in the marginal areas in region.

**ICRISAT/ICBA/ICARDA:** ICRISAT as a lead world center for sorghum and pearl millet improvement has developed a wide range of breeding materials and populations/varieties that have been found to be

tolerant of salinity elsewhere. These populations/varieties and technologies will be used in Central Asia to exploit the potential of halophytes in rehabilitating the marginal environments.

**2.3 Research Approach to Develop International Public Goods:** see MTP 2007-2009.

#### **2.4 Partners' Roles**

For Output 2 partnerships have been expanded to involve the following:

- *Kazakhstan:* Kazakh Institute of Irrigation and Water Management
- *Tajikistan:* Tajikistan Academy of Agricultural Sciences (TAAS); Institute of Soil Sciences, TAAS; Directorate of Soils Reclamation Station, Khodjent
- *Turkmenistan:* Turkmen Research Institute of Agriculture
- *Uzbekistan:* Faculty of Chemistry of the National University of Uzbekistan, Dept. of Entomology of Tashkent State Agrarian University; Gulistan State University, Karakul Sheep Breeding Institute

CIP is also working in partnership with NGOs, such as the International Association for Agriculture Development (IAAD) and the FAO Emergency Coordinating Unit, Dushanbe, to strengthen informal seed systems in Georgia and Tajikistan, respectively, thus playing a facilitative role to increase and sustain food availability.

### **Output 3: Integrated natural resource management practices, technologies and institutions for improved soil and water productivity (ICARDA, IWMI, CIMMYT, ICBA)**

#### **3.1 Relation to SP goals**

The output targets under this theme contribute to the goals of System Priorities 4C, 4D, 5A, 5C and 5D through developing sustainable and more productive natural resource management technologies and practices.

#### **3.2 Description of Impact Pathways**

**ICARDA and CIMMYT:** In addition to the impact pathways indicated in the MTP 2007-2009, it can be mentioned that Ukrainian no-till implements have become available in Kazakhstan leading to adoption minimum/reduced till agriculture there in sizeable area. Lack of small size drill/planter continues to hinder the spread of zero tillage technology in the rest of Central Asia.

**IWMI:** Main changes from the previous MTP include the selection of three pilot canals with three WUAs (Water User Associations) for pilot testing. In addition, IWMI has been mobilizing farmers to form water users groups (WUGs) and associations (WUAs). Informal WUGs headed by rural leaders (Aksakals) have now become operational at 3rd or 4th level canals and are effectively solving water distribution issues without conflicts and also dealing with the WUAs for collecting water from the supply canal and payment for water and /or services. This has improved equal distribution, reduced the wastage of water and conflicts and helped to ease the operations of the WUAs. The representatives of those WUGs do participate in the governance of WUA and representatives of the WUAs are engaged in the governance of the main canal. For the first time in post Soviet era, joint canal management is established in Kyrgyzstan in February 2007. Similar arrangements are being organized in Tajikistan and Uzbekistan. The pilot canal governance is done by a "Joint Management Board", comprising government representatives and water Users based on their financial contribution to the operation of the canal. It is expected that the share of financial contribution of the water users to be increased gradually, and the canal management to be passed over to the users. The pilot WUA experiences are now spreading along the pilot Main canals and establishment of new WUS based on hydrographic boundaries are in progress. The project is promoting new approaches of water use planning, Business planning and Asset management for WUAs, water and land productivity improving methods to farmers, Canal management and Federation of Water Users in each pilot Canal. Lessons learned from these experiences are brought to the attention of concerned Ministries through national coordination support groups (NCSG) established in each country under the IWRM Fergana Project. Project is also involved in the dissemination of best water management practices from around the world on small holder situations to other regions of the Fergana valley.

Under the Bright Spots Project, IWMI, ICBA and ICARDA are guiding and facilitating with the local NARS in testing and promoting promising technologies for rehabilitation of salt affected soils. Large scale adoption of best-bet practices is likely to arrest salinization and improve crop productivity. The knowledge sharing activities linked to the Bright spots project is creating a huge impact; last year first ever farmer fair

in Central Asia was organized in Gulistan and it has been picked up by the Uzbek Agricultural Ministry and will hold national farmer fair in Tashkent in 2007. Two learning Alliances created in Uzbekistan and Kazakhstan are functioning very well.

A new initiative with Israeli scientists has started to look at ways of mapping the saline lands using satellite-sensed data.

IWMI with Uzbek HydronGEO Institute and its partners started model simulations of ground water recharge during the winter season and use for irrigation in summer. This activity will be further expanded in 2008.

Water productivity assessment methodology will be developed for Syr Darya basin. Efforts in finding the linkages in rural poverty and water management are continuing in Fergana Valley project encompassing three countries (Uzbekistan, Kyrgyzstan and Tajikistan).

**ICBA:** Salinity and waterlogging problem are increasing in Tajikistan adversely affecting productive irrigated lands. Productivity of cotton and vegetable crops has declined in Tajikistan. Alternate land use for these areas has to be worked out for improved livelihood of farmers and rehabilitating the degraded salty lands. Several strategies such as (i) identification of integrated management practices for lowering water table on farm level by using salt tolerant plants for bio-drainage; (ii) identification of local and exotic germplasm and (iii) suitable agronomic practices for the establishment and management of forage halophytes in saline environments are to be identified.

### **3.3 Research Approach to Develop International Public Goods**

In addition to elements already indicated in the MTP 2007-2009, IWMI partners have prepared a number of guidelines and manuals for social mobilization and institutional development (SMID) activities. These manuals have been translated into Russian, Kyrgyz, Tajik and Uzbek languages and provided to line-departments. IWMI has introduced a time-based water management concept which has captured the attention of smallholders in Kyrgyzstan. The water distribution, equity, reliability and fairness are being quoted and water conflicts have come down considerably. With ADB and SDC support, five different WUA development guidelines have been developed and are available on IWMI website. IWMI is planning to publish additional research reports and peer reviewed papers in international journals.

### **3.4 Partners' Roles**

For Output 3 partnerships have been expanded to involve the following:

- *Kyrgyzstan:* Osh Technical University
- *Tajikistan:* Tajik Academy of Agricultural Sciences;
- *Uzbekistan:* Plant Research Institute

Ukrainian company "Agrosoyuz" is marketing no-till planters in Kazakhstan and is organizing training on no-till technologies with ICARDA scientists and other international experts.

## **Output 4: Strengthened national plant genetic resources (PGR) programs (ICARDA, Bioversity, ICBA).**

### **4.1 Relation to SP goals**

The output targets under the theme contribute to achievement the goals of System Priorities 1A, 1B and 5B through strengthening PGR conservation, documentation and information system, renovation/establishment of national Gene Banks, organizing collection missions, and developing a regional strategy on PGR.

### **4.2 Description of Impact Pathways**

Impact pathways remain same as in the MTP 2007-2009 for ICARDA and Bioversity (former IPGRI). ICBA is now strengthening its activities under this theme.

**ICBA:** The activities related to plant genetic resources (PGR) range from field studies to collection missions; seed storage and multiplication, propagation and distribution to evaluate their salt tolerance. Availability regional database on salt tolerant germplasm would be the first step to strengthen the national halophyte research in CAC. Initiatives are being taken through ADB project on Bright Spots and collaboration between ICBA and ICRISAT has resulted in introduction of new germplasm in CAC. Results of the preliminary work indicate to large scope for halophytes.

**4.3 Research Approach to Develop International Public Goods:** refer to MTP 2007-2009

#### **4.4 Partners' Roles**

For Output 4 partnerships have been expanded to involve the following:

- *Azerbaijan:* Institute of Genetic Resource
- *Kazakhstan:* Scientific Production Center of Soil and Crop Management
- *Tajikistan:* Research Institute of Soil and Crop Management
- *Uzbekistan:* Research Institute of Plant Industry

### **Output 5: Institutional strengthening through capacity building of national agricultural research systems (NARS), including human resource development.**

#### **5.1 Relation to SP goals**

The output targets under this theme contribute to the goals of System Priorities 5A and 5D through organizing various human resource development and institutional strengthening activities.

#### **5.2 Description of Impact Pathways**

The Impact Pathways as described in MTP 2007-2009 remain unchanged. In addition to these, ICBA has now strengthened its activities under this theme.

**ICBA:** ICBA is focusing on different aspects of 'biosaline agriculture' in CAC and has trained some scientists at its head quarters in Dubai, UAE and in the region. Recently ICBA has identified key scientists from the region for conducting research on halophyte production and uses. In future, it would facilitate the interaction of soil, water, plant production and utilization expert groups working on halophytes.

**5.3 Research Approach to Develop International Public Goods:** refer to MTP 2007-2009

**5.4 Partners' Roles:** refer to MTP 2007-2009

### **Output 6: Enhanced cooperation among agricultural research and educational institutions at the national and regional level and with other international organizations**

#### **6.1 Relation to SP goals**

The output targets under this theme contribute to the goals System Priorities 5A and 5D, and effectively go beyond SP goals to address the specific needs of the regional NARS for better intra-regional and inter-regional cooperation. In addition, this theme directly contributes to the Millennium development Goal 8 on Building Partnerships for Development.

**6.2 Description of Impact Pathways:** see MTP 2007-2009

**6.3 Research Approach to Develop International Public Goods:** see MTP 2007-2009

#### **6.4 Partners' Roles**

All stakeholders involved in the Program will be playing their role in enhanced cooperation, sharing information, knowledge and materials.

<b>Project CAC</b>	<b>Ecoregional Program: Collaborative Research Program for Sustainable Agricultural Development in Central Asia and the Caucasus</b>
<b>Goal</b>	Improved food security, economic growth, environmental sustainability and poverty alleviation in the countries of Central Asia and the Caucasus (CAC)
<b>Purpose</b>	Sustainable increases in the productivity of cropping systems through the generation and transfer of appropriate production technologies, natural resource management practices and the conservation of genetic resources, and by strengthening national agricultural research systems in the CAC region.

Output Targets		Intended Users	Outcomes	Impact
<b>Output 1: Germplasm for improved productivity and sustainability of key cereals and legumes that are important for food security (ICARDA, CIMMYT)</b>				
<b>2008</b>	A total of around 12 additional promising varieties of facultative/winter wheat, barley, food and forage legumes submitted to the State Varietal Testing Committees (SVTC) in CAC countries (ICARDA and CIMMYT)	National crop breeding and state varietal testing programs; national seed production programs.	Release and seed multiplication of 3-4 improved varieties of wheat, barley, food and feed legumes	Increased farm yields and production from newly released varieties
	At least 1-2 promising varieties of spring wheat submitted to SVTC in Kazakhstan for evaluation (CIMMYT)	National crop breeding and state varietal testing programs; progressive farmers involved in seed production	Testing of improved varieties of spring wheat at farmers fields	
<b>2009</b>	A total of around 12 additional promising varieties of facultative/winter wheat, barley, food and forage legumes submitted to SVTC in CAC countries (ICARDA and CIMMYT)	National crop breeding and state varietal testing programs; national seed production programs.	Release and seed multiplication of 4-5 improved varieties of facultative/winter wheat, barley, food and feed legumes	Increased farm yields and production from newly released varieties
	Seed multiplication of 1-2 promising varieties of spring wheat started at least at five locations (CIMMYT)	National crop breeding and state varietal testing programs; progressive farmers involved in seed production	Seed of improved varieties made available to farmers of Northern Kazakhstan	Increased farm yields and production from new varieties
<b>2010</b>	A total of around 12 additional promising varieties of facultative/winter wheat, barley, food and forage legumes submitted to SVTC in CAC countries (ICARDA and CIMMYT)	National crop breeding and state varietal testing programs; national seed production programs.	Release and seed multiplication of 3-4 improved varieties of wheat, barley, food and feed legumes	Increased farm yields and production from newly released varieties
	At least 1-2 promising varieties of spring wheat submitted to SVTC in Kazakhstan for evaluation (CIMMYT)	National crop breeding and state varietal testing programs; progressive farmers involved in seed production	Improved varieties of spring wheat for farmers	Increased farm yields and production from new varieties
<b>Output 2: Options for diversification of agricultural production systems (ICRISAT, CIP, IIRI, AVRDC, ICARDA)</b>				
<b>2008</b>	Newly identified/released groundnut varieties promoted for large scale adoption and their seed multiplied (ICRISAT)	National crop improvement programs; private farmers	Release of at least 1 or 2 improved groundnut varieties following seed multiplication by national programs	Increased area and production of groundnut and increased farm incomes

Output Targets	Intended Users	Outcomes	Impact
Improved rice breeding materials tested through INGER and japonica material from South Korean evaluated (IRRI)	National crop improvement programs	Use of improved rice varieties following testing and seed multiplication by national programs	Increased area and production of rice and increased farm incomes.
<p>Promising germplasm materials identified using in-vitro clones and true potato seed (TPS) families (CIP)</p> <p>Tuber families multiplied in each location to provide sufficient seed for trials (CIP)</p> <p>Network of public and private institutions established for multiplication and dissemination of good-quality potato seeds in Georgia and Uzbekistan (CIP)</p> <p>Potato virus distribution in different agro-ecological conditions of Uzbekistan determined (CIP)</p> <p>Distribution and importance of potato pests (esp. CPB) and natural enemies assessed and documented in the main potato production areas of Uzbekistan (CIP)</p>	National crop improvement programs and seed production agencies; private seed companies; seed growers, entomologists, virologists and resource-poor potato farmers in general	<p>National potato breeding and testing programs developed</p> <p>Informal and formal seed systems providing quality seed to farmers</p> <p>Virus-free seed potato growing areas determined.</p> <p>Documentation of the presence and distribution of potato viruses</p> <p>Entomoparasites identified and multiplied in Uzbek biological laboratories</p>	<p>Increased potato area and production</p> <p>Increased farm incomes</p> <p>Reduced seed imports</p> <p>Reduced micronutrient deficiencies in population at risk of malnutrition</p> <p>Farmers use less pesticides to control CPB</p>
<p>A new set of vegetable crops supplied to 3-4 countries of the region and varietal trials established (AVRDC)</p> <p>Hybrid trials of tomato and cucumber initiated and seed production of improved varieties of vegetable crops undertaken (AVRDC)</p> <p>Recommendations on vegetable soybean cultivation technology printing on Russian (AVRDC)</p>	National crop improvement programs; seed production agencies Farmers in CAC countries	National vegetable breeding and testing and quality seed production programs developed Wide cultivation of valuable crop	<p>Increased area and production of traditional and non-traditional vegetable crops, and increased and diversified farm incomes</p> <p>Increased market opportunities for vegetable soybean</p>
Salt tolerant lines/accessions of sorghum and pearl millet suitable for salt affected areas of Kazakhstan, Turkmenistan, Tajikistan and Uzbekistan are identified (ICBA, ICRISAT)	NARES for introduction of new germplasm in the region	Identification of lines and varieties of sorghum and pearl millet that can be introduced in salt-affected areas	Better productivity in salt affected farms. Improved livelihood of farmers.
On-farm management practices of salt affected areas, including the introduction of conventional and non-conventional forage species, are introduced and evaluated (ICBA)	NARES for introduction of new germplasm in the region	Identification of suitable species that are adapted to the agro-climatic conditions of different CAC republics	Improved land and water conditions for cultivation of alternate forage production system
Pilot sites for the rehabilitation of Kyzylkum Desert of Uzbekistan through introduction of halophyte production system using artesian saline water are established (ICBA)	National program on sheep breeding in Uzbekistan. Farmers of Kyzylkum region	Cultivation of halophytes using artesian saline water in desert area to provide forage for animals	Marginal areas to be turned into production system.
Crop diversification in spring wheat-summer fallow and winter wheat - fallow based cropping systems and in irrigated cotton or wheat based cropping systems in CAC adopted in 10% area / by farmers in CAC/ILM project area (ICARDA)	Associations of Farmers; private farmers	Diversified agricultural production using different crop options in existing predominant cotton or wheat systems	Sustainable land management; improved cropping intensity and increased farmers' incomes in target areas

	Output Targets	Intended Users	Outcomes	Impact
2009	A new set of groundnut varieties evaluated (ICRISAT) Farmers trained in groundnut seed production (ICRISAT) Informal seed sector at the village level promoted (ICRISAT)	National crop improvement programs; associations of farmers; private farmers	Farmers produce and supply seeds of improved groundnut varieties at the local level	Increased area of improved groundnut varieties and increased groundnut production
	Newly identified/ released rice varieties promoted for large scale adoption and their seed multiplied (IRRI)	National crop improvement programs; seed production agencies	Release of improved rice varieties following testing and seed multiplication by national programs	Increased area and production of rice and increased farm incomes
	Four elite clones combining virus resistance and high micronutrient content adapted to long days are identified in CAC for evaluation under farmers' conditions (CIP) Role of positive and negative selection combined with disease-detection techniques evaluated and documented for its contribution to improve formal and farmer-based potato seed systems in Uzbekistan and Georgia (CIP) TPS, as an alternative seed potato production technology, tested and documented in Uzbekistan and Tajikistan. (CIP) Potato seed strategy disseminated and validated in Tajikistan and Kyrgyzstan (CIP) IPM for CPB tested and documented in Uzbekistan (CIP). Potential use of biocontrol agents (entomopathogens, parasitoids) for potato pest management assessed and documented in Uzbekistan (CIP).	National crop improvement programs and seed production agencies; private seed companies; seed growers, resource-poor farmers, entomologists, and virologists	National potato breeding and testing programs developed Informal and formal seed systems providing quality seed to farmers NARS, seed potato growers and cooperatives adopt improved seed multiplication techniques to reduce seed imports. IPM research documented in CAC Farmers replace their own seed with highland sources only every 3-4 seasons, and acquire basic understanding of seed management. Medium and long-term productivity gains maintained through the continuous provision of quality seed.	Increased potato area and production Increased farm incomes Reduced seed imports Reduced micronutrient deficiencies in population at risk of malnutrition Reduced use of pesticides
	At least 100 new accessions of vegetable crops supplied from AVRDC Gene Bank to 5-6 countries of the region and varietal trials established (AVRDC) Crossing program for genetic improvement of onion and melon launched and vegetable crops promising varieties seed multiplication initiated (AVRDC) Booklet on vegetable soybean and leaf cabbage recipes printed in Russian and made available to general public (AVRDC)	National crop improvement and seed production programs  Rural and urban consumers in CAC countries	National vegetable breeding and testing and quality seed production programs developed  Expanded demand for vegetable soybean and leafy cabbage	Increased area and production of traditional and non-traditional vegetable crops  Increased and diversified farm incomes  Increased market opportunities for vegetable soybean and leafy cabbage. Producers' diversified diet.
	Potential lines/varieties of sorghum and pearl millet are multiplied to meet farmers' demands in the region (ICBA, ICRISAT).	National agricultural system of the region and farmers	Availability of germplasm in the region for further upscaling and expansion	Self sufficiency and maintenance of germplasm in the region

Output Targets		Intended Users	Outcomes	Impact
	Management strategies for optimizing productivities of selected conventional and non-conventional forage germplasm are identified (ICBA, ICRISAT)	National agricultural system of the region and farmers	Identification of agronomic and other practices for selected better of germplasm for forage	Application of management strategies for improvement of marginal areas and increased forage production
	Successful indigenous and introduced halophyte species in Kyzylkum Desert of Uzbekistan for large scale forage production system are identified (ICBA)	Karakul Sheep Breeding Institute and farmers	Identification of potential halophytes that can be grown with artesian saline water available in the area	Supplemental forage production for Karakul Sheep Breeding Institute and others in the region.
	Forage quality evaluation and animal feeding trials established in Kazakhstan, Turkmenistan, Tajikistan and Uzbekistan (ICBA, ICRISAT, ICARDA)	Karakul Sheep Breeding Institute and other animal production centers in the region.	Identification of germplasm with high nutritional value, palatability and digestibility	Alternate forage crops with high nutritional value for animals
	Crop diversification in spring wheat-summer fallow in rainfed area, in winter wheat-fallow cropping systems and in irrigated cotton or wheat based cropping systems adopted by farmers in CACILM project area (ICARDA)	Associations of farmers; private farmers	Diversified agricultural production using different crop options in existing predominant cotton or wheat systems	Sustainable land management; improved cropping intensity and increased farmers' incomes
<b>2010</b>	Three CIP-derived potato varieties identified and incorporated in local seed systems in Uzbekistan and Tajikistan (CIP) Adaptation of a set of ten TPS families to long day conditions of CAC highlands documented (CIP) Five elite clones combining earliness, resistance and high micronutrient content identified in the CAC region (CIP) A strategy for promotion and diffusion of varieties implemented in at least two CAC countries (CIP) Strategies for improving formal and farmer-based seed systems documented in two countries of CAC (CIP) One strategy for CPB control in potato cropping systems in Uzbekistan assessed (CIP)	NARS, NGOs, universities, resource poor farmers, seed growers' associations and cooperatives, certification agencies	Mechanisms of release of beneficial insects and entomopathogens described and mutually agreed respecting international biosafety standards.  NARS, private sector and farmers' organizations develop efficient seed production schemes  NARS, private sector and farmers' organizations work collaboratively to facilitate seed multiplication and distribution.	Effects of using IPM strategy on potato yield and environmental safety assessed.  Increased availability of quality seed permits reducing seed imports  Medium and long-term productivity gains through quality seed maintained through the continuous provision of quality seed.
	A new set of vegetable crops varieties evaluated (AVRDC) Newly identified/ released vegetable crops varieties promoted for large scale adoption and their seed multiplied (AVRDC) Farmers trained in vegetable crop cultivation and seed production (AVRDC)	National crop improvement and seed production programs	National vegetable breeding and testing and quality seed production programs developed	Increased area and production of traditional and non-traditional vegetable crops  Increased and diversified farm incomes

Output Targets		Intended Users	Outcomes	Impact
	Salt tolerant sorghum and pearl millet genotypes identified as suitable for salt affected regions up-scaled and distributed to at least 15 farmers in Kazakhstan, Turkmenistan, Tajikistan and Uzbekistan (ICBA, ICRISAT)	National agricultural system of the region and farmers	Increased forage productivity in the salt affected areas of the region	Increased livelihood of farmers
	Seed multiplication and field expansion of successful germplasm of conventional and non-conventional forage established in Kazakhstan, Turkmenistan, Tajikistan and Uzbekistan (ICBA)	National agricultural system of the region	Salt tolerant germplasm for the region stored and multiplied locally.	Germplasm availability in CAC republics
	Management strategies for optimizing halophyte forage production identified and applied (ICBA)	Karakul Sheep Breeding Institute and other animal production centers	Increased forage productivity	Alternate forage production system in Kyzylkum region
	Animal feed production guidelines for the use of conventional and non-conventional forages grown under saline conditions identified and made available to NARES (ICBA)	Karakul Sheep Breeding Institute and other animal production centers	Development of feed industry in the region	
<b>Output 3: Integrated natural resource management practices, technologies and institutions for improved soil and water productivity (ICARDA, IWMI, CIMMYT)</b>				
<b>2008</b>	<p>Recommended policy changes for introducing sustainable 'Bright' spots in the Aral Sea basin conveyed to policy makers through roundtable discussions (IWMI/ICARDA).</p> <p>Cost-benefit analysis of the farming practices introduced in project sites in the Aral Sea basin completed (IWMI/ICARDA).</p> <p>Analysis of market advantages and constraints for crops grown on salt-affected soils in project sites in the Aral Sea basin completed (IWMI/ICARDA)</p> <p>Recommended 'Bright Spots' disseminated and transferred to other targeted areas in Aral Sea basin (IWMI/ICARDA).</p> <p>Soil quality mapping using remotely sensed data developed and provincial maps developed for Uzbekistan (IWMI)</p> <p>Water productivity maps produced for the basin (IWMI)</p> <p>Policy recommendation developed to improve Basin water management and quality through groundwater development in the Fergana Valley (IWMI)</p>	<p>Policy makers</p> <p>Farmers in project pilot sites; National R&amp;D programs</p>	<p>Policy makers adopt appropriate policy options that support the development of 'bright spots' in the Aral Sea basin</p> <p>Farming communities in project pilot sites adopt project interventions. National R&amp;D programs actively disseminate and promote the project's recommendations in other sites in the Aral Sea basin</p>	Improved soil quality, crop productivity and farm incomes in Aral Sea basin

Output Targets		Intended Users	Outcomes	Impact
	No-tillage technologies adopted for rainfed spring wheat based systems in northern Kazakhstan, in winter wheat based systems in Kyrgyzstan, and raised bed technologies in irrigated cotton and winter wheat systems in CAC (ICARDA)	Associations of farmers; private farmers	Adoption of no-tillage practices	Improved soil management, reduced cost of production and increased yields
	Prospectus on Sustainable Land Management (SLM) Research in CAC for CACILM Program designed (ICARDA)	NFP, national R&D programs, farmers associations	National partners undertake analysis and land degradation assessments and generate policy options for sustainable development  SLMR Prospectus integrates with NFP. Donors and institutions become sensitized to new SLM issues for improved livelihoods.	Farmers use best bet practices Resilience of degraded natural resources
	Conservation tillage practices applied in rainfed spring wheat based system in 20 sites in at least three administrative regions of Northern Kazakhstan (CIMMYT)  Bed planting technology for irrigated wheat production applied in 10 sites in four countries (CIMMYT)	National R&D programs; progressive farmers	National R&D programs actively promoting technologies for use by farmers	Improved soil and water management and improved productivity of wheat in target areas
	On-farm integrated resource management practices for salt affected areas are introduced and evaluated in selected farms in Tajikistan (ICBA)	National agricultural system of the region and farmers	Knowledge on resource management of soil and water	Salt affected abandoned lands brought back to production
2009	Large scale adoption of no-tillage technologies in CAC s in CACILM project area (ICARDA)	Associations of farmers; private farmers	Adoption of no-tillage practices	Improved soil management, reduced production costs and increased yields
	Enhancing water productivity in irrigated agriculture in Uzbekistan through a rice wheat cropping system (IWMI/ICARDA/IRRI)  Basin scale soil quality maps produced (IWMI)  Enhanced functionality of WAUs in the Fergana Valley achieved along with enhanced water productivity (IWMI)	National R&D program; progressive farmers	National R&D programs actively promoting technologies for use by farmers	Improved soil and water management and enhanced productivity of rice/wheat systems.
	Role of biodrainage as on-farm management in reclamation of saline-waterlogged farms in Khodjent, Tajikistan evaluated (ICBA)	National agricultural system of the region and farmers	Role of trees in lowering water tables for growing other crops	Improved soil management for other cash crops in salt affected areas

Output Targets		Intended Users	Outcomes	Impact
	Conservation tillage practices applied in rainfed spring wheat based system in total area of 300,000 ha in at least three administrative regions of Northern Kazakhstan (CIMMYT)  Bed planting technology for irrigated wheat production applied in at least 5% of the total winter wheat area (CIMMYT)	National R&D programs	National R&D programs actively promoting technologies for use by farmers	Improved soil and water management and improved productivity of wheat in target areas.
2010	No-tillage technologies adopted on 15% of rainfed cropland and raised bed planting technologies for irrigated cropland adopted by farmers in CACILM project area (ICARDA)	Associations of Farmers, Departments of Agriculture	Farmers adopt project interventions related to Conservation Agriculture	Improved soil and water , reduced land degradation and improved resilience of degraded lands
	Management strategies for optimizing productivities of conventional and non-conventional forage plant species in saline areas reclaimed through bio-drainage developed and applied in selected farms (ICBA)	National R&D programs; progressive farmers	Efficient utilization of resources	Increased productivity on abandoned farms
	Wheat rice cropping systems applied and expanded in irrigated agriculture in Uzbekistan (IWMI).  WUA's enhanced and effectively self sufficient (IWMI)	National R&D program; progressive farmers	National R&D programs actively promoting technologies for use by farmers	Improved soil and water management and enhanced productivity of rice/wheat systems
	Conservation agriculture for rainfed spring wheat introduced in all main wheat producing areas of Northern Kazakhstan (CIMMYT)	National R&D programs; farmers	National R&D programs actively promoting and farmers widely using conservation agriculture technologies	Improved soil and water management and improved productivity of wheat in target areas
<b>Output 4: Strengthened national plant genetic resources (PGR) programs (ICARDA, Bioversity International)</b>				
2008	Medium term gene banks in the CAC region are fully function with trained personnel (ICARDA)	National PGR conservation programs	All available accessions of plant genetic resources are stored in gene banks	Reduction in genetic erosion
	Practices and knowledge to support the maintenance and use of temperate fruit diversity in production systems in Central Asian countries identified and under evaluation (Bioversity)  Effective documentation and information systems for crop wild relatives are available, disseminated and used by national programs in two CAC countries (Bioversity)	National PGR conservation programs	Farmers, local institutions and NARS use diversity-rich options to enhance production systems productivity and resilience, supported by appropriate policies and beliefs.  Genetic resources of crop wild relatives, conserved <i>in situ</i> , are fully documented within a common system that facilitates access to and exchange of information	Farmers benefit from increased areas planted to horticultural crops and wild fruit species diversity  Reduction in genetic erosion

Output Targets		Intended Users	Outcomes	Impact
	Field survey and seed collection of salt tolerant plant genetic resources of CAC region (ICBA, Bioversity, ICARDA)	National PGR conservation programs	In-country distribution data on salt tolerant species Sustainable conservation ( <i>ex situ</i> and <i>in situ</i> ) of salt-tolerant germplasm Identification of salt-tolerant germplasm	Continued availability of salt-tolerant germplasm to national programs and other stakeholders
2009	Methodology and procedures for use by national partners and farmers/communities for <i>in situ</i> /on farm conservation of fruit crops and their wild relatives are available (Bioversity)	National PGR conservation programs; farming communities	Wild relatives, landraces and species of fruit crops effectively conserved through <i>in situ</i> /on farm methods	Reduction in genetic erosion Returns to farming communities from <i>in situ</i> conservation (incentives, income from seed production, etc)
	Socio-economic aspects of <i>in situ</i> / on-farm conservation of PGR studied and results included in policy recommendations (Bioversity)	Policy makers	Policy options adopted that encourage and enable rural communities to implement <i>in situ</i> conservation	Farming communities benefit from <i>in situ</i> conservation activities
	Seed multiplication and propagation of salt tolerant plant genetic resources of CAC region initiated (ICBA, IPGRI, ICARDA)	National PGR conservation programs; farming communities	Improved access to potentially salt tolerant germplasm by farmers	Productive use of salt affected lands
2010	Community-based PGR management system developed for fruit crops (Bioversity)	National PGR conservation programs, farmers, community members, researchers, policy makers	Community-based PGR management system for fruit trees established in two CAC countries	Reduction in genetic erosion Communities benefit from fruit tree PGR management activities
	The income generation potential of the horticultural sector in at least 4 countries examined (Bioversity)	Farmers, community members, researchers, policy makers, business persons	Findings motivate farmers to continue maintenance of local diversity of fruit crops and help policy makers to strategize development of agriculture based on local agrobiodiversity	Local varieties of target fruit crops are better conserved and their use will contribute to income generation of farmers
	Status of crop wild relatives assessed and action plans developed for their <i>in situ</i> conservation in two CAC countries (Bioversity )	National PGR conservation programs and decision makers	Action plans implemented in target areas in two CAC countries	Reduction in genetic erosion. Crop wild relatives, adapted to local agroecological conditions, available for future crop improvement research
	Seed distribution and establishment of salt tolerant plant genetic resources <i>in situ</i> gene bank in CAC Region (ICBA)	National PGR conservation programs	Increased cropping area under salt-tolerant plant species	Improved productivity and contribution of agriculture to GDP
	Catalogue on characterization of different accessions produced	National PGR conservation programs; farming communities	Better use of genetic resources is ensured	Increased farmers' income

Output Targets		Intended Users	Outcomes	Impact
<b>Output 5: Institutional strengthening through capacity building of NARS</b>				
2008	Regional level meeting for yellow rust and Sunn pest management in wheat (ICARDA) SLM-R workshop organized for assessment of land degradation, common methodologies and ex-ante analysis	National research programs; university students and young scientists	Trained national staff	Enhanced national and regional capacity for agricultural R & D Well trained and experienced human resource
	Specialized training of national scientists in: <ul style="list-style-type: none"> <li>– rice research and development (IRRI)</li> <li>– IPM techniques to control Colorado Potato Beetle and other emerging pests (CIP)</li> <li>– vegetable research and development (AVRDC)</li> <li>– integrated feed and livestock management (ICARDA)</li> <li>– improved WUE and crop diversification (ICARDA)</li> <li>– germplasm evaluation, documentation and collection management (Bioversity )</li> <li>– use of GIS for assessment of diversity distribution (Bioversity)</li> <li>– participatory approaches in agro-biodiversity management (Bioversity )</li> <li>– resource management in salt affected areas (ICBA, ICARDA)</li> </ul>	National research programs; university students and young scientists	Trained national staff	Enhanced national and regional capacity for agricultural R & D Well trained and experienced human resource
2009	Training of trainers to build Farmers' Field Schools for IPM (ICARDA) Regional and national training centers on priority fruit crops established; training of instructors on PGR policy issues (Bioversity) Workshop of specialized working groups on production and utilization of salt-tolerant forage crops (production and management of crops; and animal feeding (ICBA, ICARDA)	National research programs; university students and young scientists	Trained national staff Centres of Excellence on Priority Fruit Crops Training	Enhanced capacity of national staff Enhanced national and regional capacity for agricultural R & D
	Specialized training of national scientists in: <ul style="list-style-type: none"> <li>– potato breeding &amp; selection (CIP)</li> <li>– molecular marker technology for PGR evaluation for two scientists (Bioversity )</li> <li>– on-farm research of dynamic production systems</li> </ul>	National research programs; university students and young scientists	Trained national staff	Enhanced capacity of national staff Enhanced national and regional capacity for agricultural R & D

Output Targets		Intended Users	Outcomes	Impact
2010	Workshop of specialized working groups on socio-economic aspects of adoption of production and utilization of salt-tolerant forages in the targeted countries (ICBA, ICARDA)	National research programs; university students and young scientists.	Trained national staff	Enhanced capacity of national staff Enhanced national and regional capacity for agricultural R & D
	Specialized training of national scientists in: <ul style="list-style-type: none"> <li>– improved irrigation and drainage (IWM)</li> <li>– use of molecular marker technology for PGR evaluation (Bioversity)</li> <li>– designing dynamic production systems combining minimum tillage with diversified crop rotations</li> </ul>	National research programs; University students and young scientists.	Trained national staff	Enhanced capacity of national staff Enhanced national and regional capacity for agricultural R & D
<b>Output 6: Enhanced cooperation among agricultural research and educational institutions at the national and regional level and with other international organizations.</b>				
Annually	One regional planning and coordination/steering committee meeting. One regional conference, one regional training course and one regional traveling workshop. Regional conferences, seminars, workshops and English training. Knowledge of new technologies and varieties disseminated through publications, reports, CAC Newsletter and web site. Collaboration among NARS in CAC region strengthened through support to the Regional Forum – CACAARI	National agricultural R&D programs and universities	Regional exchange of information and results on agricultural R&D Integration of CAC national programs into international agricultural R&D community Regional and international partnerships in agricultural R&D	Sustainable increases in agricultural productivity through the transfer of appropriate production technologies, natural resource management practices and the conservation of genetic resources.