CGIAR COLLABORATIVE RESEARCH PROGRAM FOR CENTRAL ASIA AND THE CAUCASUS

Annual Report (2001-2002)[1]

Raj Paroda
Head, CGIAR-PFU
Tashkent, Uzbekistan

1. BACKGROUND

During the year under report, most of the CAC countries in the region celebrated their first decade of independence. As is evident, there had been uneven progress in the process of transforming the formerly centrally planned economies into market economies, and the process has led to significant consequences in some countries. While on one side, the importance of agriculture in the region increased through its share, on the other, the agricultural production dropped in the mid- 1990s. While it recovered in some countries, on an aggregate, agricultural, crop and livestock production indices are still ranging between 50-90% of the pre-independence base of 1989-91. As a result, GNP per capita has declined by an average of 25% between 1991 and 1997. Six of the CAC countries (Armenia, Azerbaijan, Georgia, Kyrgyzstan, Tajikistan and Uzbekistan) are now classified as low income countries, and GNI per capita for the CAC region as a whole is presently less than the overall average for the developing countries in the world[2]. Consequences of all these led to increased poverty (25 to 40%) in the region.

Also since independence, the institutional and human resource base got depleted, for want of support for agricultural research for development, justifying thereby the need for major support for agricultural research partnership within the region with other NARS and with international organizations such as CGIAR. Accordingly, with an overall goal of the CGIAR program of providing food security, economic growth and poverty alleviation in the Central Asia and the Caucasus, nine CGIAR Centers started working jointly in the region, with ICARDA taking the facilitation function through World Bank funded system wide program, in 1998 and later through other donor funded initiatives. In this report, major achievements of the CGIAR program for CAC are being highlighted, with emphasis on important accomplishments during the last one year:

1.1. PROGRAM ESTABLISHMENT

In February 1995, the Lucerne Declaration and Action Program emphasized the need for strengthening the linkages with research institutes in Central Asia, Russia and Eastern Europe to tap the enormous potential of these areas to contribute significantly to global food supply.

Late in 1995, a CGIAR Task Force on Central/Eastern Europe and the states of the Former Soviet Union was formed to identify the needs of agricultural research of these countries. A consultation meeting between the CGIAR Centers and Central Asia and the Caucasian NARS was organized by ICARDA in Tashkent, during September 1996. The consultation reinforced the need for collaboration in agricultural research. The Task Force recommended to the CGIAR to extend support for agricultural research and human resource development by expanding its geographic mandate to the CAC region. The CGIAR accordingly approved this recommendation at the International Centers Week (1996), and encouraged the CG Centers to develop partnerships with the NARS in CAC in their respective mandated areas of

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[2] According to latest figures available for 2000, average GNI per capita for CAC countries was US$ 615 compared with the average of US$ 1,240 for all developing countries (World Bank, 2001).

agricultural research. Accordingly, in October 1997, the nine CG Centers (CIMMYT, CIP, ICARDA, ICRISAT, IFPRI, ILRI, IPGRI, ISNAR and IWMI) agreed to form a Consortium with ICARDA being the lead Center. The main objective of the Consortium was to develop a strategy for inter-center partnership collaborative research with greater involvement of the national programs in the region. The Consortium eventually developed a *CGIAR Collaborative Research Program for CAC* in May, 1998 and the same was launched in September, 1998 with its approval by the Steering Committee in a meeting held in Tashkent, Uzbekistan. Also a Program Facilitation Unit (PFU) was established in the CACRP Office of ICARDA in Tashkent. PFU has since then been providing facilitation function for the inter-center and inter-NARS initiatives in the region.

For effective implementation, coordination and governance of the collaborative program, in consultation with all stakeholders a strategy was developed, which was evaluated by TAC in March, 2000 and approved by the CGIAR in May, 2000.

1.2 REGIONAL PRIORITIES IDENTIFIED

Since the establishment of the collaborative program, there have been extensive consultations between CG Centers and the NARS to identify and prioritize thematic research areas (for instance, germplasm improvement, soil and water management, livestock development, policy orientation, and NARS institutional strengthening). With the seed money provided by the CGIAR and additional funds raised by the participating centers, the program has made significant progress. Annual meetings have been held regularly between all participating CG Centers and NARS at which work plans are reviewed and adjusted according to re-assessed priorities.

During the year under report, in line with the bottom-up priority setting approach adopted by the CGIAR under “Plank 4” of the CGIAR’s vision and strategy, the CAC Regional Forum and ICARDA organized a brainstorming meeting with NARS leaders and representatives of concerned CG Centers and donors on 20 September, 2001 in Tashkent and more recently again in Aleppo on 8-10 May, 2002 in order to revisit earlier priority-setting efforts. According to the broad consensus, the following research priorities were identified:

- Productivity enhancement of crops and thrust on seed development, with major emphasis on cereals, legumes, oilseeds, fruits and vegetable crops. Breeding of high yielding varieties with resistance to diseases, pests, drought and salinity. Also search for genotypes that can withstand better the low input conditions.
- Soil and water management for sustainable agriculture, including thrust on nutrient and water use efficiency, on-farm water management, marginal water utilization, salinity, drainage, conservation tillage etc.
- Conservation of genetic resources (crops and livestock) in view of existing rich diversity in the region.
- Livestock improvement and management with emphasis on market oriented breed improvement, health, feed management and rangeland resources.
- Crop diversification, with greater emphasis on incorporation of legumes in cropping systems for long-term sustainability, for better income generation and for household nutrition security.
- Post-harvest management, storage and value addition of crops, livestock, fruit and vegetable products that can help small and marginal farmers in rural areas.
- Socio-economic and policy research for infrastructure development, economic feasibility of technologies, resource evaluation, marketing, finance, and policy interventions for required adjustments in market economy.
- Strengthening of NARS and human resource development, with greater emphasis on training, including language training.

The partners also recognized that to achieve these objectives, multi-disciplinary, inter-institutional participatory research with a community-based approach would be needed.

The policy makers of the CAC region also recognized the value of the collaborative research and committed themselves to strengthening research for development and sustainable agriculture. Policy makers met with CG Centers and donor representatives in June 2001 in Issyk-kul, Kyrgyzstan and adopted the *Issyk-kul Declaration* in support of agricultural research for development, which desired

all key partners in international agricultural research to play a proactive role in building the agricultural research system in the region. As a result of this, various national governments are now re-examining their research support strategy in the agricultural sector.

2. GERMPLASM ENHANCEMENT

In the past, the CAC countries were essentially a specialized commodity-producing region importing inputs from other places and exporting its produce elsewhere. In Uzbekistan, Turkmenistan, Azerbaijan, cotton was a major crop, whereas in Georgia, Armenia, and Tajikistan, fruits and vegetable crops were dominant. At present, given the pressing need to meet domestic food demands, national policies tend towards promoting food security, both through increased production and diversification of the crops produced. Major constraints to improving crop production are the lack of improved high yielding varieties and poor access to germplasm. Research activities on germplasm enhancement have focused on testing different crop varieties to identify promising breeding material with resistance to both biotic and abiotic stresses.

- Annually, about 4200-4500 entries from 80 different nurseries of cereals, legumes, groundnut and potato supplied by ICARDA, CIMMYT, ICRISAT and CIP are tested in CAC region. Practically in all the eight CAC countries, the new promising breeding material has been identified, which is being used now either for improvement of the local germplasm or for direct multiplication and introduction on farmers' fields.

- For crop diversification in Central Asia and the Caucasus countries, the important role of legumes is being increasingly felt since testing of chickpea, lentil, vetch, groundnut, etc. started under the program. Collaboration during last 3-4 years has resulted in identification of some promising breeding material, which has been taken for seed multiplication and for on-farm trials and demonstrations.

- CIP provided potato germplasm for testing in the Caucasus and found that new varieties tested were promising over the local checks. Also specific need assessment for Central Asian countries has been made for proposed collaboration. Similarly, ICRISAT tested groundnut varieties in six countries of the region and found several promising lines that significantly outyielded the local checks.

In summary, during the last four years of collaborative research, six promising varieties of winter wheat (2), winter barley (1), spring barley (1), chickpea (1), and lentil (1) have already been released in the region based on their superior performance. These varieties have recorded consistently 30 – 40 % higher yield with superior cold tolerance and disease resistance over the local checks. In additions, more than 25 varieties of different crops are presently being tested in the State Varietal Trials, and are awaiting decisions for their release and wide scale adoption.

2.1 WHEAT VARIETAL IMPROVEMENT

- **Winter wheat:**

- During the last few years, area sown to cereals, especially bread wheat has significantly increased in the CAC countries, except in Kazakstan. In view of the growing importance of winter wheat in the region, wheat breeders from Turkey, CIMMYT and ICARDA in partnership with concerned national breeders have identified a number of promising varieties of winter wheat. These are:

  Ani-326 (Armenia: for both irrigated and rainfed conditions, average yield gain 34%, potential productivity 6.0 t/ha).
  Azametli-95 (Azerbaijan: early maturity, good resistance to diseases, for irrigated conditions and foothills, average yield gain 32%, potential productivity 7.0-8.0 t/ha).
  Gobustan (Azerbaijan: resistant to yellow rust for rainfed, foothills and semi dry conditions, average yield gain 29%, potential productivity 7.0 t/ha).
  Guncha (Turkmenistan: for irrigated conditions, heat and drought tolerant; average yield gain 15%, potential productivity 6.0 t/ha).
  Bitarap (Turkmenistan: for irrigated and high temperature conditions, average yield gain 18%, potential productivity 6.5 t/ha).
  Garagum (Turkmenistan: for irrigated and drought conditions, average yield gain 20%, potential productivity 7.0 t/ha).

Dostlik (Uzbekistan: for irrigated conditions, average yield gain 25%, potential productivity 8.0 t/ha, highly efficient variety in terms of economic water use).
Mtskhetis-1 (Georgia: for rainfed conditions, average yield gain 41%, potential productivity 7.0 t/ha).
Jamin (Kyrgyzstan, for both irrigated and rainfed conditions, average yield gain 20%, potential productivity 8.0 t/ha).
Norman (Tajikistan, for irrigated conditions, average yield gain 15 – 30%, potential productivity 8.0 t/ha).
Tacika (Tajikistan, for irrigated conditions, average yield gain 12 – 26%, potential productivity 7.0 t/ha).

All the new varieties demonstrate yield advantage of 15-20% combined with good resistance to major diseases, especially the yellow rust.

On-farm testing

- Large scale on-farm promotion of new varieties and technologies was jointly supported and conducted in each of the countries. These were:
  Armenia: in cooperation with the State Variety Testing Commission and Armenian Technology Group (USA NGO).
  Azerbaijan: in cooperation with Azerbaijani Agriculture Research Institute and Tovuz-Baltya (private seed company).
  Georgia: in cooperation with the State Variety Testing Commission.
  Kazakstan: as a part of GTZ-CIMMYT project.
  Kyrgyzstan: in cooperation with Kyrgyz Agriculture Research Institute and some externally funded projects (WB, TACIS, DFID).
  Tajikistan: as a part of GTZ-CIMMYT project and in cooperation with the Soil Research Institute.
  Turkmenistan: in cooperation with the Turkmen Agriculture Research Institute
  Uzbekistan: as a part of GTZ-CIMMYT project, and ICARDA support for seed development

The on-farm testing and seed development programs so undertaken provided either higher yield or considerable savings on inputs and labor.

Information exchange and Human capacity building

- In May, 2002, ICARDA in collaboration with the Ministry of Agriculture and Water Resources of Uzbekistan organized a traveling workshop on "Establishing demonstration trials under on-farm conditions". In all, 57 participants of the workshop jointly visited the demonstration sites in Tashkent, Syrdarya, Jizak and Bukhara provinces to see the performance of the new promising wither wheat varieties sown in 20 locations in Uzbekistan.

- On 2-8 June, 2002, International Regional Travel Scientific-Practical Seminar on "Breeding, seed production and on-farm experiments of winter wheat in Central Asia and the Caucasus" was organized jointly by GTZ, CIMMYT and ICARDA in Kazakstan and Kyrgyzstan. The objective of this seminar, involving about 55 participants from CAC countries as well as from Turkey and Iran, was to examine breeding, seed production and on-farm experiments of winter wheat and to facilitate interaction between the scientists from different countries thus enhancing regional and inter-regional cooperation in this sphere.

➢ **Winter triticale:**

The winter triticale from CIMMYT-Mexico proved superior in grain yield and forage potential for areas with warm winters. The varieties being officially tested are:
Azerbaijan: Manati, Shirvan
Uzbekistan: Farhad, Norman

➢ **Spring wheat**

Kazakhstan-Siberia Network on Spring Wheat Improvement (KASIB) held its annual meeting in Shrotandy, Kazakhstan in August, 2002. The major activities of the network facilitated by CIMMYT during the year 2001-2002 were:

- Distribution and evaluation of the 2nd Kazakhstan-Siberia Spring Wheat Nursery (bread and durum wheat) as a vehicle for regional germplasm exchange

- Coordinated evaluation of germplasm for disease resistance

- Coordinated efforts for variety development resulting in an enhanced efficiency of work.

Shuttle breeding between Kazakhstan and Mexico to combine drought tolerance, disease resistance and superior bred-making quality.

- The first lines selected in Mexico from the crosses between Mexican and Kazakh/Siberian varieties were screened under the conditions of Northern Kazakhstan. Their adaptation appeared to be better compared to conventional Mexican germplasm. Their testing on bigger plots will take place in 2002.

On-station experiments with zero tillage have also been established in Shortandy and Karagandy, Kazakhstan. The first year results suggest that optimal combination of green manure crops, herbicide treatment and several other factors will need to be defined for this technology to be economically attractive and technically feasible. The sample planter was manufactured allowing little soil disturbance while planting.

2.2 BARLEY VARIETAL IMPROVEMENT

After wheat, barley is the second most important grain crop in all the CAC countries. In the FSU (Former Soviet Union) in Kazakstan, 7.0 million ha have been sown to barley. Even now, after a considerable reduction of the area sown to all grain and forage crops, barley is still grown in Kazakstan on rather large area of about 3.0 million ha. Usually, barley yields are, on an average, about 10-15% higher than wheat under rainfed conditions and this has justified growing barley on large area. But this yield increment became less attractive when the wheat grain prices went up. Therefore, barley varieties must yield more by 25-30% over present wheat varieties.

The main limiting factors in barley are diseases, insects, and weeds, whereas drought, high temperature during grain filling stage, cold in winter time, and high soil salinity are major constraints of abiotic origin. Taking into consideration these limiting factors, the following promising barley varieties have been identified through major facilitation role played by ICARDA:

- **Winter barley:**

  Adel (Kyrgyzstan: for rainfed conditions, very early variety, promising for malting, average yield gain 28%, potential productivity 6.0 t/ha).
  Bakharly (Rihane-03) (Azerbaijan: for semi arid and irrigated conditions, average yield gain 18%, potential productivity 6.0 t/ha).

- **Spring barley:**

  Mamluk (officially released variety in Armenia for rainfed conditions and supplementary irrigation, average yield gain 29%, potential productivity 5.0 t/ha).

In 2001, 1520 breeding lines of winter barley were distributed by ICARDA and 786 entries of spring barley by CIMMYT.

2.3 LEGUME VARIETAL IMPROVEMENT

As a result of monoculture dominant during the former Soviet period, many valuable plants fell in the category of “neglected crops” and received very little attention despite their importance for nutritional security and sustainability of production systems. However, food and forage legumes have great potential and importance in the farming systems in Central Asia and the Caucasus, especially in Uzbekistan, Kazakstan, and Azerbaijan. Under the program, ICARDA laid greater emphasis on food and forage legume testing against drought, heat, diseases and weeds and identified several new promising lines for large scale state varietal testing and release.

- **Food legumes:**

In case of chickpea and lentil, yield trials data have clearly demonstrated the importance of the proper planting date. Early planting in spring in cool areas and autumn planting in mild environments have considerably increased yield of chickpea and lentil. As an example, in Azerbaijan Research Institute of

Agriculture near Baku, yields of the best chickpea lines in autumn planting were 16-20 qtls/ha whereas in spring planting the yield was around 9-10 qtls/ha. The similar results were observed for lentil: yield of line ILL 6037 in autumn planting was 16 qtls/ha, whereas in spring planting it was only 7 qtls/ha. In Georgia, standard check variety of lentil in spring planting produced only 4 qtls/ha, whereas improved ICARDA line 8069 performed well with grain yield of 20 qtls/ha. As for chickpea, yield in spring planting was 13 qtls/ha, whereas it was 21 qtls/ha in autumn. In Uzbekistan, yield ranged between 7-8 qtls/ha for winter chickpea and 4-5 qtls/ha for spring chickpea.

In 2001, a large number of international nurseries have been tested in Central Asia and the Caucasus countries: chickpea-6 nurseries, 227 entries, lentil-5 nurseries, 133 entries, vetch-3 nurseries, 48 entries, lathyrus-2 nurseries, 32 entries.

The most promising varieties of chickpea and lentil identified under the program are:

- *Chickpea:*
  Narmin (Azerbaijan: for rainfed conditions, large seed with good feeding quality, average yield gain 19%, potential productivity 3.0 t/ha).
  Elixir (Georgia: for rainfed and semi irrigated conditions, average yield gain 22%, potential productivity 3.5 t/ha).
  ICARDA (Southern and Central Kazakstan: for rainfed conditions, large seed with high feeding quality, average yield gain 18%, potential productivity 2.5 t/ha).

- *Lentil:*
  Pablo (Georgia: for rainfed conditions, large seed, average yield gain 15%, potential productivity 2.0 t/ha).

➢ **Forage legumes:**

As for forage legumes, such as vetches and grasspea that are recognized for their potential to produce extra feed from fallow land, and through the interruption of cereal monoculture, screening for drought tolerance material has been carried out in Uzbekistan. New promising lines of grasspea and vetches have also been identified in Azerbaijan and large scale seed production taken up. In Uzbekistan, four lines of vetch L-628, L-1004, L-694/1, L-651/2 were identified as promising for seed multiplication and the large scale trials. In Kazakstan, new promising lines of forage legumes have been identified and multiplied for large scale testing. The ICARDA line IFLS 225 Sel 554 performed well during last 3 years and demonstrated 16% of average yield gain with productivity of 3.0 t/ha. This line under the name Ali-Bar has been submitted for official state yield trials in Southern and Central Kazakstan.

2.4 GROUNDNUT VARIETAL IMPROVEMENT

- During the year under report, ICRISAT supplied new materials for groundnut trials to Georgia (one set each of short-duration, medium-duration, and confectionery international groundnut trials), Uzbekistan (three varieties), and Azerbaijan (eighteen elite breeding lines).

- From earlier materials supplied by ICRISAT, several promising varieties in different maturity groups with specific traits have been identified in Armenia (ICGV # 96048, 96066, 96234, 94031, 94016, 94062, 93260, 86635, 93233, 94341, 95299, 95319), Azerbaijan (ICGV # 94350, 95244, 95271, 92160, 95179, 95163, 93058, 95361, 94094, 94118, 94093, 96275, 96262, 94031, and 92029), Tajikistan (ICGV # 96262, 96073, 96100, 95245, 95248, 93143, and 94037), and Uzbekistan (ICGV # 95290, 95322, and 94088).

- Two short-duration varieties, ICGV # 95290 and 95322, and one medium-duration variety ICGV # 94088, based on their superior performance, have been identified for on-farm trials in Uzbekistan. They are currently under seed increase.

Information exchange and Human capacity building

- Till date, five scientists (one each from Armenia, Azerbaijan, Kyrgyzstan, Tajikistan, and Uzbekistan) have received training in groundnut breeding and production technologies at ICRISAT, Patancheru, India. They got ‘hands-on’ experience in hybridization, handling of segregating populations, selection in breeding populations, conduction of multilocation trials,

seed production, general agronomy, and plant protection against diseases and insect pests. Two scientists (one each from Georgia and Turkmenistan) are scheduled for training during 2002.

- ICRISAT also supplied scientific literature to groundnut scientists in the region and to PFU-CAC, Tashkent.

2.5 MAIZE VARIETAL IMPROVEMENT

Since 2000, CIMMYT has also been working on maize improvement in CAC region. In 2001, for the first time maize international nurseries from Mexico were grown across the region. Most of the germplasm was found to be late both for spring and summer seasons.

In 2002, 150 open-pollinated early maturing varieties and hybrids, including also the quality protein maize (QPM) were sent for distribution in the region. Also seven international trials: 1) CHTSW (subtropical white hybrid trial); 2) CHTSY (subtropical yellow hybrid trial); 3) CHTSEW (subtropical early white hybrid trial); 4) CHTSEY (subtropical early yellow hybrid trial); 5) EVT 16A (experimental variety trial); 6) EVT16B (experimental variety trial); 7) EVT 16EWY (experimental early varieties trial), were distributed.

2.6 IRRI SUPPORT ON RICE

As a new initiative, facilitation unit ensured support for rice research from IRRI in Central Asia. Dr. Gurdev Khush, an eminent Rice Breeder, visited Uzbekistan and Kazakstan. Based on his report, IRRI decided to provide some rice germplasm including hybrid rice trial for testing in Uzbekistan, Kazakstan and Tajikistan. Also IRRI agreed to extend support for training of two scientists at Los Banos, Philippines and also invited three scientists from the region to participate in the International Rice Conference being held later this year in China. Also a meeting of all rice breeders is planned in the region to have an interaction with Dr. Ren Wang, Deputy Director General, IRRI during his visit to the region in June, 2002.

2.7 SEED PRODUCTION

Quality seeds of high-yielding varieties being critical for further dissemination, emphasis was laid on seed development activities in the region. On-farm trials and demonstration plots were also taken up. The details of seed production activities are:

- Wide scale promotion of on-farm trails and field demonstrations for evaluation and seed multiplication of new varieties on farmers' fields was introduced jointly with NARS and CIMMYT in Tajikistan (4 locations), Azerbaijan (3 locations) and Uzbekistan (22 locations). These initiatives attracted attention of administrative authorities and also received very positive response from farmers.

- ICARDA supported Karakalpakstan Republic of Uzbekistan in seed multiplication of salt tolerant barley variety Unumli-Arpa (6.0 tons), and the new promising winter wheat varieties Gairat (2.0 tons). Seeds of Dostlik variety (5.0 tons) were procured from Turkey (4.0 tons) and Tajikistan (1.0 ton) for further seed multiplication (around 100 tons) in Tashkent and Syrdarya regions of Uzbekistan. This variety is likely to be released soon in Uzbekistan in view of its seed availability.

- About 300 kg of super early winter wheat varieties Chillaki and others were procured for Khojent region of Tajikistan. As many as 1000 tons of spring barley variety Mamluk already produced by Armenia, and 1500 kg of chickpea variety Elixir and 600 kg of lentil variety Pablo has been produced by Georgia. In other countries, breeder seeds of promising varieties were distributed to farmers, experimental stations and private farms to speed up the process of their multiplication.

- Twenty tons of winter wheat variety Mtskhetis-1 was produced in Georgia.

- Twenty tons of winter wheat variety Egemen was produced in Kazakstan before its submission for official testing

GTZ-CIMMYT project "Regional network on wheat variety promotion and seed production" has completed its first year, whereas another project on "Revitalization of wheat breeding, variety testing and early

generation seed production in Tajikistan" enabled the national system to procure 700 tons of Kazakh varieties resistant to yellow rust.

2.8 Integrated Disease and Pest Management

Activities on integrated pest and disease management are an important part of germplasm improvement. Several surveys have been carried out by the scientists of ICARDA and CIMMYT in collaboration with specialists from USA, Canada, and Australia to study the overall situation in the CAC countries and develop appropriate mechanisms and recommendations for controlling the most severe cereal disease – yellow rust. The main achievements had been:

- Elaboration of the regional Wheat Yellow Rust Network to unite efforts of national breeders, pathologists and geneticists with the aim to facilitate developing resistant wheat varieties. Establishment and distribution of resistant germplasm (Gene Pool) and Yellow Rust Trap Nursery (CWAYRTN) to NARS.
- Extensive survey on cereal diseases and identification of physiological races in Azerbaijan, Kyrgyzstan, Tajikistan, and Uzbekistan. Data for mapping the distribution frequency of new races. Identification of effective resistance genes to yellow rust for Azerbaijan, Kyrgyzstan, Tajikistan, and Uzbekistan in 1999-2000: Yr 5, Yr 15, Yr 18, Yr Sp, Yr Sk and sharing information for selection of new sources of resistance. Defeated Resistance Genes in CAC, 1999-2000: Yr1, Yr2, Yr 9, Yr 11, Yr 6, Yr 7, Yr 8, Yr A, Yr17, Yr24, Yr 26. Recommendation for replacement of varieties susceptible to yellow rust with resistant ones, and application of fungicides for leaf protection of susceptible varieties.
- According to the 2002 workplan, research activities on studying the effect of biological agent TG-1 on cereals to control root rot diseases were initiated by ICARDA scientists in collaboration with the Institute of Genetics and Experimental biology, Uzbekistan. The pathogenic fungus TG-1 has already shown a significant effect against all kinds of root rot diseases of cotton with evident growth stimulation.
- Monitoring of the leaf rust population on spring wheat has been conducted as part of CIMMYT global survey mission. It was based on the isogenic lines. Effective genes and sources of resistance have been identified.

Considerable areas of cereal crops in Central Asia and the Caucasus are annually affected by the most pestiferous insect – Sunn Pest decreasing yields and spoiling wheat grain quality, and also the cereals leaf beetle. In this context, main achievements had been:

- Regular field survey on insect pests of wheat and barley has been conducted. Identification of sources of resistance to major insects: Russian wheat aphid, sunny bug, Hessian fly, cereal leaf beetle (new), wheat stem sawfly. Distribution to NARS nurseries for tolerance/resistance to insects. Developing by ICARDA in partnership with University of Vermont, USA a biological method of wheat control against Sunn Pest with the use of insect-killing fungi collected from the affected insects. New strains of fungi have also been identified with almost 90-100% of effectiveness.
- A total of 413 barley entries have been selected by ICARDA scientists for resistance to the insect in partnership with Kyrgyz Research Institute of Agriculture and Galla-Aral Branch of Andijan Research Institute of Grain, Uzbekistan.

2.9 Crop diversification

With the current land reforms and the emergence of small farm units, the role of alternative crops to replace the monoculture practice becomes very important. Introduction of alternative crops will ensure the diversification of agriculture. Several alternative crops have been identified, such as chickpea, lentil, buckwheat and field peas that might be more profitable than wheat and therefore have potential for wide-scale adoption in future.

Similarly, diversification would demand changing existing food habits. Food legumes have already been found to be the good meat replacement for poor people in Georgia, Uzbekistan and Tajikistan. On the other hand, food legumes could also be exported to other countries in Asia. Crop diversification may also help in reducing barren fallow areas, such as in Kazakstan.

During the two years of joint ICARDA-NARS research activities within the framework of the ADB-funded project on 'On farm soil and water management for sustainable agricultural systems in Central Asia', food legumes such as chickpea, lentil and dry pea gave comparable yields to those of wheat while market

prices for the legume crops were two-three times higher. In addition, the introduction of food legumes into crop rotations dominated by cereals could also help in improving the soil fertility. Other possible alternative crops for diversification are buckwheat and oats.

Sugar beet and maize followed by food legumes were also identified as economical crop rotations for irrigated conditions in Kyrgyzstan.

In wheat and cotton based cropping systems, there are opportunities to introduce food legumes as double crops and forages for growing in winter period. In Tajikistan, promising crops for double cropping after harvest of winter wheat are cotton, rice, buckwheat and millets.

There are many useful crops, which now need proper attention both for research and production, such as, potato, soybean, cowpea, rice, maize, safflower, sunflower, groundnut, rapeseed and alfalfa. In this context, new germplasm has been arranged from different countries and international centers:

- German NGO Agro Action supplied three potato varieties, super-early variety Molly (30 kg), early Agave (30 kg), and moderate Koretta (30 kg), to be distributed in the region.
- New varieties of chickpea, mustard and soybean procured from ICARDA, India, Iran and Nigeria were distributed in Kazakstan, Azerbaijan and Uzbekistan.
- Kazakstan received from ICARDA 12 kg of vetch seeds (3 varieties), 5.5 kg of Lathyrus seeds (3 varieties) and 5.0 kg of lentil seeds.

Through the efforts of the CGIAR-PFU, seeds of new crops such as cowpea, urd bean, mungbean, rapeseed-mustard, alfalfa, and berseem were supplied by the research institutes from Iran, India, Turkey, Egypt and Nigeria, and distributed for testing in Uzbekistan and Azerbaijan. In addition, Uzbekistan was supplied with 9.0 kg of alfalfa seeds (3 kg of each variety) from Turkey. Also, Gurjat Agricultural University in India provided two new varieties of safflower and alfalfa to Azerbaijan (0.5 kg of each variety) and Uzbekistan (1.0 kg of each variety). Performance of these new materials will be watched during the current year.

2.10 ECONOMICS

The Economics project on “Wheat competitiveness, future productivity, and regional linkages in Central Asia and the Caucasus,” continued with fieldwork in Tajikistan, Uzbekistan, and Kyrgyzstan completed during 2001. Data were also collected to update the existing wheat productivity and competitiveness report on Kazakhstan. Working papers for these countries, as well as for Azerbaijan and Armenia, where fieldwork took place in 2000, are currently being prepared.

2.11 HUMAN RESOURCE DEVELOPMENT

Following HRD activities were undertaken by CIMMYT and ICARDA concerning various germplasm improvement activities:

Date and venue	Organization	Event	Participants
30 Jul-1 Aug, 2001 Shortandy, Kazakstan	CIMMYT and NACAR	International conference on Improvement of spring wheat tolerance to abiotic and biotic stresses: current status and prospects.	More than 50 scientists from Kazakstan, Russia and Mongolia
30 Jul-1 Aug, 2001 Shortandy, Kazakstan	CIMMYT and NACAR	Regional conference on spring wheat breeding for resistance to abiotic and biotic stresses	Thirty-five scientists northern Kazakstan and Omsk and Barnaul in Siberia (Russia)
July-Nov, 2001 Mexico, CIMMYT	CIMMYT	Four-month training course on maize improvement”	One scientist from Kazakstan
4-9 Aug, 2001 Shortandy, Kazakstan	ICARDA	Spring barley workshop and consultation meeting	NARS from Kazakstan, Kyrgyzstan, and Uzbekistan
4-9 Aug, 2001 Shortandy, Kazakstan	ICARDA	Food legume workshop and consultation meeting	NARS from Kazakstan, Kyrgyzstan, and Uzbekistan
August 16 Headquarters in Mexico	CIMMYT	One-and-half-month advanced course on wheat quality	One scientist from Kazakstan
3-5 Sep, 2001 Almaty	CIMMYT, GTZ and	National workshop on regional network on wheat varieties promotion and seed production	Twenty-five scientists from Kazakstan

Kazakstan	NACAR		
13 Sep, 2001 Baku	CIMMYT and AzARI	National consultation meeting to discuss the results of the previous season and preparation field work for planting	NARS from Azerbaijan
17-18 Sep, 2001 Merke, Kazakstan	GTZ and CIMMYT	Field seminar bed-furrow technology of wheat production	Thirty farmers from Kazakstan and Kyrgyzstan
26-28 Nov, 2001 Almaty	GTZ and CIMMYT	International Regional Workshop on the status of the national systems for cereal varieties testing and plant variety protection in Central Asia	Twenty-eight scientists from Kazakstan, Kyrgyzstan, Tajikistan, Uzbekistan and Russia
29 Nov, 2001 Almaty	CIMMYT and NARS	Kazakstan-Kyrgyzstan-Tajikistan joint seminar on problems of wheat breeding and wheat production	NARS from Kazakstan, Kyrgyzstan, Tajikistan
7 Nov, 2001 Astana	CIMMYT, NACAR, the WB	National workshop on improvement of productivity, profitability and sustainability of the wheat industry in Kazakstan	More than 40 scientists, farmers, admin. Officials from Kazakstan
16-20 Mar, 2002 Alexandria, Egypt	ICARDA and Egyptian NARS	International Conference on biotechnology and sustainable development: voices of the South and the North	ICARDA sponsored six scientists from Armenia, Kazakstan, Uzbekistan and Tajikistan
24 Mar-4 Apr, 2002 Aleppo	ICARDA	Training course on pest management	One scientist from Uzbekistan
31Mar-1 Apr, 2002 Almaty	CIMMYT and GTZ	International regional workshop on coordinated regional assessment of winter wheat disease resistance	Fifteen scientists from Uzbekistan, Kyrgyzstan and Kazakstan
1-30 Apr, 2002 Aleppo	ICARDA	Training course on cereal diseases	One scientist from Azerbaijan
11 Apr, 2002 Almaty	CIMMYT	National planning meeting on the project "Wheat salinity tolerance improvement for Kazakstan and Central Asia soil conditions"	Fourteen Kazakh scientists
20-26 May, 2002 Turkey	ICARDA	Traveling workshop on crop diversification	Ten scientists from the five CA countries
May, 2002 Tashkent, Syrdarya, Jizak and Bukhara provinces	Uzbekistan-ICARDA	Traveling workshop on establishing demonstration trials under on-farm conditions	Fifty-seven participants from Uzbekistan
2-8 Jun, 2002 Kazakstan and Kyrgyzstan	CIMMYT, ICARDA and GTZ	International regional travel scientific-practical seminar on breeding, seed production and on-farm experiments of winter wheat in Central Asia and the Caucasus	Fifty five participants from CAC countries and Iran

3. SOIL AND WATER MANAGEMENT

Alongside the difficulties associated with a transitional period, one of the major reasons of low agricultural productivity is poor natural resource management. In the past, the use of natural resources was mainly focused on rather short-term economic developments, which contributed to serious environmental disasters that continue to have an impact on current economic growth. Therefore, in Central Asia and the Caucasus, there are critical problems common to the efficient management of water and land. These problems include: allocation and rational use of natural resources, deficiencies in available technologies and their adoption due to poor knowledge dissemination, insufficient financial, institutional and policy support.

In addition, agrarian reforms and attention to socio-economic problems have progressed at different rates in countries of the CAC region. Those countries that have moved ahead with de-collectivization and privatization of land are also encountering problems arising from the fragmentation of land, and the sharing of water, particularly the management of large-scale irrigation systems to meet the demands of various small scale farmers.

For the new nations of Central Asia and the Caucasus to attain long-term sustainable growth and to increase agricultural productivity, it is critical that their enormous natural resources are managed more efficiently in an integrated manner. Integrated soil and water resource management must form the basis for policy decisions at all levels. There is also an urgent need for appropriate policy orientation and reforms for input use efficiency. The emerging small farmers need assistance with enterprise

development and improvement of their skills relating to the rational use of inputs, introduction of new crop rotations, and generation and adoption of more efficient production technologies.

Two CGIAR centers, ICARDA and IWMI, are addressing the issues of natural resource management at on-farm and basin levels, respectively.

During 2001/2002, major activities of IWMI in the region were conducted through the following two projects:

- "Integrated Water Management in the Fergana Valley", a Swiss Development Cooperation (SDC) funded project, and

- A project on "Adoption of the best practices for water conservation in the Syr-Darya and the Amu-Darya river basins in Central Asia", funded from the IWMI's core budget.

3.1 Integrated Water Management in the Fergana Valley

Based on the agreement on implementation of a project on "Integrated Water Management in the Fergana Valley", signed between IWMI and the SDC in August 2001, a six-month inception phase of the project commenced from September 1, 2001.

At the end of the inception, a three-day workshop on the "Integrated Water Management in the Fergana Valley" was organized to discuss detailed aspects of the proposed activities of the project. The Project Steering Committee (PSC) approved the draft logical framework and the SDC decided to provide a bridge funding. The implementation of the three-year project started from 1 May, 2002. The key objectives of the project are to: (i) introduce and pilot test integrated water resources management and water users participation among the water management institutions in the pilot canals in the Fergana Valley; and (ii) demonstrate options for increasing water and land productivity at all levels of water management hierarchy of the other. In this project, the existing water users associations (WUAs) will be federated along the entire Aravan Akbura Canal in Kyrgyzstan, and two WUAs will be created each along selected pilot sub-systems of South Fergana Canal in Uzbekistan and Gulya-Kandoz Canal in Tajikistan.

In April 2002, the Swiss Development Cooperation (SDC) mission visited the newly established training center in Osh and field sites on the Aravan Akbura Canal in the Aravan district of Osh Province.

3.2 Adoption of the best practices for water conservation of the Syr-Darya and the Amu-Darya river basins in Central Asia

In July, 2001, IWMI approved the implementation of the project "Adoption of the best practices for water conservation of the Syr-Darya and the Amu-Darya river basins in Central Asia". The project agreement was signed between the Scientific Information Center of the Interstate Commission on Water Coordination (SIC-ICWC) and IWMI and it will be implemented in 9 provinces of the five Central Asian countries. With the assistance of local communities, NGOs, and water managing organizations, the best practices of water conservation will be advertised to farmers for adoption.

3.3 ICARDA Project "On-farm soil and water management for sustainable agricultural systems in Central Asia"

This is the last year of the first phase of the ADB-supported project on "On-farm soil and water management for sustainable agricultural systems in Central Asia". Its objectives are: (i) increase agricultural productivity and production through improved management of cropping systems, including optimal use of water resources and improved management of soils and nutrients; and (ii) achieve sustainable irrigated cropping systems through an appropriate farm-level management of irrigation and drainage and safe use of marginal water sources.

Through its four components, the project activities are addressing the issues of:

- Development of improved strategies for on-farm soil, water and crop management

- Assessing and improving farm-level irrigation and drainage management to ensure the sustainability of irrigated cropping systems
- Assessing and improving the utilization of marginal water sources
- NARS Capacity Building.

Component I includes research activities on water conserving irrigation technologies, soil tillage and crop diversification.

Water conserving irrigation technologies

- In steep slope areas, soil erosion and significant water losses for surface runoff are major constraints to sustainable agriculture. At Boykozon Integrated Research Site, Uzbekistan, improvement in traditional 'joyak' (zigzag) irrigation technology demonstrated reduced soil erosion (from 2.7 to 0.12 - 1.10 t/ha) and proved to be efficient for cereal, vegetable, and melon crops production.

- Uniformity of water distribution on irrigated sloping areas is usually low. Application of improved irrigation technologies using portable chutes has provided a uniform water jet to each furrow and has also increased water productivity by almost 50 – 100%. This technology is suitable for adoption on small scale farms.

- Growing annual and perennial crops and vine on terraced lands in Tajikistan was found to be an efficient farming practice for water harvesting and moisture conservation. At Fakhrabad site, different mulching technologies have been tested to ensure better moisture conservation. Effect of plant residues mulching was similar to that of black and transparent plastic film application that are associated with higher input cost.
- At the Demonstration site in Kyrgyzstan, application of water-saving technologies through utilization of water siphons and cleaning of drainage network contributed to a considerable decrease in groundwater level. Taking into consideration the weather conditions of the year 2002, when the precipitation has significantly exceeded the average annual rates, this appeared to be a very timely action.*Soil tillage*

- In rainfed semi-arid conditions of northern Kazakstan, minimum and zero tillage proved to be promising as compared to general practice of deep conservation tillage, provided adequate fertilization has been applied.In rainfed conditions of southern and southeastern Kazakstan, shallow and deep conservation tillage gave almost the same grain yield as that of ploughing but reduced conservation tillage was found to be the most economical. Though conservation tillage is now widely adopted only in Kazakstan, it could be possibly spread to neighbor countries growing grains.
- In Turkmenistan, two years in a row, soil tillage before planting winter wheat at various depths (from 10-12 cm to 30-32 cm) have not significantly affected grain yields; whereas reduced conservation tillage contributed to resource saving and allowed timely planting. Water productivity under application of reduced tillage at 10-12 cm was 25% higher than that of deep ploughing at 30-32 cm.

- In Tashkent province of Uzbekistan, on typical non-saline gray soil, rotor cultivation (10-12 cm deep) with sub-soiling at 45 cm provided the highest yield of winter wheat compared to traditional deep moldboard ploughing.

- In the Hissar valley, Tajikistan, on irrigated dark gray soil, deep ploughing at 40-42 cm ensured higher soil moisture content and as a result higher yield of winter wheat compared with traditional ploughing at 28-30 cm.

- In the rainfed farming conditions of Galla-Aral area of Uzbekistan, experimental data favored traditional ploughing.

Component II, addresses the issues of assessing and improving farm-level irrigation and drainage management to ensure the sustainability of irrigated cropping systems.

- In water deficit conditions, at Arys-Turkestan site of Southern Kazakstan, two irrigation technologies, discrete and cutback alternate furrow irrigation, were tested. Improved technologies of alternate furrow irrigation contributed to irrigation water saving by 30% as compared with traditional furrow irrigation technology and reduced pressure to the drainage system by 40%.

- At the experimental site in Fergana Valley, research results demonstrated that subirrigation could be another option to increase available water for crops. Closing horizontal drainage outlets increased groundwater share for irrigation, thus contributing to better crop yield.

- Another research approach for improving irrigation efficiency is lysimeter method that provides detailed information on water–salt balance elements. This method allows estimating appropriate irrigation and leaching rates. A lysimeter station has been installed at the experimental site in Gafur Gulam farm in Syrdarya province of Uzbekistan. Irrigation scheduling based on data from lysimeters contributed to increase in cotton yield from 3.9 t/ha to 4.5 t/ha.

Component III includes research activities on assessing and improving the utilization of marginal water of different quality.

Treated wastewater (TWW) use

- Utilization of treated wastewater for irrigation of fodder crops and tree plantations was tested in Sorbulak lake area in Kazakstan. After mechanical and biological treatment, the treated wastewater of Almaty city flows to Sorbulak collector with a capacity of about 1.0 million m^3. Based on the 1999-2001 research results, treated wastewater proved to be an important source of nutrient supply ensuring sustainable yields of fodder crops and good growth of tree plantations. Content of heavy metals (Zn, Fe, Cd, Cu, Cr, Ni, Pb) in fodder crops produced under TWW irrigation does not exceed the threshold rates. Slight increase in Co content was recorded once in Jerusalem artichoke, sunflower and sugarbeet.

- Treated wastewater of Hodjent city was also tested for cotton irrigation at Kyzyltukay experimental site, northern Tajikistan. Besides minimizing the risk of fresh water contamination, the use of TWW for irrigation reduced dependence on chemical fertilizer use, thus significantly reducing production cost.

Drainage water use

- At Dustlik experimental site in Fergana Valley, drainage water was tested for irrigation of recently planted forest shelterbelts consisting of Californian poplar, mulberry, pomegranate, almond, fig and pistachio trees. Rooting rate of the majority of saplings varied from 69 to 100%, except that of fig trees, which was only 18%. Winter wheat was planted in the field protected by these shelterbelts.

- Drainage water utilization for irrigation of winter wheat was tested at the experimental site located in Vatan farm, central Turkmenistan. Water from an open drainage system with TDS varying between 2.0–3.0 g/l was used for irrigation in two experimental variants of which one was presuming its alternation with fresh water from Karakum canal. The yield of winter wheat in two experimental treatments was lower as compared to irrigation by surface water by 14% and 19% for alternated and drainage water irrigation, respectively.

DEVELOPMENT OF A PROPOSAL FOR SECOND PHASE OF THE PROJECT

The objectives of the first phase of the project, such as establishing experimental sites and identifying and testing technologies to improve soil and water management, were successfully achieved, but the majority of findings need further verification and refinement, as well as dissemination. Some issues of socio-economic, policy and technology transfer need to be addressed in detail. There are some identified, adapted and improved technologies, that have been tested at small experimental sites which are now ready for on-farm testing over large areas. Therefore, the Project Implementation team is working on development of a proposal for the second phase.

3.4 ICARDA-IWMI COLLABORATIVE ACTIVITIES IN KARAKALPAKISTAN

First Deputy Minister of Agriculture and Water Management, Uzbekistan requested both ICARDA and IWMI to conduct research and prepare wider project proposal for the potential donors on reforming agriculture and water sector in Uzbekistan. At the pre-project stage, IWMI and ICARDA have already formed a joint team to take up work on institutional reforms in agriculture and water management in the drought affected Karakalpakistan region. The project includes a component on establishing WUA that will be addressed by IWMI, whereas ICARDA research activities will target increased economic efficiency of crop production through WUE. Already a suitable site has been identified and a collaborative research team including scientists from the Farming Research Institute of Karakalpakistan, SANIIRI branch in Karakalpakistan and the Ministry of Agriculture and Water Resources of Karakalpakistan, has been formed.

3.5 HUMAN RESOURCE DEVELOPMENT

Following HRD activities were undertaken on various aspects:

Date and venue	Organization	Event	Participants
9-12 Jul, 2001 Dushanbe, Tajikistan	ICARDA	Training course on optimizing soil fertility and water benefits using terracing in sloping areas	One researcher and one farmer from Kazakstan, Kyrgyzstan, Tajikistan and one researcher from Azerbaijan, Armenia, Georgia and Uzbekistan
July 2001, Tashkent	SIC-ICWC and IWMI	Regional training workshop under the project "Adoption of best practices for water conservation in the Syr-Darya and the Amu-Darya river basins of Central Asia"	Twenty-nine participants from Uzbekistan
August 2001 Uzbekistan, Kazakhstan, Kyrgyzstan, and Tajikistan.	IWMI	Demonstration workshops on best practices in water conservation	Farmers from the participating countries
11-21 Sep, 2001 Almaty	FAO and IWMI	Workshop on water policy analyses	Twenty specialists from Kazakstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan
1-3 Nov, 2001 Dushanbe	ICARDA, TSSRI and FAO	First Congress of Soil Scientists of Tajikistan	About fifty participants from Central Asian and other countries
26-28 Feb, 2002 Tashkent	IWMI and SANIIRI	Three-day workshop for the Swiss Development Cooperation (SDC)-funded project "Integrated Water Management in the Fergana Valley"	Seventy participants from Kyrgyzstan, Uzbekistan, and Tajikistan
10-16 Mar, 2002 Ashgabad, Turkmenistan	ICARDA	Short-term course on drainwater reuse strategies with management considerations for soil physiochemical properties	Twelve participants from Kazakstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan
Apr-Jun, 2002 Aleppo	ICARDA	Long-term training courses on management of Water resources and improvement of water use efficiency in the dry areas	Four young specialists from Kazakstan, Kyrgyzstan, Tajikistan, and Uzbekistan
3-8 May, 2002 Dushanbe, Tajikistan	ICARDA	Short-term course on improved soil, water, and plant fertility analyses	Twelve scientists from Kazakstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan
12-15 Jun, 2002 Taraz, Kazakstan	ICARDA	Short-term course on water saving technologies and its socio-economic implications under drought condition	Twelve scientists from Kazakstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan

4. FEED AND LIVESTOCK MANAGEMENT

In the course of a consultation process, sponsored by ILRI, ICARDA and some other partners, in 1999, the NARS of CAC region identified three priority livestock research themes: increasing feed resources and efficiency of utilization; conservation and utilization of ruminant genetic resources under new production conditions; and policy options to create enabling environments for improved small holder production and markets. The project being implemented by ILRI has the overall objective to identify and target technologies and enabling policies that will improve the efficiency of smallholder production systems. For increasing feed resources and efficiency of feed utilization, two parallel studies are being carried out. These are:

- Assessing rangeland use and coordination and preparation of guidelines for range-based animal production by smallholders

- Identifying technologies for feed production and utilization in crop livestock systems.

For conservation and utilization of ruminant genetic resources, sampling of indigenous sheep and cattle breeds in Armenia, Azerbaijan, Georgia and Uzbekistan for molecular genetic characterization was carried out. A total of 416 samples were collected in the first round from 18 locations and these are being processed and analyzed at ILRI, Nairobi.

4.1 ICARDA PROJECT ON "INTEGRATED FEED AND LIVESTOCK PRODUCTION IN THE STEPPES OF CENTRAL ASIA (IFL-CA)"

The IFAD-funded project on Integrated feed and livestock production, initiated in 1999, addressed four major components: socio-economic activities; range management; feed production; livestock production and flock management. The major findings are

Socio-economic activities

Three main farm types are presently operating in the region. These are:
- Big scale farms (various types of cooperatives) that used to produce the main share of livestock product currently contribute up to 20%.
- Medium-scale farms (private farms) recently emerged as a result of reforms and they contribute around 2-4%.
- Rural households contribute up to 95% to different countries' livestock product.

The diagnosis covering concerns of livestock producers revealed that:
- The main problem for all types of producers is lack of forage in wintertime.
- In countries where big scale farms got dismantled, the producers are experiencing the lack of resources associated with poor infrastructure.
- With Soviet Union collapse, traditional markets for pelts and fine wool have disappeared, thus causing decrease in income to the farmers.

Relating to marketing, the studies have revealed following aspects:
- Local markets now provide more income to producers than selling products to processing companies as before (except Kazakstan).
- Among all types of products, sale of live animals generate the maximum income.
- Sheep milk may also become an additional source of income.

Range management

Rehabilitation technologies are being introduced to recover overgrazed rangelands.
- *Haloxylon* and *Salsola* planted in range stripes got established quite successfully on 8 ha at the Yzgant site, Turkmenistan in spite of three-year drought and *Haloxylon-Kochia-Salsola* stripes on 9 ha at Buhtulin, Kazakstan and on 58 ha at Nurota, Uzbekistan. The survival rate of Haloxylon bushes ranged from 23-81%, Kochia from 78-86% and Salsola from 90-100%.

- Collection of range species' seeds and establishment of nurseries for future range rehabilitation was done in Kazakstan, Uzbekistan and Turkmenistan. Seeds will be used for planting in larger areas next year.

- Testing options for the rational utilization of rangelands: a mobile flock to restore seasonal rotational grazing with participation of farmers and assistance of farmers federation has been organized in community Birlik, Kazakstan which allowed pooling small flocks of poor farmers to form a large mobile flock and moving it to remote unused range to avoid overgrazing of range around the village. In addition, the village rangeland was divided into two equal parts for the alternation of grazing on these two parts. As a result, every year one of the portions is "resting" in spring or in autumn.

Feed Production

Sowing feed mixtures as intermediate winter crops to improve the fodder availability.

- To help farmers improving the fodder availability in Kyrgyzstan, 20 ha of sainfoin were sown in 2000 along with barley as a cover crop. The mixed crop yielded 2 t/ha of barley grain and 1.5 t/ha of barley straw and sainfoin hay. In addition, the crop left about 0.7 t/ha of stubble that was fully utilized by sheep in October.

- Intensive use of irrigated land for fodder production in Uzbekistan was achieved through introduction of intermediate winter crops (mixture of triticale, oat and fodder pea) for forage harvested in April followed by planting maize for grain. Net production of biomass in experimental field was 67 t/ha of GM/ha and 4.5 ton of maize grain, whereas the control, widespread practice of spring planted maize for silage, rendered only 35 ton of GM/ha.

Use of drainage water for fodder production on marginal saline lands.

- Four halophytes, Klimokoptera lanata, annual Atriplex, perennial Atriplex and Suaeda altissima, were sown in Turkmenistan to test irrigation with drainage water. The results revealed that halophytes could provide additional animal fodder and improve the land use in the areas with high soil salinity.

Use of mulberry leaves as alternative source of fodder (Uzbekistan).

- Trial was conducted on substitution of concentrates through introduction of mulberry leaves into feed mixtures and feed blocks. Four groups of 7-month age ram-lambs were formed for sixty-day fattening with different diets. The highest weight gain was observed in the group where mulberry leaves were incorporated into feed blocks as a substitute of concentrates.

Introduced technology of feed block production

- Feed blocks were introduced to improve the diet for sheep during wintertime and in last period of pregnancy. The experiment was carried out from 10 January to 30 March. The diet of the experimental group was based on feed blocks produced from alfalfa, hay, barley, cotton cake, and concentrates. The control group used range grazing and additional feeding with barley when the animals stayed in barns. The weight gain of sheep in the experimental group was 10 kg/sheep against 0.7 kg in the control.

Livestock production and flock management

- In Uzbekistan and Turkmenistan, early mating and lambing of Karakul sheep is being tested successfully to produce lambs for sale in high market price time. Lamb fattening technologies are considered here to satisfy the demand on lamb meat in late summer and having ewes ready for mating at this time.
- The project started on-farm activity on sheep milking to improve farmer's diet and eventually to generate extra income.

4.2 COLLABORATION WITH USAID-GL-CRSP

The GL-CRSP research activities can be summarized as follows:

- The University of California Davis (UCD) accomplished more than 90% updating of the model *based on SRCRSP 78-88* and a new program structure for web-based application is being developed. Also a preliminary data set for sheep in semi-desert Artmesia rangeland has been assembled. The emphasis is now for the development of tools that can be released and made available broadly trough the Internet.

- During 2000 and 2001, base line data were collected and sites (11 farms and 18 flocks) were visited 3 -4 times between 10/2000 and 08/2001. The data is being processed presently.

4.3 COLLABORATION WITH ILRI

ILRI fulfilled part of its commitments and organized training for the national animal health professional in epidemiological surveys. The training course was organized for all member countries in Kazakstan. The training workshop was organized by ILRI with logistical support of ICARDA in Tbilisi for the Caucasus countries on molecular characterization of livestock breeds. On the other hand, the plan to train some Central Asian scientists in Kenya was not accomplished because of the poor English level of the candidates. This was replaced by training at university of Konya, Turkey, where scientists had less language problem.

Under a joint small ILRI-ICARDA project, studies were carried out on increasing forage resources in the Caucasus. The project had two components:

Assessment of the current situation of feed resources

- Activities conducted: analysis of available information on production and utilization of the different feed resources, socio-economic survey to identify feeding gaps and constraints faced by farmers, agronomic survey of rangelands, assessment of the forage and range seed production sector, assessment of the current feeding calendar.

Technologies to improve feed resources

- Activities conducted: identification of techniques for range improvement and rehabilitation, identification of local and alternative cultivated forages to enhance the feed base for winter-feeding, identify potential crops and agro-industrial by-products to balance the feed gaps, identify schemes for seed production, review rangeland and forage technologies that are readily to be transferred to farmers.

Two workshops were organized to discuss results of the assessment of the current situation of feed resources and to validate recommendations. Books on increasing forage resources in the Caucasus have been partly published.

4.4 HUMAN RESOURCE DEVELOPMENT

Following HRD activities were undertaken concerning feed and livestock management aspects:

Date and venue	Organization	Event	Participants
September 2001 Tashkent province	ICARDA	Training course on methodology of individual interviewing of livestock breeders	Six young specialists
8-11 Nov, 2001 Tunisia	FAO-CIHEAM, INRAT and MoA of Tunisia	International Conference on sheep and goat feeding and management in arid zones	Three CA scientists sponsored by IFLP project
3-4 Feb, 2002 Aleppo	IFAD and ICARDA	Annual Steering Committee meeting of the project on Integrated feed and livestock production in the steppes of Central Asia	Representatives of IFAD, ICARDA and NARS from Central Asia
13 Feb, 2002 Ashgabad, Turkmenistan	ICARDA	National workshop on livestock management	Thirty-three participants from Turkmenistan
6 Mar, 2002 Nurota, Uzbekistan	ICARDA	National workshop on milk production	Thirty participants including farmers and scientists
March-April, 2002 Aleppo	ICARDA	One-month training of young scientists to socioeconomic methodologies	Three scientists
March, 2002 Aleppo	ICARDA	Ten-day training of scientists to socioeconomic methodologies	Three scientists
10 Mar-10 Apr, 2002 Aleppo	ICARDA	Training on methodologies of data processing and analysis	Six scientists from Kazakstan, Kyrgyzstan, Turkmenistan and Uzbekistan
13 Apr, 2002 Nurota, Uzbekistan	ICARDA	National workshop on new technologies of milk processing,	Twenty participants including farmers and scientists
April-May	ICARDA	Two-month training to data management	One scientist from Uzbekistan

27-29 Mar, 2002 Kyrgyzstan	ICARDA	Traveling workshop on assessment of pasture biomass	Ten scientists from the region
May-June, 2002 Aleppo	ICARDA	One month training to feed laboratory analysis	Two scientists from Kazakstan and Uzbekistan

5. CONSERVATION OF GENETIC RESOURCES

The CAC region is the center of origin of a number of economically important crop species and has rich genetic diversity. Here exists one of the world's best collections of fruits, nuts, and melons. Due to financial constraints, the plant genetic resources programs are rather weak. Hence, IPGRI, ICARDA and CIMMYT are working with national systems to provide support to the national genetic resource institutes to collect, conserve, and document local and exotic genetic resources. Some of the important achievements had been:

A CATCN -PGR has been established under support of IPGRI and ICARDA

- Within the framework of the CATCN Network, eight plant genetic resources documentation units were established in each member country under the support of ICARDA. Each unit comprises four specialists on grain crops, legumes, fodder crops and documentation. All eight units are making inventory and documentation of PGR maintained in their national collections, for which appropriate equipment and training on documentation have been provided.

A number of collection missions have been organized by ICARDA in the Central Asian and Caucasus republics. The details are:

- Following the collection missions in 6 countries of CAC region organised in 1998-2000, ICARDA in July-August 2001, in collaboration with local NARS and VIR and Australian scientists, launched collection missions to Armenia and Azerbaijan. A total of 397 accessions (245 in Azerbaijan and 152 in Armenia) have been added to previous 1045 accessions of cereals, food legumes and their wild relatives and forage and range species. The collection mission covered 3,134 km and the accessions were collected from 81 sites. The collected germplasm is now kept by the host country and stored "in-trust" in ICARDA's gene bank, providing safety duplication.

IPGRI is undertaking the following efforts to enhance NARSs' activity on conservation and sustainable utilization of PGR in the region:

- Regional *ex situ* collection of pistachio has been established with the purpose to enhance conservation and use of genetic resources of this valuable nut crop used before only as forest species in the region. Promising forms with economically valuable traits selected from collected material will be used in breeding programs in the whole region

- Use of melon genetic resources through the strengthening of on farm and *ex situ* conservation is enhanced. More than 100 accessions of local varieties maintained by farmers are collected, characterized morphologically and conserved *ex situ.* The catalogue of local varieties of melon in English, Uzbek and Russian and illustrated with photos is prepared for publishing

- Collaboration between WANA and CAC region in research on pomegranate genetic resources has been established through development of collaborative action plan and conducting joint assessment of pomegranate collection maintained in Garry Gala, Turkmenistan to seek donors' support to the collection

- Mission on eco-geographic survey, agro-morphological characterization and collecting *Pyrus* genetic resources in Central Asia was conducted. Total 96 accessions of cultivated and wild pear species: *Purus turcomanica, P. regelii, P. korshynskyi, P. vavilovii, P. tianshanica, P. bucharica, P. sogdiana, P. turkestanica, P. communis* have been collected and grafted in the field collection of Uzbek RI of Plant Industry for further study.

- Regional data base on Fruit Genetic Resources has being established in Central Asia. The dBase is hosted by Tajikistan Research and Production Centre "Bogparvar". Passport data on *Prunus armeniaca* – 140 accessions; *Prunus persica* - 61 accessions; *Prunus domestica* & P. *cerasifera* – 15 accessions; *Prunus avium* – 29 accessions; *Cerasus* sp – 18 accessions; *Malus domestica, M. Siversii, M. silvestris, M. caucasica, M. Nedsvetsky* – 104

accessions are prepared for entering in dBase. 30% of prepared data have been computerized.

- Regional dBase on Forest GR is established in Central Asia and hosted by Uzbek RI of Forestry: 154 plus trees of 8 species, six field collections, 19 permanent forest seed production plots and 108 varieties belonging to four horticultural/forest species;

- National dBase on Cotton is established in Uzbekistan and hosted by RI of Genetics & Experimental Plant Biology. Data on 1,500 accessions of cotton varieties and hybrids (*Gossipium barbodensas, G. hersotum*) as well as of 40 accessions of wild cotton (*G. lobatum, G. andum, G. gossipiouidis*) have been entered in computerized dBase.

- It is planned to support best world collections of apple, grapes, pomegranate, pistachio, walnut, almond and perennial cotton, beside valuable melons and vegetables.

New Project on socio-economic studies on plant genetic resources

- The project 'Strengthening community institutions to support the conservation and use of plant genetic resources in Uzbekistan and Turkmenistan' has being undertaken by IPGRI in collaboration with its sister center IFPRI under the support of System-wide Program on Collective Action and Property Rights (CAPRi). The project seeks to understand as to how changes in land tenure and rural institutions have affected conservation and use of plant genetic resources in Turkmenistan and Uzbekistan. The project will work with farmers' organizations and national institutions to examine impacts of recent changes in land tenure and decentralization of agrarian institutions to devise support for the local management of agro-biodiversity and further its contributions to livelihoods. The research will also focus on the national policy implications of tenure and local institutions for in situ conservation.

UNEP-GEF: Support farmers' community in conservation of traditional varieties of horticultural crops and their wild relatives

- Implementation of PDF B phase of UNEP-GEF Project on "In situ/on-farm conservation of agrobiodiversity (horticultural crops and their wild relatives in Central Asia" will be started on1 July 2002 with the purpose to develop the full project proposal, the three main objectives of which are: (1) to enhance and support conservation action by farmer communities through supporting a framework of knowledge on farmer decision-making processes that influence in situ/on-farm conservation of the traditional varieties of horticultural crops and their wild relatives; (2) to strengthen national institutions, particularly farmer communities and NGOs for the planning and implementation of conservation programs for horticultural and forest genetic resources; (3) to broaden the sustainable use of horticultural genetic resources in improving production and the participation farming communities and other groups in conservation and use of this diversity.

Strengthening of Gene Banks

- Based on request from Uzbek Research Institute of Plant Industry (UzRIPI), USDA, ICARDA and IPGRI have jointly agreed to upgrade the storage facility in the Gene Bank and turn it into a medium-term storage facility. Under PL 480 Fund, a sum of 57,380,000 Uzbek sum has been agreed to by USDA for renovation of the present facility. USDA has also requested ICARDA to provide technical backstopping. The Ministry of Agriculture and Water Management, Uzbekistan has awarded the work to a construction company and the work started from 31 May. ICARDA has helped in developing a design of the storage facilities. IPGRI has allocated US$ 5,000 to purchase the necessary equipment for the gene bank. ICARDA is also considering some additional financial support for required additional equipment.

- Based on request of Director General of Agrarian Science Center of Azerbaijan, ICARDA organized a visit of Mr. Bilal Humeid, Gene Bank expert from Genetic Resources Unit of ICARDA to Azerbaijan in April, 2002. The purpose of this trip was to assess ways to strengthen the Azerbaijan Plant Genetic Resources conservation program and to conduct an appraisal of a potential seed storage facility in Azerbaijan. It was decided that an in-county proposal could be developed and put up to the competitive grants scheme that is already operational in Azerbaijan. Also scientists and specialists of ICARDA will develop a funding concept note to be presented to the international donor community.

HUMAN RESOURCE DEVELOPMENT

Following HRD activities were undertaken on genetic resource conservation and management:

Date and venue	Organization	Event	Participants
Jul-Sep, 2001 Tashkent, Dushanbe, Bishkek, Almaty, Ashgabad	IPGRI	National workshops on development of logical framework of project for its submission to donors (within PDF A phase of UNEP-GEF project)	Different national stakeholders
26-30 Nov, 2001 Tashkent	ICARDA	Training workshop on plant genetic resource documentation	Representatives of the Central Asian PGR units
Feb-Apr 2002 Perth, Australia	ICARDA	Two-month training course on working with modern gene bank and on the Australian PGR network	Two scientists from Armenia and Georgia
10-12 Apr, 2002 Tashkent	ICARDA and USDA	Regional workshop for plant genetic resource units	Representatives of the PGR units from the region

6. STRENGTHENING OF NARS

Most of the training activities have already been mentioned in this report under respective themes. Below are the details on cross-cutting human capacity building:

All centers have made considerable efforts in the area of human resource development. It includes training on courses, study tours, participation in international, regional and national scientific meetings and workshops, supply of computers and other research equipment. From September 1998 to June 2002, the CAC Program arranged 44 short and long term training courses with participation of 416 scientists, 34 study visits with participation of 67 scientists, 37 regional and national workshops with participation of 804 scientists and farmers, 14 International Conferences with participation of 233 scientists, and 43 consultation planning meetings with participation of 759 scientists. A total of about 2400 scientists and farmers from the CAC countries have so benefited from different training and human resource development activities.

Information Technology and Equipment Procurement

Information exchange has been improved through participation in the international and regional workshops, establishing e-mail links and providing Internet access to the collaborating institutions. In the last two years, NARS were provided with 60 PCs, 10 cars, three automatic weather stations, portable laboratory equipment and four digital cameras by ICARDA. The Centers involved organized also the courses on data management.

7. OTHER ACTIVITIES:

Besides providing facilitation function to all the Consortium partners, PFU had also undertaken other activities, which were:

Memorandum of Agreement with Tajikistan and Turkmenistan

- During 2001-2002, preparatory work has been carried out to develop and sign an agreement between ICARDA and Tajikistan Government. The objective of this agreement is to strengthen the partnership between ICARDA and Tajikistan. The Ministry of Agriculture of Tajikistan has already discussed all the items of the agreement and are ready for its signing. The Prime Minister of Tajikistan and the Director General of ICARDA will sign the agreement in September, 2002, during the ICARDA-CAC Regional Coordination Meeting, which is to be held in Dushanbe, Tajikistan.

- It is also planned to sign an agreement with the Government of Turkmenistan, as in principal draft MoA has been agreed on both sides.

Publications

- CGIAR-PFU (CAC) quartetly published (both in English and Russian) and circulated to all the Consortium partners and regional NARS and CGIAR institutions a newsletter "CAC News", covering all activities undertaken by CGIAR Program in the region.

- A brochure on "Collaborative Research Program for Sustainable Agricultural Development in Central Asia and the Caucasus" was brought out in English and Russian by PFU-CGIAR, Tashkent, during 2001.

- A brochure on "ICARDA in Central Asia and the Caucasus. Ties that Bind" was published recently. Its English version was printed through ICARDA Headquartes, whereas ICARDA Regional Office in Tashkent published the Russian version.

- A publication entitled 'Groundnut production in Central Asia and Caucasus countries: Outlook for the future' was brought out by ICRISAT and widely circulated in the region.

- Russian version of the bulletin on maize improvement in the region "Managing trials and reporting data from CIMMYT's International Maize testing Program" was published and distributed to all concerned collaborators.

Other publications, such as translation into Russian the "Soil and Plant Analyses Manual", workshop and training course proceedings, etc. are in progress and will be circulated soon.

Website

- The web site of the CGIAR Collaborative Program for CAC is available on the Internet since September, 2001. The site contains the basic information on CG Centers and NARS-CAC involved in the pogram activities, detailed information on each country of CAC region, texts of the Collaborative CGIAR Program for CAC and the Strategy on its development, and other useful information. The site is also being regularly updated with current program reports and publications covering recent achievements of the collaborative research activities. The PFU office continues working on improvement of the site interface to make it more useful for the program stakeholders. In future, some relevant information will also be posted in Russian language as well. Those interested are welcome to visit our site at: www.icarda.cgiar.org/cac/index.htm

Partnership with Global Mechanism (GM)

ICARDA as a representative of the CG Centers, participated in the 9th Session of the Facilitation Committee of the Global Mechanism (GM) of the United Nations Convention to Combat Desertification (UNCCD) held in Rome on 29 April, 2002. The Regional Coordinator, ICARDA-CAC made presentations on the two Challenge Programs on Desertification involving ICARDA and ICRISAT and on Sustainable Agriculture in Central Asia and the Caucasus. One of the important points discussed in the meeting was that ICARDA might consider signing the "Strategic Partnership Agreement" for GM initiatives in the Central Asian Countries, and also explore the possibilities of playing a more proactive role in the New Program for Africa's Development (NEPAD) initiative in partnership with ICRISAT.

As a first positive step in collaboration between ICARDA and GM, ICARDA Regional Office for CAC will be hosting a Regional Management Environmental Consultant who will undertake the coordination of Global Mechanism's work in Central Asia to facilitate the effective implementation of the UNCCD in this region.

Hosting of Meeting for Consortium on Afghanistan

- In January, 2002, ICARDA's Regional Office for Central Asia and the Caucasus hosted a meeting for Consortium on Afghanistan under support of the United States Agency for International Development (USAID). Seventy-four representatives of international and non-governmental organizations, United Nations agencies and donors came together to form Future Harvest Consotium to Rebuild Agriculture in Afghanistan. Ten of the sixteen Future Harvest Centers of the CGIAR, such as CIAT, CIMMYT, CIP, ICARDA, ICRISAT, IFPRI, ILRI, IPGRI, ISNAR and IWMI participated in this meeting, of which the immediate aim was to develop a work plan for a 12-month project on seed systems, and lay a framework for longer-term activities in seeds and

crop improvement; soil and water management; livestock, feed, and rangeland improvement; and horticulture.

Important Visitors:

- Dr. G.S. Khush, an eminent Rice Breeder, IRRI, Philippines, visited Kazakstan and Uzbekistan from 8 – 15 September, 2001 to explore the possibility of collaboration between IRRI and rice research programs of these countries. Dr. Khush visited NACAR, Institute of Plant Physiology, Genetics and Bioengineering (IPPGB), and CIMMYT office in Kazakstan and ICARDA/CGIAR-PFU Office, UzSPCA, Uzbek Rice Research Institute and rice fields in Uzbekistan. Dr. Khush met with the national specialists and farmers and discussed the status of the rice production, and future plans of IRRI in CAC countries.

- In November, 2001, Prof. Adel El-Beltagy, DG of ICARDA, and Dr. Geoff Hawtin, DG of IPGRI, jointly visited Central Asia to oversee and discuss activities under the CGIAR Collaborative Research Program. Dr. Hawting also visited Kazakstan and Kyrgyzstan. During the visit, the possible strengthening of joint activities in the fields of cereals, horticulture and vineyard improvement in CAC region were discussed with the NARS leaders and Head of PFU (CAC). Later in Uzbekistan, Prof. Adel El-Beltagy and Dr. Geoff Hawtin met with high officials from the Government of Uzbekistan to inform about the CGIAR strategy in the region and to brief about major research achievements of collaborative activities in Uzbekistan.

- Dr. Raymond Morton, Senior Policy Adviser, USAID and Dr. David Radcliffe, Senior Natural Resources Adviser, East Europe and Central Asia Department, DFID visited PFU during January, 2002 and had discussions with all the scientists and also saw the various activities undertaken by different CG Centers under this Consortium.

- A delegation from Uzbekistan including three members led by Dr. Sherali Nurmatov, Deputy Minister of Agriculture and Water Management and Director General of USPCA, visited research institutions, educational establishments and farms of India from 18 to 24 March. The visit was supported by ICARDA and PFU-CGIAR, at the specific request of Dr. Nurmatov, and CIMMYT rice-wheat coordinator Dr. Raj Gupta facilitated all local arrangements. The purpose of the visit was to familiarize Uzbek officials with research achievements of Indian agricultural research institutions in the field of conservation agriculture, zero tillage, diversified agriculture, small farm mechanization and management of saline soils, and to strengthen the cooperation between Uzbekistan and India.

- Mr. T. Bayarsaihan, Project Economist, Asian Development Bank (ADB), visited Tashkent in April-May, 2002 to oversee the activities undertaken by the project “On-farm soil and water management for sustainable agricultural systems in Central Asia”, funded by ADB. In his report, Mr. Bayarsaihan expressed his satisfaction regarding good achievements under the project.

- ICRISAT hosted two high level delegations from the region during 2002. The first delegation was from Tajikistan and included five members led by Mr. Tohir Ostonaev, Director of the Project Management Unit, Ministry of Agriculture. They visited groundnut and chickpea fields at ICRISAT. The second delegation consisted of Mr. Samvel Avetisyan, First Deputy Minister, Ministry of Agriculture, Republic of Armenia and Acad. Asad Musayev, Director General and Dr. Yakub Guliev, Head of the Foreign Relations Department, Agrarian Science Center, Ministry of Agriculture, Azerbaijan Republic. In addition to their interaction with ICRISAT scientists, they also visited national ICAR institutions in Hyderabad. Both delegations expressed their desire to enhance collaboration with ICRISAT to Dr. William D. Dar, Director General, ICRISAT.

- Prof. E. Radchenko, Head of Plant Protection Department of Vavilov All-Russian Research Institute of Plant Industry, visited Uzbekistan for a week in April, 2002 to participate in field survey focusing on emergence pest and disease situation in winter wheat. Together with Prof. A. Amanov, a senior adviser on Agriculture in the President Administration of Uzbekistan, and Cereals Breeder, Dr. V. Shevtsov, he visited Fergana Valley, Syrdarya, Jizzakh, Samarkand, Kashkadarya and Tashkent provinces of Uzbekistan.

8. THE FUTURE STRATEGY

THE PROPOSED CHALLENGE PROGRAM FOR CAC

The promising results obtained from the first few years of the current collaborative research program have encouraged the members of the CGIAR consortium and their national partners to elevate the game by enlisting wider partnerships to meet the challenges of food insecurity, poverty and the degradation of natural resources in the CAC region. This was further discussed in a meeting of the Directors General and senior staff of CIMMYT, CIP, ICARDA, ICRISAT, ILRI, IPGRI, and ISNAR and several donor representatives, in Washington D.C., on 27 October 2001, and there emerged an unanimous agreement to develop a Challenge Program on "Development of sustainable agricultural production systems in Central Asia and the Caucasus" that would support expanded partnerships and build on the experience gained so far in the CGIAR Program for CAC to address new priorities thus identified for achieving Sustainable Agriculture Development in Central Asia and the Caucasus. Main features of partnership philosophy are (i) to assist the CAC NARS in their efforts to overcome the difficulties of the transition period faced by agricultural sector; (ii) working together for a common goal of food security, enhanced productivity, environmental sustainability, economic growth and poverty alleviation in the CAC countries; (iii) sharing the knowledge and results achieved with other countries; and (iv) facilitation role in enhancing the communication of CAC NARS with international scientific community and maintaining close linkages between the NARS themselves through regional and global fora.
During the five years of joint activities in the region, this bottom-up approach and partnership philosophy allowed achieving considerable success in collaborative research, national research organization and management, human resource development and in the development of research networks. Collaborative research included joint activities in germplasm enhancement, seed production, soil and water management, feed and livestock management, genetic resource conservation and strengthening of NARS.

Through the proposed Challenge Program, expected outputs envisaged are: (i) well-tested and adapted cultivars for drought, salinity and low-input agriculture; (ii) established local and national seed production programs and improvements in quality control and seed health testing; (iii) low-cost technologies for improving the productivity of livestock and appropriate options for rangeland management and rehabilitation; (iv) increased efficiency of soil and on-farm water management for immediate uptake by farmers; (v) established national and regional genetic resource conservation centers to manage, conserve and utilize rich plant and livestock genetic diversity; (vi) appropriate policy and institutional options for immediate uptake of improved technologies; and (vii) enhanced national research capacity and cooperation among agricultural research institutions at the national, regional and international level.

The concept note has already been approved by iSC and Ex.Co. of CGIAR for the development of "Pre-Proposal" by 31 August, 2002. Hence, the Challenge Program has been developed in a participatory process using a bottom-up approach through a series of workshops and meetings, including its consideration by all partners and same is being proposed for endorsement by the Steering Committee in this meeting.